ISINN-32

XXXII International Seminar on Interaction of Neutrons with Nuclei

Fundamental Interactions & Neutrons, Nuclear Structure, Ultracold Neutrons, Related Topics

Dubna, 2026 **Abstracts**

Joint Institute for Nuclear Research

FUNDAMENTAL INTERACTIONS & NEUTRONS, NUCLEAR STRUCTURE, ULTRACOLD NEUTRONS, RELATED TOPICS

XXXII International Seminar on Interaction of Neutrons with Nuclei

Organized by

Frank Laboratory of Neutron Physics, JINR, Dubna

China Spallation Neutron Source Science Center, China

State Key Laboratory of Intense Pulsed Radiation Simulation and Effect, NINT, China

Dubna, May 24–30, 2026

Abstracts

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ISINN-32 Agenda

May 24, Sunday

16:00 – 20:00 Registration in DUBNA Hotel

19:00 Welcome party in DUBNA Hotel

May 25, Monday

8:30 – 9:00 Registration in International Conference Hall

Plenary sessions

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2.	**9:10 – 9:20**	**Egor Lychagin** Welcome speech	**10 min**
3.	**9:20 – 9:30**	**Sheng Wang** Welcome speech	**10 min**
4.	**9:30 – 10:00**	**Egor Lychagin** Current state of development of a new perspective neutron source for FLNP JINR	**30 min**
5.	**10:00 – 10:30**	**Sheng Wang** Current status and experiments of the CSNS and its upgrade project CSNS-II	**30 min**

10:30 – 11:00 Coffee break + Conference photo

6.	**11:00 – 11:30**	**Tianjiao Liang** Design of neutron physics and application instrument of CSNS (PGNNA / NDP / UCN)	**30 min**
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12:30 – 14:00 Lunch

Neutron properties & UCN

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May 26, Tuesday

Neutron induced reactions & ADS

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10:45 – 11:05 Coffee break

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12:30 – 14:00 Lunch

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May 27, Wednesday

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12:30 – 14:00 Lunch

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15:25 – 16:25 Coffee break + Poster session

Parallel session

Nuclear analytical methods & Life sciences

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63.	**10:25 – 10:45**	**Alexey Pakhnevich** Crystallographic texture and elemental analysis of mussel shell minerals from the west coast of South Africa	**20 min**

10:45 – 11:05 Coffee break

64.	**11:05 – 11:30**	**Vladimir Kolotov (*Invited talk*)** Nuclear methods in modern geochemical analysis: some observations and trends	**25 min**
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68.	**14:00 – 14:25**	**Dragan Radnovic (*Invited talk*)** Atmospheric deposition of ^{7}Be measured using terrestrial mosses: seasonal changes in three successive years	**25 min**
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May 28, Thursday

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10:25 – 11:05 Coffee break

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14:00 – 17:00 Excursion

17:00 – 21:00 Barbeque

May 29, Friday

Nuclear analytical methods & Life sciences

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10:45 – 11:05 Coffee break

85.	**11:05 – 11:30**	**Pavel Nekhoroshkov (*Invited talk*)** Spatial and temporal patterns in potentially toxic and other elements in wild mussels from South Africa	**25 min**
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12:30 – 14:00 Lunch

89.	**14:00 – 14:25**	**Omari Chaligava (*Invited talk*)** Radionuclide distribution and radiological hazard in soils of East Antarctic coastal oases	**25 min**
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15:45 – 16:05 Conference closing

16:05 – 16:30 Coffee break

Parallel session
Fission

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10:45 – 11:05 Coffee break

99.	**11:05 – 11:30**	**Dmitry Kamanin (*Invited talk*)** Status of the (γ,f) reactions research at the microtron beam in FLNR. Search and analysis of the double hit events in the study of (γ,f) reactions	**25 min**
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12:30 – 14:00 Lunch

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15:45 – 16:05 Conference closing

16:05 – 16:30 Coffee break

May 30, Saturday

Participants departure

May 26, Tuesday

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Aleksey Lihachev	System of thermal stabilization of BGO scintillation detectors
Alexander Andreev	The role of cascade processes in the (n,n′γ) reaction
Alexandra Tiagelskaia	Modeling of the neutron beam parameters of the time-of-flight spectrometer GNEIS using GEANT4
Anindo Adhikary	Measurements of arsenic contamination and heavy metal trace in soil in Bera, Pabna, Bangladesh, using neutron-producing facilities of FLNP, JINR
Asif Nabiyev	Effect of high-dose gamma radiation on the nanolamellar structure and crystal/amorphous interface of PVDF
Asmaa Ibrahim	Design and application of PVA/ZnO/GO as a promising nanocomposite with tunable electronic properties
Bolortuya Damdinsuren	Elemental and radionuclide characterization of lichens and mosses in the Ulaanbaatar area using nuclear analytical techniques
Cong Vu	Determination of neutron capture cross sections for the reactions $^{180}W(n,\gamma)^{181}W$ and $^{184}W(n,\gamma)^{185}W$ utilizing a photoneutron source from an electron LINAC
Dai Nan Le	Assessment of air pollution in the Hai Phong city (Vietnam) using lichens as biomonitors
Dmitrii Grozdov	Elemental profile and health risk assessment of South African rooibos cultivated under ecological conditions
Dmitrij Sitkov	Single-particle states of nucleons in iron isotopes based on folded Yukawa potential
Dongying Huo	Evaluation of pre-neutron-emission mass distributions of neutron-induced actinides fission using scission point model
Evgeniy Gudkov	Prediction of asymptotic behavior of correlation functions of scattered neutrons based on the algebraic theory of symmetry breaking

Gevorg Tepanosyan	Assessing the applicability of X-ray fluorescence spectroscopy for analyzing selected REEs in soil
Hao Wang	Dr. Sai-RongZai: LLM based neutron scattering data analysis agent
Hasret Gül Öztop	Simulation study of transport differences between neutrons and protons in solid D–D fusion targets and their impact on measured neutron yield
Constantin Hramco	PGAA setup status at the 11b channel of the IBR-2 reactor
Kuo Zhi Xu	Neutron leakage spectra benchmark of spherical iron sample with a ^{252}Cf fission source
Leonid Trofimov	Combinatorial approach to level density modeling and its application to estimate nuclear reaction cross-sections
Liudmila Mitsyna	About a possibility to obtain the forward-backward asymmetry of gamma emission studying the ^{81}Br(n,γ) reaction
Mirjana Radenkovic	Physicochemical characterization of the $PM_{2.5}$ aerosol by INAA and complementary techniques
Nhat Le	Isomeric ratio in the ^{nat}Cd(n,γ)^{115m,g}Cd reaction induced by IREN pulsed neutron source
Nikita Olkhovich	Monte Carlo simulation of a multi-section detector of a FISCO facility

May 27, Wednesday

Posters

Rashid Khafizov	The process opposite to the radiative neutron β-decay
Rong Du	Software for neutron data processing at CSNS
Rustam Akmaletdinov	COMSOL®-aided design of an adiabatic neutron spin flipper in a spatially varying magnetic field for resonance neutrons
Sheimaa Ibrahim	Development of PET/RGO composites for advanced flexible electronics
Svetlana Gorelova	Analysis of atmospheric deposition dynamics in Tula region over the past 10 years
Svetlana Lennik	Determination of magnesium and aluminum by neutron activation using the WWR-K nuclear reactor
Thi Minh Sang Nguyen	Phytoremediation potential of *Eichhornia crassipes* for heavy metal removal from industrial wastewater assessed by TXRF
Tien Doan	Metal contents in green algae (*Ulva lactuca*) from coastal water of Nha Trang Bay
Valery Kuznetsov	Investigation of low-lying resonances of ^{79}Br, ^{81}Br and ^{35}Cl at the modernized prototype “Gamma facility”

Vladimir Galustov	Application of true coincidence summing coefficients in gamma-ray spectrometry for correcting radionuclide activity values and for constructing detector efficiency calibration curve
Yulia Aleksiayenak	Drought-resistant rice mutants induced by ionizing radiation: agronomic performance of M2 generation
Alexander Ovodov	Development of structured B_4C-coated cathodes for thermal neutron detectors
Alexander Ovodov	Development of a position-sensitive scintillation detector based on ^{6}LiF/ZnS using SiPMs
Valentina Verkhoglyadova	Analysis of the power feedback of the IBR-2M reactor
Ekaterina Zhukova	Investigation of the elemental composition of the state standard samples SChS-1 and SLg-1 according to the certification program of the A.P. Vinogradov Institute of Geochemistry SB RAS by neutron activation analysis at the IBR-2 reactor and IREN facility (JINR, Russia), and the WWR-K reactor (INP, Kazakhstan)
Enkhbold Sansarbayar	Role of odd-parity α+t states in the ^{6}Li(n,t)^{4}He reaction at 3−5 MeV
Yuri Gledenov	Development of ionization chambers for measuring (n,p) and (n,α) cross sections at the IREN facility
Shakir Zeynalov	Energy resolution performance of liquid scintillator detection systems
Cristiana Oprea	Optical potential analysis in antiproton elastic scattering on ^{4}He nuclei via Monte-Carlo simulations
Olga Sidorova	Simulation of radiation transport for determining efficiency and crosstalk in the multidetector scintillation system ENGREN
Stanislav Potashev	Position-sensitive neutron detector based on boron-10 layers and multi-wire gas-filled chamber
Nelli Pukhaeva	LiF(Ti) single crystals as scintillation detectors for thermal neutron registration
Polina Filonchik	Method for describing triple angular correlations in inelastic scattering of a particle on a nucleus with subsequent gamma emission
Denis Khliustin	Conversion of the Monte-Carlo neutron transport program code ‘SHIELD’ to work together with the 299-group cross sections of neutron-nucleus interactions ‘ABBN-93’

Levels of Heavy Metals in Hair of Pregnant Women with Fetal Cardiovascular System Anomalies

Safa Abdo[1], Yushin Nikita[2], Mostafa Seleem[1], Inga Zinicovscaia[2]

[1]*Cairo University, Cairo, Egypt*
[2]*Joint Institute for Nuclear Research, Dubna, Russian Federation*

Cardiovascular system (CVS) anomalies are the most common type of fetal congenital anomalies. Heavy metal toxicity and trace element imbalance may contribute to the development of fetal abnormalities. This study aimed to assess the possible association between hair levels of Al, Cd, Co, Cu, Fe, Mn, Pb, Se, Zn, and Hg and fetal CVS anomalies. This case–control study was conducted at Kasr Al-Ainy Maternity Hospital, Cairo University, between March 2021 and October 2022, and included 47 pregnant women divided into two groups: 27 women carrying fetuses with CVS anomalies and 20 women with normal fetal anatomy (control group), confirmed by sonographic ultrasound examination. Pregnant women with known risk factors for fetal anomalies were excluded. Four grams of hair were collected from each participant. The concentrations of Al, Cd, Co, Cu, Fe, Mn, Pb, Se, Zn, and Hg were measured using Inductively Coupled Plasma Optical Emission Spectroscopy (ICP-OES).

There was no statistically significant difference in mean maternal age between the two groups. Mann–Whitney U test revealed statistically significant differences between patients and controls for Aluminium (Al), Lead (Pb), and Mercury (Hg) ($p < 0.05$), while other elements showed no significant differences. ROC curve analysis demonstrated that Mercury had the highest diagnostic performance (AUC = 0.743), with an optimal cutoff value of 0.093 mg/kg (sensitivity 63.0%, specificity 85.0%). Lead also showed good diagnostic performance (AUC = 0.726) at a cutoff value of 4.261 mg/kg, followed by Aluminium (AUC = 0.694) at a cutoff value of 151.55 mg/kg. Other elements demonstrated weak diagnostic performance (AUC < 0.70).

In conclusion, elevated hair levels of Mercury, Lead, and Aluminium were significantly associated with fetal cardiovascular system anomalies. Mercury showed the highest predictive value among the studied elements. These findings suggest a potential role of heavy metal exposure in the development of fetal CVS anomalies and highlight the importance of environmental exposure monitoring during pregnancy.

Measurements of Arsenic Contamination and Heavy Metal Trace in Soil in Bera, Pabna, Bangladesh, Using Neutron-Producing Facilities of FLNP, JINR

Anindo Adhikary, Al Amin, Pretam K. Das

Pabna University of Science and Technology (PUST), Pabna-6600, Bangladesh

Arsenic contamination in soil is a major environmental and public health concern in Bangladesh, particularly in rural areas where groundwater is the main source of drinking water and is also widely used for irrigation. Long-term exposure to arsenic through contaminated water and food can cause serious health problems. Bera Upazila of Pabna District is considered an important area for such a study because it lies directly beside the Great Jamuna (Yamuna) River and is part of an active floodplain region. Continuous deposition of river-borne alluvial sediments makes this area naturally rich in minerals, including arsenic and other heavy metals, which may enter the soil–groundwater system.

The objective is to quantify arsenic and heavy metals in in Bera Upazila's soil samples using Neutron Activation Analysis (NAA). The collected samples were carefully prepared and submitted for irradiation and gamma-ray spectrometric analysis at the IBR-2 reactor and the IREN facility of the Frank Laboratory of Neutron Physics, Joint Institute for Nuclear Research (JINR), Dubna, Russia. NAA allows the detection of trace elements at very low concentrations, including parts-per-billion levels of arsenic, which is essential for environmental studies.

The analytical results obtained from this work will be compared with international safety standards, including the World Health Organization (WHO) guideline value of 10 μg/L for arsenic in drinking water. Although the analysis is currently in progress, the expected outcomes of this study include the generation of baseline data on arsenic and heavy-metal distribution in a Jamuna River floodplain environment. This research is intended to support future environmental monitoring, risk assessment, and decision-making related to safe drinking water, sustainable agricultural practices, and environmental protection in arsenic-prone regions of Bangladesh.

Keywords: Neutron Activation Analysis (NAA), Arsenic Contamination, Alluvial Deposits.

Acknowledgment

We are grateful to the members of the Nuclear and Radiation Physics Lab at the Department of Physics, PUST, Bangladesh, and our research collaborators at IBR-2, JINR in Russia.

The Characterization of Later Stone Age Pottery from the Oakhurst Site, South Africa, Using Analytical Techniques

Shaheeda Adonis[1*], Leslie Petrik[2], Alechine Emmanuel Ameh[2], Wael M. Badawy[3,4]

[1]*Department of Chemistry, Cape Peninsula University of Technology, 1906 Cape Town, South Africa*
**adoniss@cput.ac.za*
[2]*Environmental and Nano Sciences Research Group, Chemistry Department, University of the Western Cape, Private Bag X17, Bellville 7535, South Africa*
[3]*Radiation Protection and Civil Defense Department, Nuclear Research Center, Egyptian Atomic Energy Authority, 13759 Cairo, Egypt*
[4]*Frank Laboratory of Neutron Physics, Joint Institute for Nuclear Research, 141980 Dubna, Russia*

This paper presents the results of an investigation aimed at characterising the elemental composition and defining the first geochemical reference groups for the Oakhurst archaeological site near George, in the Southern Cape of South Africa. The Oakhurst site, dating approximately to the Later Stone Age (c. 10,000 to 8,000 BP), represents a critical period of technological and socio-economic transition in the region. Understanding the ceramic technology, raw material procurement, and potential exchange systems during this period has been limited. The present research was conducted to characterise the content of samples from the Oakhurst archaeological site using analytical techniques (XRF, BET, TGA, FTIR, XRD, SEM,). The obtained data will serve as the first baseline for formation of the reference archaeological ceramic groups from Oakhurst site.

Keywords: Oakhurst Archaeological Site, Later Stone Age, archaeometric analysis, XRF

COMSOL®-Aided Design of an Adiabatic Neutron Spin Flipper in a Spatially Varying Magnetic Field for Resonance Neutrons

Rustam Akmaletdinov[1], Valery Kuznetsov[2], Vyacheslav Pchelnikov[1], Natalia Rebrova[2], Pavel Sedyshev[2], Ivan Smolyanov[1], Victor Voynov[1]

[1]*Ural Federal University, Russia*
[2]*FLNP, JINR, Russia*

Polarized neutron beams are widely used in fundamental and applied research. In experiments carried out at flight path №4 of the IREN facility ("Gamma-7"), angular and polarization correlations in (n, γ) reactions are investigated. In preparation for experiments with polarized neutrons, it became necessary to develop a device capable of reversing the orientation of the neutron beam polarization vector by 180° relative to the direction of beam propagation.

In the present work, a theoretical and computational design of an adiabatic neutron spin flipper was carried out. The device is intended for operation with resonance neutrons of energies on the order of E_n= 400 eV. Numerical modeling of the magnetic field generated by the coil system was carried out in COMSOL Multiphysics 6.3 [2] using a magnetostatic formulation. Adiabatic spin inversion is achieved in a region of static magnetic field with a spatially varying direction, for a selected threshold value of the adiabaticity parameter Γ= 0.01[3].

The 2 m long system generates, in the neutron flight region (aperture 60 mm), a spatially varying magnetic field with a maximum magnetic flux density of up to 0.3 T by two coil subsystems: a solenoid system producing the longitudinal component B_x, and a system of rectangular coils [4] generating the transverse component B_y. The longitudinal field is formed by 10 solenoids arranged in two symmetric sections with opposite current directions.

Under the ongoing modernization of the "Gamma-7" facility, it was decided to avoid the use of active cooling from the proposed spin-flipper design. Consequently, the device represents a compromise between the required magnetic induction and the dissipated thermal power. The coils are wound with enamelled copper wire of rectangular cross-section 1.50×2.80 mm (S = 4.2 mm²) operated at a current of I = 30 A.

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Drought-Resistant Rice Mutants Induced by Ionizing Radiation: Agronomic Performance of M_2 Generation

Yu. Aleksiayenak[1*], A. Kruglyak[1], K. Bakiruly[2], L. Tokhetova[3], A. Zhalbyrov[2]

[1]*Joint Institute for Nuclear Research, Dubna, Russia, *beataa@gmail.com*
[2]*Kazakh Research Institute of Rice named after I. Zhakhaev, Kyzylorda, Kazakhstan*
[3]*Korkyt Ata Kyzylorda University, Kyzylorda, Kazakhstan*

In this study, mutant forms of rice (*Oryza sativa L.*) cultivars Aikerim, Leader, and Syr Suluy were induced using gamma and neutron radiation to enhance drought and salt tolerance. Of 158 M_1 mutants grown under laboratory and field conditions until harvest, only 128 forms survived in the M_2 generation.

M_2 vegetative periods closely matched parental forms, except for some Aikerim lines. Most induced mutants, previously dwarf and sterile, reverted to parental morphology in the M_2 generation. Notably, while approximately 20% of M_2 lines remained sterile, the majority proved fertile, it's a significant improvement over M_1 and a key breeding advantage.

Biometric analysis revealed predominantly shorter plant heights compared to controls: Productive tillering and main panicle length of the mutants varied in wide range in comparison with the parental forms.

From 104 productive M_2 mutants lines only 11 showed significant grain yield improvement, with 7 derived from neutron irradiation.

These elite plants were fully preserved until harvest and further the M_3 generation will be studied.

Acknowledgment

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Possibility of In Vivo Determination of Calcium and Phosphorus Content in Human Bone Tissue by the Tagged Neutron Method

Alexakhin V.Yu., Razinkov E.A., Rogov Yu.N., Zaichik V.E., Sapozhnikov M.G.

Joint Institute for Nuclear Research, Dubna, Russia

Normal human bone tissue consists of a mineral matrix (60%), an organic matrix (30%), and water (10%). Hydroxyapatite accounts for 95% of the mineral matrix, and its presence in bone tissue provides its strength. The main elements of hydroxyapatite are calcium (Ca) and phosphorus (P). It is well known that many skeletal diseases are accompanied by significant changes in the elemental composition of bone tissue. An example of such a disease is osteoporosis, which is characterized by a significant decrease in the concentration of the mineral component of bone tissue and, consequently, the concentration of Ca and P. DEXA (Dual Energy X-Ray Absorption), an existing method for indirectly assessing the mineral component of bone tissue, has found wide application in the diagnosis of osteoporosis. However, this method has obvious drawbacks, leading to an inaccurate assessment of the mineral component and, consequently, has low sensitivity for detecting high risks of pathological fractures. This necessitates the search for alternative methods for diagnosing osteoporosis, such as direct quantitative determination of Ca and P concentrations in bone tissue and the Ca/P ratio, which directly characterize the hydroxyapatite content of bone and, consequently, its strength.

In our study, we investigated the feasibility of in vivo determination of Ca and P levels in human bone tissue using the tagged neutron method (TNM). A whole pork knuckle and its main components—soft tissue and bone—were used as a model. Additionally, calf bones were also used. It was shown that, at an absorbed dose acceptable for diagnostic purposes, TNM allows for in vivo determination of Ca and P levels in bone tissue with acceptable accuracy. A design for an instrumental system for in vivo determination of Ca and P levels in the human hand using the TNM method was also proposed.

Mobile Analyzer of Soil Elemental Composition Based on the Tagged Neutron Method

V.Yu. Alexakhin[a,b], A.V. Barinov[c], V.Y. Dimitrenko[c], R.V. Dimitrenko[c], A.N. Yesaulko[c], Yu.N. Kopatch[b], I.F. Lensky[b], E.A. Poltavskikh[c], E.A. Razinkov[a,b], Yu.N. Rogov[a,b], M.G. Sapozhnikov[a,b], V.R. Skoy[b]

[a]*Diamant LLC, Stroiteley str. 8, Dubna, 141980 Russia*

[b]*Joint Institute for Nuclear Research, Joliot-Curie, 6, Dubna, 141980 Russia*

[c]*FSBEI HE Stavropol State Agrarian University, Zootekhnichesky Lane, 12, Stavropol, 355035 Russia*

As a part of the TANGRA project (FLNP, JINR) a mobile analyzer of the soil elemental content based on tagged neutron method was developed. The analyzer consists of neutron module and remotely controlled tracked chassis, powered by electric battery. It determines the elemental composition of the soil real-time while the analyzer is moving across the field.

The neutron module contains ING-27 portable neutron generator, 6 BGO gamma-detectors, processing electronics. The analyzer has been tested on two locations in Stavropol Krai. Tests consisted in measuring soil carbon concentration of a number of square-shaped areas of field. The results of field tests as well as comparison with results from other techniques are discussed.

The Role of Cascade Process in the (n,n'γ) Reaction

A.V. Andreev[1,2*], K.O. Mataeva[2], T.Yu. Tretyakova[1,3], N.A. Fedorov[1], A.L. Barabanov[1,4,5], P.G. Filonchik[1,6], Yu.N. Kopatch[1], D.N. Grozdanov[1,7], P.S. Prusachenko[1], P.I. Kharlamov[1,3], and TANGRA collaboration

*[1]Joint Institute for Nuclear Research, Dubna, Russia, *andreev.av20@physics.msu.ru*
[2] Lomonosov Moscow State University, Faculty of Physics, Russia
[3]Skobeltsyn Institute of Nuclear Physics, Lomonosov Moscow State University, Russia
[4]National Research Center "Kurchatov Institute", Russia
[5]National Research Nuclear University MEPhI (Moscow Engineering Physics Institute), Russia
[6]Institute of Physics and Technology, Russia
[7]Institute for Nuclear Research and Nuclear Energy, Bulgarian Academy of Sciences, Bulgaria

Reactions involving the emission of γ-rays during the inelastic scattering of fast neutrons are associated with transitions between low-lying nuclear levels. The presence of characteristic gamma-ray lines, which are linked to the structure of the nucleus, allows the (n,n'γ) reaction to be used in both applied and theoretical nuclear physics [1,2].

A theoretical study of the emission of γ-rays from the inelastic scattering of fast neutrons makes it possible to determine the roles of various reaction mechanisms induced by neutrons, the probabilities of γ-transitions between nuclear levels, the populations of excited nuclear states, and also the role of "discrete" and "continuous" γ-cascades [3].

The (n,n'γ) reaction can be described as a two-stage process. The first stage is the inelastic scattering of neutrons, and the second is the de-excitation of nuclei through the emission of γ-rays. Knowledge of the population of excited nuclear states, which can be obtained within the framework of nuclear reaction theory, is essential for describing the second stage. When the energy of the incident neutrons is greater than the energy of the first nuclear level, not only direct but also cascade population of levels is possible, which can contribute significantly both to the cross section and to the parameters of the angular distributions of γ-rays. Depending on the energy of the incident neutrons, cascade population can occur through discrete levels and through the continuum spectrum of the nucleus.

This work is devoted to investigating the role of cascade processes in the theoretical description of the cross sections and angular distributions of γ-rays from the inelastic scattering of neutrons with energies from 1 to 5 MeV on ^{48}Ti, ^{52}Cr, and ^{56}Fe nuclei.

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Geochemical Reference Groups Using Neutron Activation Analysis of Pottery from Oakhurst Shelter, South Africa

Wael M. Badawy[1,2*], Igor Silachyov[3], Svetlana Lennik[2,3], Shaheeda Adonis[4], Leslie Petrik[5]

[1]*Radiation Protection and Civil Defense Department, Nuclear Research Center, Egyptian Atomic Energy Authority, 13759 Cairo, Egypt*
[2]*Frank Laboratory of Neutron Physics, Joint Institute for Nuclear Research, 141980 Dubna, Russia*
[3]*Institute of Nuclear Physics, Ibragimov Str.1, 050032 Almaty, Republic of Kazakhstan*
[4]*Department of Chemistry, Cape Peninsula University of Technology, 1906 Cape Town, South Africa*
[5]*Environmental and Nano Sciences Research Group, Chemistry Department, University of the Western Cape, Private Bag X17, Bellville 7535, South Africa*

*wael@jinr.ru

The present study investigates the elemental composition of Later Stone Age ceramics from Oakhurst Shelter (southern Cape, South Africa) in order to define archaeological reference groups and explore their cultural significance. Ceramic fragments curated by Iziko South African Museum were analysed by instrumental neutron activation analysis (INAA), yielding mass fractions for major, trace and rare earth elements (REEs). Multivariate statistics, bivariate plots, ternary diagrams and ratio biplots were used to identify compositionally coherent groups and to compare them with upper continental crust, Post-Archean Australian Shale (PAAS) and North American Shale Composite (NASC). The study establishes the first compositional reference groups for Oakhurst ceramics and demonstrates the potential of neutron activation analysis to link ceramic technology, raw-material procurement and cultural phases in southern African Later Stone Age sequences.

Keywords: INAA, archaeological ceramic, reference groups, Oakhurst Shelter

Analysis of Angular Anisotropy of Fragments in Fission of Pu Isotopes by Low and Medium Energy Neutrons

A.L. Barabanov, O.A. Shcherbakov, D.A. Sitkov, L.E. Trofimov, A.S. Vorobyev

NRC "Kurchatov Institute", Russia

Over the past decade, differential cross sections of neutron-induced fission have been measured at the Kurchatov Institute – PNPI for a number of isotopes depending on neutron energy (see, for example, [1]). The work was performed using a specially designed, original setup; measurement and data processing techniques were developed for this research. It should be noted that the range of incident neutron energies was very wide, from 0.3 to 500 MeV. A significant portion of the fission cross section data obtained, relating to specific energy intervals and specific isotopes, was obtained for the first time. The results of these measurements are of high scientific and applied value. Their scientific significance lies in the opportunity they offer to test modern approaches to the description of nuclear reactions induced by neutrons, in particular, fission reactions, using new, extensive experimental data. It should be noted that these capabilities are particularly valuable for the physics of nuclear fission by neutrons, protons, and other light incident particles. The fact is that in this area, existing methods for describing the energy dependence of both fission cross-sections and the angular distributions of fission fragments, including those we have tested (see, for example, [2,3]), are descriptive rather than predictive.

An important feature of the fission data obtained for a wide range of incident neutron energies is the following. While at low energies fission occurs in the reaction, after reaching certain thresholds, etc. channels open. Thus, the higher the energy, the greater the number of isotopes that contribute both to the fission cross section and to the angular anisotropy of the fragments. This paper presents the results of a joint analysis of data obtained in experiments with Pu [4], Pu [5], and Pu [1] targets. The possibility of testing the hypotheses about the formation of the angular anisotropy of the fragments either on the higher or on the outer hump of the double barrier is separately discussed. According to existing models, only for the isotope Pu and lighter ones, the outer hump is both higher. However, for heavier Pu isotopes, which mainly determine the data we analyze on the cross-section and angular anisotropy of fission fragments, the situation is the opposite – the inner hump is higher.

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Experimental Study of the (n_{res},γ) Reaction on the ^{175}Lu Nucleus

D. Berikov[1,2*], G. Ahmadov[2,3], V. Furman[2], W. Jiang[4,5], R. Fan[4,5], Yu. Kopatch[2], G. Yang[4], C. Hramco[2], and S. Telezhnikov[2]

[1]*The Institute of Nuclear Physics, Ministry of Energy of the Republic of Kazakhstan, Almaty 050032, Kazakhstan, *daniyar.berikov@gmail.com*
[2]*Joint Institute for Nuclear Research, Dubna 141980, Russia*
[3] *Innovation and Digital Development Agency, Nuclear Research Department, Gobu str., 20th km of Baku-Shamakhi Highway, AZ0100, Baku, Azerbaijan*
[4]*Institute of High Energy Physics, Chinese Academy of Sciences (CAS), 100049 Beijing, China*
[5]*Spallation Neutron Source Science Center, Dongguan 523803, China*

The results of an experimental study of the resonance neutron capture reaction ^{175}Lu(n_{res}, γ)^{176}Lu in the neutron energy region up to 100 eV are presented. The measurements were carried out on the Back-n white neutron beam at the China Spallation Neutron Source (CSNS) using an HPGe detector. Fifteen resonances in the energy range of 2.6 – 102.5 eV were analyzed. The spins of seven resonances were determined by analyzing primary γ-transitions using marker final states with known spins. Relative intensities of primary γ-quanta with energies above 5 MeV were obtained. The results are consistent with previous data and demonstrate the possibility of expanding the statistics and measurement range for further study of the statistical properties of radiation widths and K-mixing effects.

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Radiological and Geochemical Assessment of Beach Sands in Dubna Urban Recreational Areas

Konstantin Birkle[1], Ivan Goncharuk[1], Lev Peshkov[1], Nikita Zhabin[1], Omari Chaligava[2], Dmitrii Grozdov[2], Nikita Yushin[2], Inga Zinicovscaia[2]

[1]*Moscow Regional Physics and Mathematics Lyceum named after Academician V. G. Kadyshevsky, Dubna, Russia*

[2]*Joint Institute for Nuclear Research, Dubna, Russia*

Recreational areas play a significant role in the quality of life within urban environments. Among various types of recreational zones, beaches occupy a distinctive position due to their natural, aesthetic, and climatic characteristics. They support diverse forms of leisure, contribute to public health, and enhance the environmental and social sustainability of cities. The activity concentrations of natural radionuclides and ^{137}Cs, as well as the content of potentially toxic elements, were determined in sand samples collected from five beaches in Dubna at two depths (0–5 cm and 5–15 cm). Low-background gamma-ray spectrometry and inductively coupled plasma optical emission spectrometry were used for the analyses. The average activity concentrations of the analyzed radionuclides did not exceed the global average values. Several radiological hazard indices, including radium equivalent activity, external and internal hazard indices, gamma index, annual effective dose, and excess lifetime cancer risk, were calculated to assess potential radiological risks to the population. The calculated values were within the recommended safety limits, indicating that the soils of the studied recreational areas do not pose a significant threat to human health. The concentrations of the determined potentially toxic elements were below the maximum permissible limits. According to the contamination factor and enrichment factor, the level of sand pollution can be classified as unpolluted to slight polluted, with a low ecological risk. Overall, the results demonstrate that the investigated recreational zones do not present significant radiological or environmental hazards and can be considered safe for the population.

Ecological and Geographical Zoning of Industrial Development Potential Based on Moss Biomonitoring Data: The Case of the Ryazan Region

Blinova E.[1*], Frontasyeva M.[2**]

[1]*Ryazan State University named after S.A. Yesenin, Ryazan, Russia*
[*]*eleonora.gladkova@mail.ru*

[2]*FLNP JINR, Russia*
[**]*marina@nf.jinr.ru*

Modern economic activity is increasingly constrained by cumulative environmental damage, growing public concern regarding ecological risks, and the reduction of available territorial resources. These conditions require an integrated approach to assessing regional production potential that accounts for environmental limitations. This issue is particularly relevant for industrially developed regions such as the Ryazan Region, which possesses significant natural-resource potential and a favorable economic-geographical position in Central Russia.

The aim of this study is to develop a scheme for conducting an ecological and geographical analysis of territories based on the classical assessment of production potential, supplemented by modern methods of environmental research. A multi-layer cartographic analysis was carried out using GIS technologies based on official statistical data, reports of executive authorities, and a SWOT analysis of the region's logistics infrastructure. Environmental monitoring data were used to assess anthropogenic pressure and spatial differentiation of pollution.

Within the framework of cooperation with the UN Economic Commission for Europe, the region participated for the first time in 2017 in an international pollution monitoring program using moss bioindicators, which provided reliable data on the accumulation of heavy metals and other elements in different parts of the region.

As a result, a comprehensive ecological and geographical zoning scheme for industrial development potential was developed for the first time. The analysis identified priority areas for development for conditional development subject to strict environmental regulation, and territories with significant restrictions or a complete ban of industrial expansion. The results will serve as a basis for sustainable spatial planning that takes environmental constraints into account.

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Elemental and Radionuclide Characterization of Lichens and Mosses in the Ulaanbaatar Area Using Nuclear Analytical Techniques

D. Bolortuya[1*], M.V. Gustova[2], O. Enkhtuya[3], P. Zuzaan[1], S.P. Kaplina[2], E. Enkhjargal[3], S. Javkhlan[3]

[1]National Institute for Nuclear Science and Technology, National University of Mongolia, Mongolia, [*]bolortuya_d9@num.edu.mn

[2]Flerov Laboratory of Nuclear Reactions, Joint Institute for Nuclear Research, Russia

[3]Institute of General and Experimental Biology, Mongolian Academy of Sciences, Mongolia

Ulaanbaatar city, the political and economic center of Mongolia, has faced significant environmental challenges due to rapid urbanization and industrialization. This study evaluates atmospheric deposition in the Ulaanbaatar area using lichens and mosses as bio-monitors. Elemental and radionuclide characterization was performed using a multi-analytical approach, primarily utilizing the MT-25 microtron for neutron and gamma activation analysis, complemented by XRF and low-background gamma spectrometry.

More than 30 elements, including macro, minor, and trace metals, were determined alongside natural and anthropogenic radionuclides. Findings indicate a notable accumulation of certain trace elements in the study area, reflecting the influence of coal combustion and urban activities. This work demonstrates the efficiency of nuclear analytical techniques for comprehensive environmental monitoring and provides a detailed baseline for air quality assessment in the Ulaanbaatar area.

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Is the Narrow Asymmetric Fission of ^{180}Hg a New Type of Fission?

K. Okada[1], K. Nishio[1], N. Carjan[2,3*]

[1]*Advanced Science Research Center, Japan Atomic Energy Agency, Tokai, Ibaraki 319-1195, Japan*

[2]*Joint Institute for Nuclear Research, Dubna, Moscow Region, Russia, *carjan@jinr.ru*

[3]*LP2I Bordeaux, UMR5797, Bordeaux University, CNRS, 33175 Gradignan, France*

Whether the mechanism of low energy fission in ^{180}Hg is different from the one in the actinide nuclei is reexamined using generalized Cassini ovals, a flexible definition of the nuclear shapes involved, particularly adapted to the last fission stage.

Potential energy surfaces are calculated from the ground state to the scission point using different combinations of shape parameters selected among: α, α1, α2, α3, α4, α6. An asymmetric valley appears between saddle and scission in all but one case (α, α1, α4). The bottom of this valley corresponds to the experimentally observed fragment mass ratio (80/100). It is due to the presence of a moderate but robust shell when one of the fragments has the mass 102. This shell is octupole induced so it doesn't appear if α3 is replaced by α1.

Therefore, a similar mechanism, as in the actinides, is responsible for the asymmetric fission of ^{180}Hg. The heavy fragment 102 takes here the place of the double magic 132.

Radionuclide Distribution and Radiological Hazard in Soils of East Antarctic Coastal Oases

E. Abakumov[1], V. Polyakov[1,2], O. Chaligava[3,4*], I. Zinicovscaia[3,5], D. Grozdov[3]

[1]*Department of Applied Ecology, Faculty of Biology, St. Petersburg State University, Universitetskaya Embankment, 7/9, St. Petersburg 199034, Russia*
[2]*Arctic and Antarctic Research Institute, Beringa 38, St. Petersburg, 199397, Russia*
[3]*Department of Nuclear Physics, Joint Institute for Nuclear Research, Joliot-Curie Str., 6, 141980 Dubna, Russia, *chaligava@jinr.int*
[4]*Andronikashvili Institute of Physics, I. Javakhishvili Tbilisi State University, 6 Tamarashvili Str., 0162 Tbilisi, Georgia*
[5]*Department of Nuclear Physics, Horia Hulubei National Institute for R&D in Physics and Nuclear Engineering, 30 Reactorului Str. MG-6, 077125 Magurele, Romania*

This study provides a comprehensive assessment of natural (^{40}K, ^{226}Ra, ^{232}Th) and artificial (^{137}Cs) radionuclide activity concentrations in soils from three East Antarctic coastal oases: the Larsemann Hills (vicinity of Progress Station), the Bunger Hills, and the Molodezhnaya Station area. Despite Antarctica's geographical isolation and limited direct anthropogenic impact, long-range transport mechanisms deliver pollutants to the continent, yet baseline data for East Antarctic soils remain sparse compared to Maritime Antarctica. Surface soil samples from seven pedological profiles representing diverse landscape positions were analyzed using high-purity germanium (HPGe) gamma-ray spectrometry following 30-day secular equilibrium period.

Gamma-ray spectrometric analysis revealed significant spatial heterogeneity in radionuclide distributions. Activity concentrations of ^{40}K ranged from 513 to 1134 Bq/kg (mean: 802 Bq/kg), exceeding the world average of 400 Bq/kg by factors of 1.3–2.8. ^{232}Th concentrations (35.5–238 Bq/kg; mean: 97 Bq/kg) were consistently above the global mean of 30 Bq/kg, with maximum values observed in Larsemann Hills soils. ^{226}Ra activities (7.5–59.1 Bq/kg; mean: 25.3 Bq/kg) were elevated only at Progress Station sites relative to the world average of 35 Bq/kg. The elevated natural radionuclide concentrations are attributed to local monazite and granite lithologies of East Antarctic oases. ^{137}Cs was detectable in all samples (1.1–5.5 Bq/kg; mean: 2.8 Bq/kg), confirming widespread but low-level contamination from historical atmospheric nuclear weapons testing and global fallout. Statistical analysis (Kruskal-Wallis test, $p<0.05$) demonstrated significantly higher natural radionuclide concentrations in Larsemann Hills soils compared to Bunger Hills and Molodezhnaya sites.

Radiological hazard assessment demonstrated that although radium equivalent activities (98 – 471 Bq/kg) at one site exceeded the 370 Bq/kg safety threshold, and external hazard indices (Hex: 0.26 – 1.27) exceeded unity at two Progress Station locations, annual effective doses (0.008 – 0.038 mSv/y) and excess lifetime cancer risks (0.03×10^{-3} – 0.13×10^{-3}) remained well below international public exposure limits (1 mSv/y and 1.45×10^{-3}, respectively) due to restricted occupancy (1205 h/y).

These findings establish essential baseline radioactivity data for East Antarctic terrestrial ecosystems, demonstrate significant lithogenic enrichment of natural radionuclides in specific oases, and confirm ubiquitous but low-level ^{137}Cs contamination from global fallout. While localized radiological hazards exist, particularly in Larsemann Hills soils, current exposure scenarios pose minimal health risk to station personnel.

Progress in the Neutron Total Cross-Section Measurements at CSNS Back-n

Yonghao Chen*

Institute of High Energy Physics, Chinese Academy of Sciences, China
*chenyonghao@ihep.ac.cn

The neutron total reaction (n, tot) cross-section is crucial for evaluating neutron-induced nuclear reaction data, with significant implications for both fundamental nuclear physics and nuclear technology. The measurement of the (n, tot) cross-section is supposed to be very accurate, since it is usually implemented via the transmission method, in which the neutron flux and the detection efficiency are canceled out, and so are the corresponding systematic errors. The back-streaming neutron facility (Back-n) at the China Spallation Neutron Source (CSNS) is very suitable for neutron transmission measurements and therefore for (n, tot) cross-section measurements, due to its unique geometry system: the sample and neutron detector can be installed far away (~20 meters) along the beam line, and a collimator is located between them to suppress the background to a negligible level. In this talk, the unique geometry and basic setup for transmission measurements at CSNS Back-n will be introduced, the technical highlights of the measurement and analysis will be presented, an overview of the (n, tot) cross-section measurements performed so far will be given, and specific examples will be discussed.

Web Application for Unfolding the Neutron Spectrum Measured by a Multi-Sphere Spectrometer

K. Chizhov[1,2*], A. Chizhov[3], S. Shirkov[1], D. Borschev[2], M. Akimochkina[2], A. Bely[1]

[1]*Radiation Safety Department, Joint Institute for Nuclear Research, Dubna, Russia*
[*]*kchizhov@jinr.ru*

[2]*Dubna State University, 141980, Universitetskaya St., 19, Dubna, Russia*

[3]*Laboratory of Radiation Biology, Joint Institute for Nuclear Research, Dubna, Russia*

We propose a software designed to unfolding neutron spectra at nuclear physics facilities based on measurement results obtained with the Bonner multi-sphere spectrometer. The software consists of the algorithms developed to the numerical solution of the Fredholm integral equation of the first kind. The algorithms are built on various regularization methods such as the expansion of the neutron spectrum in shifted Legendre polynomials with the Tikhonov regularization, truncated singular value decomposition, iterative solutions based on the Landweber method, information entropy maximization, maximum likelihood, including combination of the developed methods. The software is implemented as a web application that stores the original data and the decomposed spectrum with calculated dosimetric values. A comparison of the developed methods for ISO reference spectra and IREN facility is provided.

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Cross Sections of the $^{16}O(n, \alpha_0)^{13}C$ Reaction in the MeV Neutron Energy Region

I. Chuprakov[1,2], E. Sansarbayar[1,3], Yu.M. Gledenov[1], Guohui Zhang[4], G. Khuukhenkhuu[3], Jie Liu[4], Cong Xia[4], Haofan Bai[4], Wenkai Ren[4], Zepeng Wu[4,5], V.S. Chaikovskiy[1,2], B. Usukhbayar[1,6]

[1]Frank Laboratory of Neutron Physics, Joint Institute for Nuclear Research, Dubna 141980, Russia
[2]Institute of Nuclear Physics of the Agency of the Republic of Kazakhstan for Atomic Energy, Almaty 050032, Kazakhstan
[3]National Institute for Nuclear Science and Technology, National University of Mongolia, Ulaanbaatar13330, Mongolia
[4]State Key Laboratory of Nuclear Physics and Technology, Institute of Heavy Ion Physics, School of Physics, Peking University, Beijing 100871, China
[5]National Key Laboratory of Intense Pulsed Radiation Simulation and Effect, Northwest Institute of Nuclear Technology, Xi'an 710024, China
[6]School of Engineering and Technology, National University of Mongolia, Ulaanbaatar 14201, Mongolia

Accurate cross-section data for the $^{16}O(n,\alpha)^{13}C$ reaction are of significant interest for nuclear astrophysics and the design of next-generation nuclear reactors, particularly those employing oxide fuels or coolants. However, significant discrepancies persist between existing experimental data and major evaluated nuclear data libraries in the MeV region. In this work, we present preliminary results from new measurements of the $^{16}O(n,\alpha)^{13}C$ reaction cross section in this energy range.

The measurements were carried out at the EG-5 Van de Graaff accelerator at the Frank Laboratory of Neutron Physics, Joint Institute for Nuclear Research. Monoenergetic neutrons were generated via the $D(d,n)^3He$ reaction using a deuterium gas target. A double-section gridded ionization chamber (GIC) served as the detector for the emitted charged particles. A $^{238}U_3O_8$ sample, positioned inside the GIC, was used for neutron flux monitoring.

The obtained preliminary cross-section data are compared with earlier experimental datasets and evaluations. Our results are intended to help resolve the existing discrepancies in the evaluated nuclear data for this important reaction.

Cross Sections and Angular Differential Cross Sections Measurement for the $^{16}O(n, \alpha_0)^{13}C$ Reaction at E_n = 8.24 and 9.50 MeV

Cong Xia[1], Jie Liu[1], Zepeng Wu[1, 2], Haofan Bai[1], Wenkai Ren[1], Yu.M. Gledenov[3], E. Sansarbayar[3, 4], G. Khuukhenkhuu[4], L. Krupa[5, 6], I. Chuprakov[3, 7], Xichao Ruan[8], Hanxiong Huang[8], Jie Ren[8], Qiwen Fan[8], Xiaofei Wang[8], Bin Shao[8], Li'ao Zhao[8], Wentian Cao[1], Tieshuan Fan[1], Guohui Zhang[1]

[1]*State Key Laboratory of Nuclear Physics and Technology, Institute of Heavy Ion Physics, School of Physics, Peking University, Beijing 100871, China*
[2]*National Key Laboratory of Intense Pulsed Radiation Simulation and Effect, Northwest Institute of Nuclear Technology, Xi'an 710024, China*
[3]*Frank Laboratory of Neutron Physics, Joint Institute for Nuclear Research, Dubna 141980, Russia*
[4]*Nuclear Research Centre, National University of Mongolia, Ulaanbaatar, Mongolia*
[5]*Flerov Laboratory of Nuclear Reactions, Joint Institute for Nuclear Research, Dubna 141980, Russia*
[6]*Institute of Experimental and Applied Physics, Czech Technical University in Prague, Horska 3a/22, Prague 212800, Czech Republic*
[7]*The Institute of Nuclear Physics, Ministry of Energy of the Republic of Kazakhstan, Almaty 050032, Kazakhstan*
[8]*China Institute of Atomic Energy, Beijing 102413, China*

Cross sections and angular differential cross sections of the $^{16}O(n, \alpha_0)^{13}C$ reaction were measured at E_n = 8.24 and 9.50 MeV based on the HI-13 tandem accelerator of China Institute of Atomic Energy (CIAE). A gridded ionization chamber (GIC) was used as the charged particle detector, filled with the working gas of 0.7 bar Xe+5%H_2. Two WO_3 foil samples back-to-back set with Ta backings were used as the solid samples. Two $^{238}U_3O_8$ samples inside the GIC was used to determine the relative and absolute neutron fluences and an EJ-309 scintillation detector was placed on the beam line to measure the neutron energy spectra to correct the events induced by the low-energy neutrons. The present measurement cross sections were compared with the existing measurement data and evaluation data. Notably, the present measurement cross sections exhibit consistency with our previous measurement results using gas samples. The present measurement angular differential cross sections exhibit irregular shapes, suggesting that the reaction mechanism of the $^{16}O(n, \alpha_0)^{13}C$ reaction is relatively complex.

*Corresponding author: guohuizhang@pku.edu.cn

Determination of Neutron Capture Cross Sections for the Reactions $^{180}W(n,\gamma)^{181}W$ and $^{184}W(n,\gamma)^{185}W$ Utilizing a Photoneutron Source from an Electron LINAC

L.H. Khiem[1,2], V.D. Cong[1, 2], L.T.M. Nhat[2, 3], P.T. Thanh[1, 2], T.H.B. Phi[1, 2], L.V. Huy[4], N.T.X. Thai[1,2], N.A. Son[3], N.T.M. Sang[3], D.V. Trung[1], N.T. Binh[1], N.T. Dinh[5], H.S. Than[5], N.T. Vinh[5], V.N. Shvetsov[2], S.B. Borzakov[2], A.Yu. Dmitriev[2], V.V. Lobachev[2]

[1]*Institute of Physics, Vietnam Academy of Science and Technology, Hanoi, Vietnam, 10 Dao Tan, Ba Dinh, Ha Noi, Vietnam*
[2]*Joint Institute for Nuclear Research, Dubna, 141980 Russia*
[3]*Dalat University, 01 Phu Dong Thien Vuong, Ward 8, Dalat, Vietnam*
[4]*Institute of Fundamental and Applied Sciences, Duy Tan University, Ho Chi Minh City, Vietnam*
[5]*Vietnam Atomic Energy Institute, Hanoi, Vietnam, 59 Ly Thuong Kiet, Hoan Kiem, Ha Noi, Vietnam*

In this study, the cross sections for neutron capture processes on ^{180}W and ^{184}W isotopes induced by thermal and resonance neutrons were determined experimentally. The activation technique combined with offline gamma-ray spectrometry was employed for the measurements. Several correction factors, including those for gamma-ray self-absorption and coincidence summing effects were carefully applied during the radioactivity assessment. Furthermore, potential contributions from interfering nuclear reactions were identified and accounted for to enhance the precision of the obtained cross-section values. The final results are compared with previously published data, providing useful information for nuclear databases. These findings also offer valuable input for theoretical modeling of nuclear reactions and support various applications in nuclear science and technology.

Characterization of Secondary Activated Elements Generated during the Production of 18F-Fluorodeoxyglucose Using Cyclotron at INCART

E.M. Coronado[1] and F. Montero[1,2]

[1]School of Chemistry, Science and Technology Faculty, Pedro Henríquez Ureña National University (UNPHU), Santo Domingo, Dominican Republic
[2]National Cancer Institute Rosa Emilia Sanchez Perez de Tavares (INCART), Santo Domingo, Dominican Republic

Nuclear medicine has emerged as a fundamental tool in oncological diagnosis, establishing the radiopharmaceutical ^{18}F-fluorodeoxyglucose (18F-FDG) as one of the most widely used in PET studies. In the Dominican Republic, the National Cancer Institute Rosa Emilia Sánchez Pérez de Tavares (INCART) leads its production using an 18 MeV cyclotron. This research focuses on the characterization of secondary activated elements generated during this process. Using gamma spectroscopy, radionuclides were identified in components such as the target, synthesis filters, and cooling water. The results confirmed the presence of activation products such as ^{93}Mo in the target and validated the effectiveness of radioactive waste management protocols, demonstrating regulatory compliance and the environmental safety of the operations.

Measurement of Holmium-165 Spectra at the INES TOF Spectrometer of the Spallation Neutron Source RADEX

R.M. Djilkibaev, D. Khliustin*

Institute for Nuclear Research, Russian Academy of Sciences, Moscow, Russia
**denhlustin@gmail.com*

The work presents experimentally measured TOF spectra, obtained using samples-radiators of Holmium-165 thin patterns as target materials at the INES TOF spectrometer. Data were measured using 8-sectional liquid scintillator gamma-detector. Helium-3 counters were used as a neutron source intensity monitor.

Obtained data are compared with ENDF/B-VIII and other available literature sources, resonance structure is discussed.

Measurements were carried out with a channel duration 100 nanoseconds of the data acquisition system, and proton linear accelerator operating with parameters: proton beam duration 250 nanoseconds at half-maximum current amplitude, proton beam energy 267 MeV, flash frequency 50 Hz. TOF spectrometer base 50 meters provided resolution factor 6 nanoseconds per meter.

Metal Contents in Green Alcae (*Ulva lactuca*) from Coastal Water of Nha Trans Bay

T.T.P. Doan[1,2*], I. Zinicovscaia[1], N. Yushin[1], P. Nekhoroshkov[1], H.V. Tran[2], D.V. Do[2], T.D. To[2], T.T. Vo[2]

[1]*Joint Institute for Nuclear Research, Dubna, Russia*

[2]*Institute of Oceanography, Vietnam Academy of Science and Technology, Vietnam*

** email: doantien@io.vast.vn*

Five samples of green algae (*Ulva lactuca*) were collected along the coastline of the tourist zone in Nha Trang Bay, Vietnam. The content of 10 elements, Cr, Mn, Fe, Co, Ni, Cu, Zn, Sr, Cd, and Pb, in samples was determined by Inductively Coupled Plasma Optical Emission Spectrometry, with high reliability, and relative uncertainties of less than 10%. The maximum content of Cr, Mn, Fe, Co, Ni, Cu, and Pb was determined in the sample N5. The maximum content of Zn, Cd, and high content of Cu were determined in the sample N4. Both sampling locations are positioned in proximity to the Cai River mouth. Conversely, the high Sr content was determined in the samples N1, N2, and N3 in the order N2>N1>N3, which are sites characterized by coral reef. In general, the studied area is a touristic zone with no major sources of pollution, and the content of elements in algae samples were lower than the permissible limits for algae set by competent international organizations.

Keyword: *Ulva lactuca,* heavy metal, Nha Trang Bay

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Evaluation of Pre-Neutron-Emission Mass Distributions of Neutron-Induced Typical Actinide Fission Using Scission Point Model

Dongying Huo

Lanzhou University, China

Since the phenomenon of neutron-induced fission of uranium was discovered in 1938, research has been going on the process of nuclear fission. In particular, actinides are important nuclear fuel for fission devices, and its fission yields data are the key to determining burnup and transmutation system. The model of actinides fission is mainly by asymmetric splitting including mass distributions and charge distributions, shown as bimodal shape, especially, low excitation energy.

The yield distributions of neutron-induced fission of actinides were calculated and evaluated by using the improved scission-point model with considering octupole deformation of fragments. We studied the influence of the octupole deformation on the asymmetric yields of actinides fission. The more probable scission configuration is the pear-shaped heavy fragments rather than more spherical shape. We used the improved scission model to calculate the peak of charge and neutron distributions and compared results with the experimental data. The results confirm that the main asymmetric fission mode of the heavy actinides fission is indeed characterized by "ZH $\approx$ 54." The protons configuration of heavy fragment plays a dominant role in asymmetric fission of actinides.

Basic Installation EG-5 in JINR: Technical Capabilities and Current Scientific Tasks

Doroshkevich A.S.[1,2], Mezentseva Zh.V.[1], Chepurchenko I.A.[1], Perez M.A.C.[1,3], Ibrahim M.A.[1,4], Isayev R.Sh.[1,5], Mirzayev M.N.[1,5], Kruglyak A.I.[1], Tuan Ph.L.[1,6,7], Kirillov A.K.[1], Asgerov E.[5], Erceg T.[8], Teofilović V.[8], Ristić I.[8], Jovanović Z.[9], Stojanovic M.[10], Ksenevich V.K.[11], Gremenok V.F.[12], Khoroshko V.V.[12], Appazov N.O.[13], Bakiruly K.B.[14], Oksengendler B.L.[15], Taskaev S.Yu.[1,16], Salama E.[17]

[1]Joint Institute for Nuclear Research, Dubna, Russia; [2]Dubna State University, Dubna, Russia; [3]Voronezh State University, Voronezh, Russia; [4]Tomsk Polytechnic University, Tomsk, Russia; [5]National Center for Nuclear Research, Baku, Azerbaijan; [6]Graduate University of Science and Technology, Vietnam Academy of Science and Technology, Vietnam; [7]Institute of Physics, Vietnam Academy of Science and Technology, Vietnam; [8]Tehnološki Fakultet Univerziteta u Novom Sadu, Serbia; [9]University of Belgrade, Laboratory of Physics, Serbia; [10]National Museum Belgrade, Serbia; [11]Belarusian State University, Minsk, Belarus; [12]Belarusian State University of Informatics and Radioelectronics, Minsk, Belarus; [13]Korkyt Ata Kyzylorda University, Kyzylorda, Kazakhstan; [14]Kazakh Research Institute of Rice named after I. Zhakhaev, Kyzylorda, Kazakhstan; [15]The Institute of Material Sciences SPA "Physics - Sun", Tashkent, Uzbekistan; [16]G.I. Budker Institute of Nuclear Physics SB RAS, Novosibirsk, Russia; [17]The British University in Egypt, Ain Shams, Egypt

The EG-5 electrostatic accelerator remains one of the most effective and convenient nuclear physics instruments for solving a wide range of topical scientific problems in nuclear physics, in particular, obtaining nuclear data for nuclear and thermonuclear power engineering, astrophysics [1]. The EG-5 accelerator is part of the modern park of basic facilities - sources of ionizing radiation at JINR.

As part of the deep modernization of the EG-5 accelerator "Modernization of the EG-5 accelerator and its experimental infrastructure" (2024 - 2026) with the support of the Budker Institute of Nuclear Physics of Siberian Branch Russian Academy of Sciences (Novosibirsk), the accelerator's basic service systems were updated, a neutron source based on a lithium target (10 keV−800 keV) was launched, and a complementary methodological base was developed.

As a result of the modernization of the EG-5 systems in the basic configuration, the ion beam current was increased to the passport value (from 1.5 to 30 μA) and the energy of accelerated particles was increased by 85% of the passport value (from 2.8 to 3.5 MeV), which corresponds to 60% and 85% of the values planned in the Seven-Year Plan for the Development of JINR for 2024–2030 [2]. By the end of March 2026, it will be possible to resume operation of EG-5 in the basic configuration.

The developing of accelerator-based ion-beam powder nanotechnologies are planed aimed at developing radiation-resistant materials and functional environments for critical technologies. Specifically, the development of nanopixel radiation detectors and advanced electronics capable of stable operation in neutron fields is planned.

1.Nuclear Data High Priority Request List [https://www.oecd-nea.org/dbdata/hprl/search.pl?vhp=on]
2.JINR SEVEN-YEAR DEVELOPMENT PLAN FOR 2024–2030.

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Mass–Total Kinetic Energy Correlations in the Fusion–Fission of the Compound Nucleus ^{206}Rn

Punit Dubey[1*], Mahima Upadhyay[1], Mahesh Choudhary[1], Namrata Singh[1], Shweta Singh[1], Sriya Paul[1], N. Saneesh[2], Mohit Kumar[2], Rishabh Prajapati[2], K.S. Golda[2], Akhil Jhingan[2], P. Sugathan[2], Raghav Aggarwal[3], Kiran[3], and Ajay Kumar[1]

[1]*Banaras Hindu University, Varanasi, India*
[2] *Inter University Accelerator Centre, New Delhi, India*
[3] *Panjab University, Chandigarh, India*
*punitdubey@bhu.ac.in

Previous studies show that heavy-ion fusion–fission dynamics are strongly influenced by numerous factors such as entrance channel mass asymmetry (α), shell effects, and the neutron-to-proton ratio (N/Z). In the present work, we have obtained the mass distribution and total kinetic energy (TKE) of fission fragments from the compound nucleus ^{206}Rn**.**

The experiment was performed at the Inter-University Accelerator Centre (IUAC), New Delhi, India, using the 15UD Pelletron + LINAC accelerator facility. A pulsed ^{28}Si beam ranging 139−180 MeV was bombarded onto ^{178}Hf target, leading to the formation of the compound nucleus ^{206}Rn.

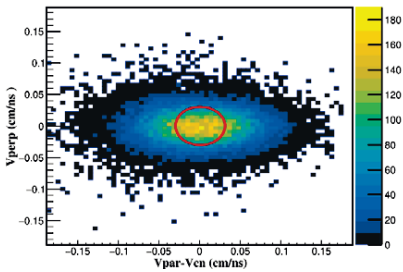

Figure 1. The distribution of velocity components V_{par} -V_{cn} and $V_{\perp}$ for the reaction ^{28}Si+^{178}Hf at beam energy 139.7 MeV.

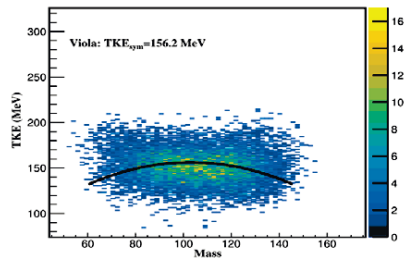

Figure 2. Mass − TKE correlations for the reaction ^{28}Si+^{178}Hf at beam energy 139.7 MeV.

The experimental results shown in Figure 1 display a symmetric distribution of velocity components centred around zero. This indicates the formation of a fully equilibrated compound nucleus, ^{206}Rn**.** In addition, the mass–TKE correlation presented in Figure 2 shows a symmetric mass distribution. The total kinetic energy (TKE) values closely follow the Viola systematics, which is standard indication for fusion–fission reactions. These observations suggest that the reaction is mainly governed by the standard liquid-drop type fission, with very little contribution from non-equilibrium processes such as quasi-fission at this energy. Further details of this study will be presented during conference.

Acknowledgment

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X-Ray Diffraction, Instrumental Neutron Activation Analysis, X-Ray Fluorescence, and Optical Microscopy Investigation of Unconsolidated Sediments of Serbian Danube Sector and Its Main Tributaries

Octavian G. Duliu[1,2,3], Tatjana Trtić-Petrović[4], Otilia Culicov[3,5], Ana-Voica Bojar[2,6], Delia-Georgeta Dumitras[1], Pavel Nekhoroskov[3], Ramona Visalom[1], Veronica Alexe[1], Lidia Manac[1], Hans-Peter Bojar[6]

[1]Geological Institute of Romania, 1, Caransebes str., 0127721 Bucharest, Romania
[2]University of Bucharest, Faculty of Physics, Department of Structure of Matter, Earth and Atmospheric Physics, Astrophysics, 405, Atomistilor str., 077125 Magurele (Ilfov), Romania
[3]Joint Institute for Nuclear Research, Frank Laboratory of Neutron Physics, Sector of Neutron Activation Analysis and Applied Research, 6, Joliot Curie str., 141980 Dubna, Russian Federation
[4]University of Belgrade, National Institute of the Republic of Serbia, Laboratory of Physics, Vinča Institute of Nuclear Sciences, P.O. Box 522, 11001 Belgrade, Serbia
[5]National Institute for R&D in Electrical Engineering ICPE-CA, 313, Splaiul Unirii, 030138 Bucharest, Romania
[6]Universal Museum Joanneum, Mineralogy, Weinzöttelstrasse 16, 8045 Graz, Austria

For a more detailed investigation of the recent, unconsolidated sediments of the Serbian sector of the Danube River and its main tributaries – Sava and Tisa, 12 samples consisting of unconsolidated recent sediments were collected and analyzed by more complementary analytical methods.

Accordingly, X-Ray Diffraction (XRD) permitted identification of more mineralogical phases, e.g. quartz, calcite, dolomite, clinochlore, and muscovite to which minerals belonging to alkali and plagioclazic feldspar group are added. Among them, quartz indicated the highest concentration of 65 to 95%, while feldspars presented the lowest one, up to 3%.

A tree diagram based on the Mahalanobis distances showed the presence of two main clusters, which evidenced rather a phenomenological grouping in two clades: one consisting of quartz and muscovite, alkali feldspars and clinochlore, while the other ~~on~~ consisted of carbonates (calcite and dolomite) and the plagioclazic feldspar.

The optical microscopy evidenced the presence of opaque minerals, of which total amount was less than 3%. The mineralogy of opaque minerals are a suplementary source of information regarding the provenience of the sedimentary material.

At their turn, INAA and XRF allowed determining the mass fraction of about 38 elements, useful in characterize the sediments origin as well as the degree of contamination with some Presumably Contaminating Elements (PCE). Accordingly, the incompatible and High Field Strength Elements (HFSE) pointed towards a dominant felsic origin of sedimentary material, close to the Upper Continental Crust (UCC), but without a sign of significant recirculation. As regards the presence of PCE, INAA and XRF showed increased mass fractions of V, Cr, Co, Ni, Zn, As and Sb with respect to UCC which was considered as the most con, but relatively lower values of Cd and Hg, confirming the existence of some anthropogenic contamination processes, mainly in the vicinity of great urban area such as Novi Sad or Belgrad.

Light-Nucleus (n, $n'\alpha$) Reactions within the Faddeev Framework in Momentum Space

M. Egorov*

Physics Faculty, Tomsk State University, Tomsk, Russia

**egorovphys@mail.ru*

Reactions (n,$n'\alpha$) play a crucial role in the nuclear breeding of transuranic elements and provide unique insights into the cluster structure of light nuclei within the energy range from the threshold up to 20 MeV. The most consistent framework for investigating light nucleus (n,$n'\alpha$) reactions involves solving the corresponding few-body Faddeev and Faddeev-Yakubovsky equations. In this work, the quantum mechanical three-body problem for particles of unequal masses is solved in momentum space in vector form, based on the Faddeev integral equations [1], as applied to processes involving ^{7}Li(n,$n'\alpha$)T, ^{8}Be (n, $n'\alpha$)α, and ^{12}C(n,$n'\alpha$)2α . Each of these processes yields unique information regarding the structure of the parent target nucleus, enables the verification of the few-body dynamics computational framework, and allows for a performance comparison with the predictions of the Continuum-Discretized Coupled-Channels (CDCC) model [2] and the discretized wave packet model [3].

To determine the cross sections for the three-body processes under consideration in the energy continuum, two-body t-matrices in separable form were reconstructed for the $n\alpha$,nT and αT,$\alpha\alpha$ interactions based on phase shifts reported in the literature. These matrices were subsequently employed in solving the three-dimensional integral Faddeev equations to obtain the elastic scattering and breakup reaction amplitudes. The cross section for the ^{12}C(n,$n'\alpha$)2α reaction was calculated within the three-body Born approximation by determining the three-body cluster wave function of the ^{12}C nucleus in the $\alpha-\alpha-\alpha$ form through the solution of homogeneous Faddeev equations and by specifying the two-body t-matrix for the $n - {}^{12}C$ interaction. The role of the Coulomb $\alpha\alpha$ interaction in the investigated reactions is discussed, and the contribution of the ^{8}Be(n,$n'\alpha$)α process as a final-state interaction (FSI) in the electromagnetic reaction ^{9}Be (γ,n)^{8}Be [4] is estimated.

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Next-Generation Nanomaterials: Bridging the Gap between Molecular Modeling and Sustainable Technological Solutions

H. Elhaes[1*] and M.A. Ibrahim[2,3,4]

[1]*Physics Department, Faculty of Women for Arts, Science and Education, Ain Shams University, 11757, Cairo, Egypt*
*hanan.elhaes@women.asu.edu.eg
[2]*Spectroscopy Department, National Research Centre, 33 El-Bohouth St., Dokki, Giza, 12622, Egypt*
[3]*Molecular Modeling and Spectroscopy Laboratory, Centre of Excellence for Advanced Science, National Research Centre, 33 El-Bohouth St., Dokki, Giza, 12622, Egypt*
[4]*Center for Converging Sciences and Emerging Technologies (CoSET), Benha National University (BNU), El-Obour 13518, Egypt*

We concentrate our investigation on the design, synthesis, characterization, and use of new polymer–metal oxide nanocomposites. Our work combines experimental methods with sophisticated molecular modeling; especially Density Functional Theory (DFT).This work concentrates on creating nanocomposites based on natural polymers/metal oxides and graphene, in order to customize the electronic, optical, and structural characteristics of polymer matrices. Molecular modeling serves the purpose of forecasting electronic properties, structural stability, and interaction mechanisms, thereby offering valuable insights for the rational design of advanced functional materials.

The resulting nanocomposites are investigated for a range of technological applications, including: Materials with tunable ΔE and enhanced electrical conductivity for Optoelectronic Devices. Development of gas sensors (e.g., using Cs/GO/$TiO_2$for CO_2or humidity sensors based on carbon nitride/GQDs). Designing highly efficient photocatalysts, such as Graphene/N-doped ZnO nanostructures, for the degradation of organic pollutants like dyes. By augmenting polymer sorbents with graphene derivatives, heavy metal ions can be effectively extracted from wastewater. Our research proposes a synergistic strategy that merges experimental synthesis with theoretical analysis to design nanocomposites with optimized nanoscale properties. This strategy shows effective management of material behavior to tackle key challenges in environmental remediation, sensing technologies, and advanced electronic applications.

Investigating Different Experimental Configuration at YuMO Spectrometer Required for Optimal Data Collection Using Standard Apoferritin Samples

A.H.A. Elmekawy[1,2,3], O. Ivankov[1], T. Murugova[1], A. Solovev[1], A. Islamov[1], A.I. Kuklin[1,4]

[1]*Joint Institute for Nuclear Research, Dubna, Russia*
[2]*Experimental Nuclear Physics Department, Nuclear Research Centre, Egyptian Atomic Energy Authority, Cairo 13759, Egypt*
[3]*Cyclotron Facility, Nuclear Research Centre, Egyptian Atomic Energy Authority, Cairo 13759, Egypt*
[4]*Moscow Institute of Physics and Technology (MIPT), Dolgoprudny, Russia*

The main part of modernization of the YuMO time-of-flight small angle neutron scattering spectrometer at the IBR-2 pulsed reactor (JINR) was the replacement of a single-detector acquisition scheme with a two-detector with central holes system [1]. This transition provides a much wider dynamic Q-range to be recorded in a single experiment and therefore reduces the effective measurement time [YuMO 2det. system] [2,3]. A second major element of the modernization was the improvement of the data treatment workflow moving from separate processing of each detector to a seamless, integrated procedure that continuously combines data from all detectors available at the spectrometer [4]. The modernized spectrometer and data-treatment software make it possible to obtain optimal results immediately after the measurement procedure, without additional time losses, allowing experimental conditions to be controlled almost in real time. Nevertheless, the duration time of one experiment remains an important practical question due to the differences in the neutron scattering from sample to sample.

In the present study we try to shed a light to the question of selecting an optimal measurement time and instrument settings for a given experiment. We discuss typical experimental parameters, including moderator temperature, collimator diameter, and detector positions.

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A Database of Gamma-Ray Emission Cross-Sections for 14.1 MeV Neutron-Induced Reactions

Nikita Fedorov[1], Alexander Andreev[1,2], Polina Filonchik[1], Dimitar Grozdanov[1], Constantin Hramco[1], Petr Kharlamov[1,2], Yuri Kopatch[1], Pavel Prusachenko[1], Vadim Skoy[1], Tatiana Tretyakova[2]

[1]*Joint Institute for Nuclear Research, Dubna, Russia*
[2]*Moscow State University, Moscow, Russia*

The study of characteristic γ-ray emission from fast neutron-induced reactions is crucial for both fundamental nuclear physics and applied research. It provides valuable information about nuclear structure and the probabilities of exciting specific nuclear states. Gamma-ray spectroscopy of products of reactions with fast neutrons (particularly around 14 MeV) is a prospective technique for investigating the elemental composition of materials. A comprehensive series of experiments to measure γ-ray emission cross-sections has been conducted within the framework of the TANGRA (TAgged Neutrons and Gamma-RAys) project at the Frank Laboratory of Neutron Physics, JINR. The experimental setup employed four $LaBr_3$(Ce) scintillators positioned at different angles to measure angular distributions of γ-rays and two high-purity germanium (HPGe) detectors used for high-quality γ-spectroscopy. The ING-27 D-T neutron generator provided 14.1 MeV neutrons, and the tagged neutron method was utilized to precisely select events originating from the sample under study. As a result, γ-ray emission cross-sections were measured for 53 elements. Significantly, for 20 of these elements, the data were obtained for the first time. The results of these experiments were compiled to a database which could be useful for fundamental and applied purposes.

This report will discuss the key features of the experiments, the content and structure of the database, and the current status of experimental data for γ-ray emission cross-sections.

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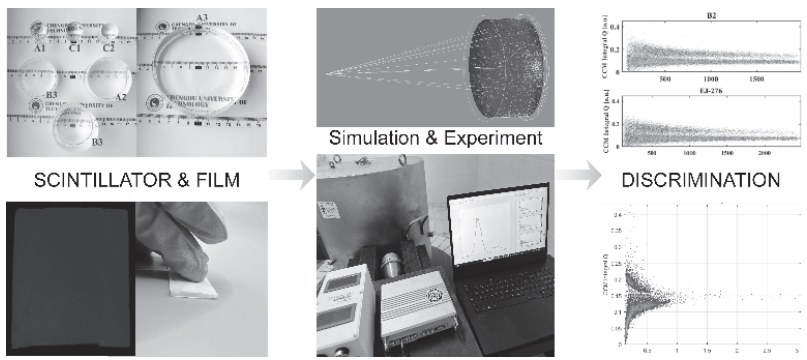
Development and Optimization of Plastic Scintillators and Perovskite Composite Films for Neutron-Gamma Discrimination

Fei Li*, Bingqi Liu, Xianghe Liu, Hongtao Xu, Liangquan Ge, Guoqiang Zeng, Yi Gu, Meng Wang, Qingxian Zhang, Qiang Yang

*Chengdu University of Technology, China, *lifei17@cdut.edu.cn*

Accurate neutron-gamma discrimination is of paramount importance in fields such as nuclear physics and space radiation detection. Although traditional plastic scintillators are widely utilized due to their stable physicochemical properties, further enhancing their comprehensive detection performance and optimizing pulse shape discrimination (PSD) remain critical scientific challenges that urgently need to be addressed. Concurrently, copper-based halide perovskites, characterized by their high light yield and excellent luminescent properties, have emerged as a research hotspot for next-generation high-performance detection materials. This study focuses on the development and optimization of two novel scintillator systems to achieve efficient neutron-gamma discrimination: copolymer-based plastic scintillators and zero-dimensional $Cs_3Cu_2I_5$ perovskite composite films. For the plastic scintillators, Monte Carlo simulations were incorporated to conduct an in-depth analysis of the energy deposition process. This guided the successful fabrication of copolymer samples with high optical transmittance and excellent mechanical properties, culminating in the complete optoelectronic packaging of the detector. In terms of the perovskite materials, $Cs_3Cu_2I_5$ crystals were successfully introduced into flexible polymer matrices via an in-situ process, and the impact of different matrix components on the discrimination performance was investigated. Experimental evaluations utilizing an ^{241}Am-Be neutron source demonstrated that the plastic scintillators, following dimensional and compositional optimization, exhibited exceptional neutron-gamma discrimination capabilities. Meanwhile, the prepared perovskite composite films also successfully achieved effective pulse shape discrimination, with their performance being systematically influenced by the polymer matrix ratio. These findings validate the immense potential of both material systems in advanced radiation detection, providing a crucial reference for future efforts to overcome detection efficiency bottlenecks and material structural limitations.



Neutronics Study of Pelletized Mesitylene Moderators for China Spallation Neutron Source

Fei Shen, Bin Zhou, Xufen Han, Tianjiao Liang

Dongguan Research Department, Institute of High Energy Physics, Chinese Academy of Sciences, China

Mesitylene, a molecule comprising a benzene ring substituted with three methyl groups, achieves its neutron moderation performance primarily through the presence of methane-like low-energy rotational levels of the methyl groups, which enable efficient moderation of thermal neutrons into cold neutrons via inelastic scattering. A Pelletized mesitylene cold neutron moderator has been operational at the IBR-2 reactor of the Joint Institute for Nuclear Research in Dubna, Russia, since 2013. The China Spallation Neutron Source (CSNS) currently operates three moderators: a coupled liquid hydrogen moderator (20 K), a decoupled water moderator (300 K), and a decoupled poisoned liquid hydrogen moderator (20 K). In this paper, the neutronic parameters of coupled, decoupled, and decoupled poisoned moderators using cold Pelletized mesitylene at the CSNS are analyzed using the MCNPX code. Parameters such as neutron integrated intensity, peak intensity of the neutron pulse, and pulse full width at half maximum are evaluated and compared with those of the existing moderators at the CSNS.

Keywords: Pelletized Mesitylene Moderator, Monte Carlo Simulation, China Spallation Neutron Source

Method for Describing Triple Angular Correlations in Inelastic Scattering of a Particle on a Nucleus with Subsequent Gamma Emission

P.G. Filonchik[1,2,3,*], A.L. Barabanov[3,4]

[1]*Joint Institute for Nuclear Research, FLNP, Dubna, Russia*
[2]*Moscow Institute of Physics and Technology, Moscow, Russia*
[3]*National Research Center "Kurchatov Institute", Moscow, Russia*
[4]*National Research Nuclear University MEPhI, Moscow, Russia*
**E-mail: filonchik.pg@phystech.edu*

The process of inelastic scattering of a nucleon or other particle by a nucleus, accompanied by the transition of this nucleus to an excited state and subsequent return to the ground state via the emission of a cascade of gamma quanta, has attracted the attention of researchers for decades. On the one hand, the cross sections for the formation of excited states with a specific energy, spin, and parity can be used to infer the mode of inelastic scattering, namely, whether it involves a small or large number of degrees of freedom. An example of extreme approaches is the treatment of inelastic scattering as a direct reaction or a reaction involving the formation of a compound nucleus. In reality, when describing inelastic scattering, the contributions of both these mechanisms are typically taken into account. On the other hand, the measured energies of cascade gamma quanta and their intensities allow us to establish, with a certain degree of reliability, the characteristics (energy, spin, parity) of the levels of the target nucleus lying below the state excited in inelastic scattering.

Information obtained in inelastic scattering studies is necessary for testing microscopic approaches to describing the structure of atomic nuclei and nuclear reactions, but this same information also has significant practical significance [1]. In particular, the authors of recent experimental studies [2,3] of the $^{12}C(n,n`\gamma)$ process emphasized the importance of the data obtained both for the development of next-generation nuclear technologies and for improving methods for remote determination of the carbon content in samples. At the same time, the astrophysical reasons for interest in the $^{12}C(p,p`g)$, $^{16}O(p,p`\gamma)$, $^{12}C(\alpha,\alpha`\gamma)$ processes, which occur, in particular, during solar flares, are discussed in [4,5].

An important source of information about the reaction mechanism and nuclear states are also the angular distributions of both the inelastically scattered particle and the emitted gamma quanta. However, there are objective difficulties in interpreting the rather extensive data on angular distributions obtained over decades of experimental research, especially in cases where the spatial correlations of three vectors - the momenta k and k` of the incident and inelastically scattered particles, as well as the momentum kγ of the gamma quantum - were studied. In the absence of agreement on how to choose the axes of the Cartesian coordinate system, different sets of angles defining the directions of the momenta k, k`, and kγ arise. Furthermore, different models of the reaction were used in different studies, and, consequently, the conclusions regarding the observed angular anisotropy turned out to be model-dependent. This paper describes a method for describing data on angular correlations of vectors k, k`, kγ in the inelastic scattering reaction N(P,P`γ) of a particle P with an arbitrary spin on a nucleus N. In this model-independent approach, the observed quantities are expressed through the elements of the S-matrix describing the inelastic scattering reaction, and the angular correlations are described by means of three-vector invariant functions, first described in [6].

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Neutron-Gamma Angular Correlations in Nuclear Reactions: ^{252}Cf(sf), ^{235}U(n,f) and ^{9}Be(α,n)^{12}C

Polina Filonchik, Yuri Kopatch, Dimitar Grozdanov, Daniyar Berikov, Gadir Ahmedov, Sabuhi Nuruev, Pavel Prusachenko, Nikita Fedorov

FLNP, Joint Institute for Nuclear Research, Dubna, Russia

The TANGRA group at the Joint Institute for Nuclear Research is studying angular correlations between neutrons and gamma rays in various nuclear reactions. Experiments were conducted to study the angular distribution of gamma rays relative to emitted neutrons in the spontaneous fission of ^{252}Cf, the fission of ^{235}U, and ^{9}Be(α,n)^{12}C using a Pu-Be source. This experiment is a preparatory study for the ROT effect in fission reactions [1]. It is assumed that the rotation of fission fragments can be observed by recording the correlation of secondary neutron and gamma rays.

This paper examines three types of angular correlations: neutron-gamma, neutron-neutron, and gamma-gamma. The main challenge in constructing angular distributions for processing this experiment is separating background events from the desired effect. Such events include random coincidences, which form the basis for all events, as well as particle rescattering from one detector to another, and the production of gamma quanta in detectors under the influence of neutrons [2, 3]. The cross-talk is primarily observed between closely spaced detectors and decays with increasing distance between detectors. To reduce the influence of background processes, particle separation by pulse shape and event selection based on the difference in response times of two detectors are used. The cross-talk was also simulated in Geant4, and experimental data were compared with a function consisting of a sum of Legendre polynomials, which describe the angular distribution of gamma quanta relative to neutrons, and a quadratically decaying function describing angular dependence of the cross-talk.

Furthermore, angular correlations were compared at different detector-source distances to account for the influence of rescattering effects.

The "Neutron Beta Decay" Installation for the Reactor PIK

A.P. Serebrov*, A.K. Fomin, N.S. Budanov, O.M. Zherebtsov, V.A. Kayaikin, A.O. Koptyukhov, V.A. Lyamkin, A.N. Murashkin, D.V. Prudnikov

NRC "Kurchatov Institute"- PNPI, Gatchina, Russia

*serebrov_ap@pnpi.nrcki.ru

The neutron instrument complex "Neutron Beta Decay" is currently being manufactured to be located on the beam of polarized cold neutrons on the GEK-3 N0 channel. The facility is designed to measure the electron, neutrino, and electron-neutrino asymmetries of neutron beta decay. The experiment is necessary because the results of the most recent, most precise neutron decay experiments, conducted at an accuracy level of 10^{-3}, cannot be described within the Standard Model. The basis of the facility is a superconducting solenoid, which generates a uniform magnetic field of 0.35 T. Electrons and protons produced during neutron decay move in a magnetic field along magnetic field lines. To select a specific electron emission angle, a magnetic mirror effect is used by creating a region with a stronger magnetic field, with an induction of 0.88 T. The decay region is selected by protons, which are further accelerated by an electric field. This is achieved by using an electrostatic system that increases the voltage in the decay region to 30 kV. Detectors at the input and output of the neutron beam are used to record the electrons and protons. The aim of the experiment is to improve the accuracy of measuring correlation coefficients by ~3 times. Comprehensive simulation of the experiment was carried out.

Structural and Defect Dynamics in He^+ Ion-Irradiated Nanostructured CuO

Silvia María Fortuné Fábregas[1,2], Samir Samadov[1], Oleg Orlov[1], Alexey Sidorin[1], Augusto Iribarren[2], Lídice Vaillant-Roca[2], Aleksandr Doroshkevich[1,3]

[1]*Joint Institute for Nuclear Research, Dubna, Russia*
[2]*Institute of Materials Science and Technology, University of Havana (IMRE-UH), Havana, Cuba*
[3]*Dubna State University, Dubna, 141980, Russia*

Copper (II) oxide (CuO) nanostructures emerge as ideal p-type semiconductors for optoelectronics, thanks to their narrow bandgap (1.21−1.55 eV), abundance, non-toxicity, and stability. Defect engineering via ion irradiation offers a powerful route to modify their properties. In this research, we investigate the defect evolution and structural modifications in CuO nanostructured layers irradiated with He^+ ions across doses from $3.13 \cdot 10^{13}$ – $3.38 \cdot 10^{16}$ ions/cm². Samples were characterized using scanning electron microscopy (SEM), X-ray diffraction (XRD), Raman spectroscopy, and positron annihilation spectroscopy (PAS). The results reveal a dose-dependent competition among radiation-induced mechanisms. At low irradiation doses, ion energy promotes lattice recovery and defect recombination, leading to a reduction of compressive strain and improved crystallinity. Higher doses induce a shift toward vacancy generation and complex defect production. Additionally, an area of complex defects was identified at the nanorod surface. This is related to a defective layer in nanorod surfaces due to increased positron lifetimes from positron trapping in those areas. These results provide a deeper understanding of defect engineering in nanostructured CuO and highlight its potential for applications in radiation-exposed environments.

The Acceleration Effect: Where We Are

A.I. Frank*, G.M. Arzumanyan, G.V. Kulin, M.A. Zakharov

*Joint Institute for Nuclear Research, Dubna, Russia, *frank@jinr.ru*

The report is devoted to the current state and immediate prospects of studying the acceleration effect (AE), the existence of which directly follows from the equivalence principle. The effect is that when a wave is scattered by any object moving with acceleration, a frequency change inevitably occurs [1]. Such an object can be an elementary or resonant scatterer, a potential structure, or any device that transmits a signal. The acceleration effect is almost as general as the well-known Doppler effect, but the frequency shift is determined not by the object's speed, but by its acceleration. Predictions of phenomena that can now be interpreted as manifestations of the acceleration effect were made many years ago both for electromagnetic waves passing through a dielectric plate moving with acceleration [2] and for neutron waves passing through an accelerated sample [3,4]. Later, a similar effect was predicted for electron neutrinos passing through an accelerating layer of matter [5]. The theoretical prediction of frequency changes during the scattering of wave packets by accelerating potential structures [6] testifies to the validity of the concept of AE in quantum phenomena.

As for the experimental observation of the effect, it is currently registered only in experiments with neutrons [7-10], which demonstrated the qualitative agreement of the results with theoretical predictions. Apparently, this situation cannot be considered satisfactory. Therefore, a significant part of the report will be devoted to discussing new experiments on the acceleration effect in neutron optics, quantum mechanics and electrodynamics. The close connection of the acceleration effect with the equivalence principle allows us to consider these experiments as a demonstration of the validity of the latter in new physical phenomena.

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Milestones in Neutron Activation Analysis History – Celebrating 90 Years

M. Frontasyeva*

*Joint Institute for Nuclear Research, Dubna, Russia, *marina@nf.jinr.ru*

Neutron Activation Analysis (NAA) is a sophisticated, non-destructive analytical technique for precise elemental composition determination, involving neutron irradiation to induce nuclear reactions, followed by gamma-ray detection and quantification. Originating in 1936 with pioneering work by György Hevesy and Hilde Levi on neutron-induced radioactivity, NAA developed including high-purity germanium (HPGe) detectors, computer-based data analysis, and advanced Compton suppression systems with BGO detectors to minimize background noise. Key contributors shaped NAA's evolution: Vincent P. Guinn (USA) pioneered forensic and archaeological applications; Frans De Corte (Belgium) and András Simonits (Hungary) advanced k_0-standardization for multi-element analysis; Richard D. Evans and Glenn T. Seaborg (USA) enhanced reactor-based techniques; Eiliv Steinnes (Norway) introduced epithermal NAA; Sheldon Landsberger (USA) developed environmental and biological NAA methods with Compton suppression techniques. Instrumentation includes nuclear reactors, radioisotope sources, and accelerators, paired with HPGe and scintillation detectors for gamma spectroscopy. These innovations, driven by neutron capture principles and varying neutron types (thermal, epithermal, fast), enhanced sensitivity for trace elements. The first work on NAA in the USSR began at the Vernadsky Institute by I.P. Alimarin and Y.V. Yakovlev. They used the OK-187 heavy water reactor, launched in 1949 at the ITEF (Moscow). Many radioanalysts from the USSR and Eastern Europe underwent practical training in NAA at this reactor: A.A. Kist, Ganiev (Tashkent), G.G. Glukhov (Tomsk), A. Dutov (Minsk), M.N. Shchulepnikov (Giredmet, Moscow), L. Mosulishvili (Tbilisi), K. Shvarts (Riga), H.B. Avsargov (Apatity), H. Popov (Bulgaria), colleagues from China, Romania, Z. Nitze (Dresden, GDR), S. Sterlinsky, R. Dybchinsky (Poland), M. Erdeg, E. Szabo (Hungary) and others. Soviet researchers such as A.P. Alexandrov, G.N. Flerov, and V.I. Mostovoy strengthened the spread of NAA in the Soviet Union. Russian scientists played a key role in intensifying research in the field of geology and metallurgy using research reactors. Nowadays, instrumental and radiochemical NAA is developed in over 100 reactor centres worldwide. In 2007, NAA was recognized as a reference analytical technique. The Hevesy Medal Award, the premier international award of excellence honouring outstanding achievements in radioanalytical and nuclear chemistry was established in 1968 in recognition of excellence through outstanding, sustained career achievements in the fields of pure and applied nuclear and radiochemistry, particularly applications to nuclear analytical chemistry. Among the laureates are three Russian scientists: I.P. Alimarin (1970), B.F. Myasoedov (2012) and P.V. Kolotov (2021), all from the Vernadsky Institute. NAA's versatility spans environmental monitoring, geology, archaeology, and biomedicine, providing indispensable insights for research and industry. Recent achievements include accelerator-based NAA and data interpretation using artificial intelligence, which promise even greater accuracy in the 21st century. An important milestone was the establishment under the leadership of Vladimir Nazarov the instrumental NAA at the pulsed periodic IBR-2 reactor of the JINR in Dubna, allowing for multi-element analysis in the fields of ecology and material science.

Application of True Coincidence Summing Coefficients in Gamma-Ray Spectrometry for Correcting Radionuclide Activity Values and for Constructing Detector Efficiency Calibration Curve

Vladimir Galustov, Dmitrii Grozdov

Department of Nuclear Physics, FLNP, Joint Institute for Nuclear Research, Dubna, Russia

The true coincidence summing effect leads to underestimation of full energy peak areas in gamma spectra. To account for this effect, the “Cascades” software has been developed. The program is written in C# using .NET Framework. The graphical user interface is implemented with API Windows Forms. For calculating true coincidence summing correction factors, the open-source application EFFTRAN has been integrated. The “Cascades” provides extends the functionality of the basic calculation core. The gamma-ray yield correction function in the radionuclide library allows accounting for the coincidence summing effect when computing radionuclide activities in gamma spectra. The separate module has been developed to account for true coincidence summing effect when calculating the efficiency of gamma-ray detection from certified sources and to create a file with calibration data. The software supports operation with point sources, cylindrical sources, and Marinelli beakers. For volumetric samples, the self-absorption effect is taken into account.

Some Features of Atmospheric Deposits of Potentially Toxic Elements in Moss Biomonitoring on the Territory of Perm Region

E. Gatina[1], I. Zinicovscaia[2], P. Sannikov[1]

[1]*Perm State University, Perm, Russia*

[2]*Joint Institute for Nuclear Research, Dubna, Russia*

The Perm Region is situated on the eastern part of the Russian Plain (80%) and the western slope of the Urals (20%). Its climate is primarily influenced by westerly and northwesterly atmospheric processes. Western and northwestern air masses are prevailed. Cyclones are more frequent (74%) than anticyclones (26%) throughout the year. In winter, south-western, western, southern, and south-eastern winds prevail, while in summer winds from the west, north-west, or north are more frequently recorded. For the first time in the region, studies on atmospheric deposition of potentially toxic elements in moss biomonitors are conducted.

In the structure of industrial production in the urban areas of Perm Region, an important place is occupied by mechanical engineering, oil and gas processing, petrochemistry, electric power, metalworking, wood processing, paper industries and the fertilizers industry.

During 2022-2025, according to the standard Moss survey protocol, 311 moss (*Pleurozium schreberi* и *Hylocomium splendens*) samples were collected in the territory of Perm Region on the pre-prepared 25 x 25 km grid. Priority areas for sampling were protected natural areas. The concentrations of 16 potentially toxic elements (PTE), namely Al, P, S, V, Cr, Mn, Fe, Co, Ni, Cu, Zn, Sr, Cd, Ba, Hg, and Pb were determined in mosses using inductively coupled plasma optical emission spectrometry method and direct mercury analyzer DMA-80 evo.

Based on the obtained data, the minimum, maximum, average, and median values of PTE concentrations were determined. Next, statistically processing (factor and correlation analyses) of the data was carried out. The results of the statistical processing were compared with spatial analysis performed using GIS.

Median con-centration s(mg/kg) of accumulated PTEs have been found to decrease in the following series: P (2062,50) > S (1238,00) > Al (554,5) >Fe (523,65) > Mn (289,60) > Zn (37,97) > Ba (36,33) > Sr (17,08) > Cu (5,58) > Pb (2,53) > Ni (1,899) > Cr (1,71) > V (1,597) >Co (0,335) > Cd (0,165) > Hg (0,030).

Phosphorus is an important element for the vital activity of mosses. It prevails in terms of absolute content both in the cities of the region and in the region as a whole. In the cities of the region (Perm, Berezniki, Solikamsk, Gubakha), phosphorus is followed by Al and Fe in the biogeochemical series of absolute contents. At the same time, outside of cities, phosphorus is followed by sulfur. This distribution indicates the local nature of atmospheric precipitation of Al and Fe in areas near the largest the cities of the region.

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Development of Ionization Chambers for Measuring (n,p) and (n,α) Cross Sections at the IREN Facility

E. Sansarbayar[1,2], I. Chuprakov[1,3], Yu.M. Gledenov[1], V.S. Chaikovskiy[1,3], B. Usukhbayar[1,4]

[1]Frank Laboratory of Neutron Physics, Joint Institute for Nuclear Research, Dubna 141980, Russia
[2]National Institute for Nuclear Science and Technology, National University of Mongolia, Ulaanbaatar 13330, Mongolia
[3]The Institute of Nuclear Physics of the Agency of the Republic of Kazakhstan for Atomic Energy, Almaty 050032, Kazakhstan
[4]School of Engineering and Technology, National University of Mongolia, Ulaanbaatar 14201, Mongolia

We have developed two detectors—a gridded ionization chamber (GIC) and a compensated ionization chamber (CIC)—for measuring (n,p) and (n,α) cross sections at the IREN white neutron source. These detectors allow the use of samples with diameters up to 120 mm and provide high efficiency (close to 100% in 2π geometry). The use of the CIC significantly reduces the influence of the gamma-ray burst, thereby expanding the neutron energy range for measurements. The pulse from the detectors contains information about the total energy and allows for particle identification. We implemented a drift-time method and a pulse-shape discrimination method to extract signal characteristics used for particle identification. These values are obtained from the digitized pulse using a digital processor, which requires a sampling frequency of 200 MHz with 12-bit resolution.

Eco-Engineered Hollow Spherical Nanocomposites: Hematite/Carbon Spheres for Fast Lead Removal from Water

Gomaa I.[1], Yushin N.[2], Bayachou M.[3], Stanic V.[4], Zinicovscaia I.[2]

[1]*The British University in Egypt, Egypt*
[2]*Joint Institute for Nuclear Research, Dubna, Russia*
[3]*Chemistry Department, College of Arts and Sciences, Cleveland State University, Cleveland, USA*
[4]*Vinca Institute of Nuclear Sciences, University of Belgrade, 11000 Belgrade, Serbia*

This work presents a facile mechano-thermal route for the synthesis of carbon-decorated, hollow, mesoporous α-Fe_2O_3 microspheres. Comprehensive characterization (XRD, XPS, FT-IR, SEM/EDX, TGA, zeta-potential) confirmed the formation of phase-pure hematite with nanoscale crystallites (~19 nm), substantial residual surface carbon (~40 wt%) consistent with Fe–O–C linkages, and a positive surface charge (+15.9 mV). The hierarchical hollow/mesoporous architecture enables fast ion transport and provides extensive interior binding sites, resulting in rapid Pb(II) uptake that reaches 92% removal in ≈15 min at pH 5.0. The adsorption follows a Langmuir isotherm (qmax ≈ 70.6 mg/g) and pseudosecond-order kinetics, indicative of chemisorption coupled to efficient mass transfer into internal sites. The composite also exhibits antibacterial activity against Escherichia coli Staphylococcus aureus, demonstrating its potential for simultaneous mitigation of heavy metal contaminants and pathogens.

Analysis of Atmospheric Deposition Dynamics in Tula Region over the Past 10 Years

Gorelova S.V.[1*], Zinicovscaia I.[2,3], Peshkova A.[2], Frontasyeva M.V.[2]

[1]Department of Biology and Technology of Living Systems, Natural Sciences Faculty, L.N. Tolstoy Tula State Pedagogical University, Tula, Russia, [*]salix35@gmail.com

[2] Frank Laboratory of Neutron Physics, Joint Institute for Nuclear Research, Dubna, Russia

[3]Horia Hulubei National Institute for R&D in Physics and Nuclear Engineering, Bucharest - Magurele, Romania

Analysis of atmospheric deposition dynamics is an important component of environmental biomonitoring, which is carried out in Europe and Asia every five years as part of the ICP Vegetation program. The Tula region participates in the program every 10−15 years since 1998.

The data is collected using passive bryomonitoring and analyzed using modern physicochemical methods of analysis (INAA, ICP-OES and AAS).

The analysis of atmospheric deposition in the region was carried out in 1998−1999 [Ermakova et al., 2004], 2015 [Gorelova et al., 2016] and 2023−2024. The analysis of samples was carried out in the Neutron Activation Analysis Sector of the JINR Laboratory of Neutron Physics using neutron activation analysis and ICP-OES (2023−2024).

During the most recent monitoring, moss samples were collected from districts across the region using a 30-square-meter grid. The data obtained during the study on the five main pollutants in the region showed that the Cu content in atmospheric deposition increased by 1.5 times compared to 2015. The content of Fe, an element that is not regulated but causes soil anomalies, in the air has increased by 31% compared to 2015 data.

The content of Mn, an element of hazard class II, increased by 2 times compared to 2015 and 2.25 times compared to 1999. According to the data obtained, the content of V, an element of hazard class III, in atmospheric fallout in the region increased by 2.4 times, and the element with carcinogenic properties Zn, an element of hazard class I, increased by 1.46 times.

The obtained data correlate with previously published data for the region's soils and indicate an intensification of production in the metallurgical and metal-processing industries.

Such worsening air pollution in the region could directly impact public health, causing chronic cardiovascular and upper respiratory diseases and leading to the development of cancer.

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Measurements of the Gamma-Ray Emission Cross Sections and Angular Distributions from (n, xγ) Reactions with 14.1 MeV Neutrons

D.N. Grozdanov[1,2,*], N.A. Fedorov[1], P.S. Prusachenko[1], Yu.N. Kopatch[1], V.R. Skoy[1], I.N. Ruskov[1,2], T.Yu. Tretyakova[1,3,4], P.I. Kharlamov[1,3,4], A.V. Andreev[1,4], C. Hramco[1], P.G. Filonchik[1,5], and TANGRA collaboration

[1]*Joint Institute for Nuclear Research (JINR), Dubna, Russia*
[2]*Institute for Nuclear Research and Nuclear Energy (INRNE), Bulgarian Academy of Sciences (BAS), Sofia, Bulgaria*
[3]*Skobeltsyn Institute of Nuclear Physics (SINP), M.V. Lomonosov Moscow State University (MSU), Moscow, Russia*
[4]*Faculty of Physics, M.V. Lomonosov Moscow State University (MSU), Moscow, Russia*
[5]*Moscow Institute of Physics and Technology, Dolgoprudny, Moscow Region, Russia*

**E-mail: dimitar@nf.jinr.ru*

The study of inelastic scattering of fast neutrons by atomic nuclei is of great importance for both fundamental and applied neutron-nuclear physics. Reactions induced by neutrons provide a unique source of information for describing the processes of strong interaction between nucleons.

Inelastic scattering processes are utilized to study the characteristics of excited states of target nuclei [1]. The practical application of the (n,n'γ) reaction necessitates the expansion and refinement of experimental data on this process. Research on the inelastic scattering of fast neutrons has recently become more active, driven by new prospects for nuclear energy production using fast neutron reactors.

The purpose of this experiment was to refine the available data on emission cross sections and angular distributions from the inelastic scattering of 14.1 MeV neutrons by certain light nuclei. This work was conducted within the framework of the international TANGRA (TAgged Neutrons and Gamma RAys) project at the Frank Laboratory of Neutron Physics, Joint Institute for Nuclear Research in Dubna, Russia.

Inelastic scattering was studied using the Tagged Neutron Method [2], in which neutrons with an energy of 14.1 MeV, produced in the d(t,α)n reaction, are "tagged" by detecting alpha particles. Gamma quanta from the (n,n'γ) reaction were recorded using a new multidetector system [3]. The experimental data are presented and discussed in comparison with previously published results.

This work was conducted with financial support from the Russian Science Foundation (grant no. 23-12-00239).

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Elemental Profile and Health Risk Assessment of South African Rooibos Cultivated under Ecological Conditions

Dmitrii Grozdov[1], Inga Zinicovscaia[1,2], Rikus le Roux[3], Jacques Bezuidenhout[3], Nikita Yushin[1], Konstantin Vergel[1]

[1]Joint Institute for Nuclear Research, Frank Laboratory of Neutron Physics, 141980 Dubna, Russia

[2]Horia Hulubei National Institute for R&D in Physics and Nuclear Engineering, Bucharest - Magurele, Romania

[3]School for Science and Technology, Faculty of Military Science, Stellenbosch University, South Africa

The elemental profiles of rooibos leaves (green and fermented) and soil samples collected from a farm in the Cederberg Mountain range of South Africa's Western Cape were determined using instrumental neutron activation analysis and inductively coupled plasma optical emission spectrometry. Mass fractions of As, Cd, and Pb in plant material were below the World Health Organization's limits. Soil pollution and elemental enrichment were assessed using contamination and enrichment factors, revealing elevated mass fractions of Si, Zr, Hf, Br, and Cd. The transfer factor was used to evaluate metal translocation in the soil-plant system. Health risks were assessed based on calculated Target Hazard Quotients and the Hazard Index. Both indices were well below 1.0 for all elements, indicating that the consumption of rooibos tea containing the analyzed elements poses no significant threat to human health.

Comparison of Pulsed Neutron Sources Based on Plutonium and Neptunium

Hassan A.A.*

Frank Laboratory of Neutron Physics, Joint Institute for Nuclear Research, Dubna, Russia

*e-mail: ahmed.hassan@nf.jinr.ru

A new pulsed high flux nuclear reactor is currently being developed within the Frank Laboratory of Neutron Physics (FLNP) to replace the current IBR-2M reactor after the end of its service life. One of the proposed options is the NEPTUNE reactor (average power of 12−15 MW, pulse duration of 210 μs and an average neutron flux of $1.6 \cdot 10^{14}$ n/cm^2/s and at the peak power of $3.8 \cdot 10^{17}$ n/cm^2/s), which will use fuel based on the isotope Np-237 for the first time.

Np-237 is a threshold isotope with a fission threshold of 0.4 MeV, lower than the fission threshold of uranium-238 of 2 MeV. This gives it a greater advantage in terms of the possibility of using as the new nuclear fuel in pulsed reactors to obtain a short neutron pulses, have a low background power between pulses and use a new, more effective reactivity modulator and control rods based on neutron moderation (also for the first time in fast reactors).

The report and presentation will present a comparative analysis of reactor cores based on neptunium nitride and plutonium dioxide. The impact of beryllium reflectors of varying thicknesses surrounding both reactor cores on their neutronic characteristics was investigated.

Improving k_0-NAA Accuracy at Dalat Research Reactor: Integrated Methodological Refinement

D.M. Ho[1,2,3*], V.D. Cao[2,3], D.V. Ho[1,2,3], T.Q. Tran[2,3], A.T. Tran[2,3], N.H. Nguyen[2,3], S.T. Truong[4], P. Lathdavong[5], G.V. Pham[6,7], L.T.T. Bui[7]

[1]*Center for Nuclear Technologies (CNT), VINATOM, Ho Chi Minh, Vietnam*
[2]*Vietnam Atomic Energy Institute (VINATOM), Hanoi, Vietnam*
[3]*Dalat Nuclear Research Institute (DNRI), VINATOM, Lam Dong, Vietnam*
[4]*Ho Chi Minh City University of Education (HCMUE), Ho Chi Minh, Vietnam*
[5]*Radiation and Nuclear Safety Office, P.O. Box 2279, Vientiane Capital, Lao PDR*
[6]*Xuan Loc High School, Xuan Loc, Dong Nai, Vietnam*
[7]*University of Science-VNUHCM, Ho Chi Minh, Vietnam*

*dungmanhho@gmail.com / dunghm_cnt@mst.gov.vn

This paper reports incremental efforts to improve k_0-standardized neutron activation analysis (k_0-NAA) accuracy at the Dalat Research Reactor (DRR). Five areas were addressed: (i) re-examination of k_0 and Q_0 nuclear constants for four short-lived radionuclides (^{110}Ag, ^{116m2}In, ^{165m}Dy, ^{183m}W) with uncertain database values; (ii) characterisation and correction of fast neutron threshold-reaction interferences via ^{58}Ni and ^{54}Fe monitors; (iii) implementation of the k_0-based cyclic NAA (k_0-CNAA) and epithermal NAA (k_0-ENAA) to extend detection capability; (iv) application of the Westcott formalism for non-1/v nuclides (^{176}Lu, ^{151}Eu) using an extended Q_0* concept; and (v) preliminary benchmarking of the in-house k$_0$-DALAT software against international codes. Taken together, these measures reduced the mean absolute relative deviation from certified reference values by up to 70%, with the proportion of results satisfying $|z| \leq 2$ rising from ~74% to over 95%. The validated parameters have been incorporated into the k0-DALAT software for routine operations. This work represents an effort to enhance the method accuracy and provide a useful reference for other k_0-NAA laboratories.

Keywords: *k₀-NAA; neutron activation analysis; Dalat Research Reactor; short-lived radionuclides; Westcott formalism; fast neutron flux monitoring; metrological validation.*

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PGAA Setup Status at the 11b Channel of the IBR-2 Reactor

C. Hramco[1*], S.S. Pavlov[1], S.B. Borzakov[1,2], G.V. Nehaev[1], A.V. Strelkov[1], and TANGRA collaboration

[1]*Joint Institute for Nuclear Research, Dubna, Russia*
[2]*Dubna State University, Dubna, Russia*

**costea.edinets@mail.ru*

Prompt Gamma Activation Analysis is a widely used, nondestructive method of elemental analysis and a convenient way of investigating neutron-induced nuclear reactions. The PGAA setup was built at channel 11b of the IBR-2 reactor at the FLNP JINR. It has a mirror neutron guide and is equipped with an HPGe detector for precise gamma emission measurements. Measurements were carried out on the samples containing hydrogen and gadolinium, which are required to construct a selector for cold and ultracold neutrons. This work shows the current status of the PGAA setup at the IBR-2 reactor.

Application of "Source-Replay"-Based Monte Carlo Simulation for Evaluating Neutron Self-Shielding Factors at IREN

L.V. Huy[1,2*], P.T. Thanh[2,3], L.H. Khiem[2,3,4**], V.D. Cong[2,3], N.N. Anh[5], N.Q. Hung[1], L.T.M. Nhat[4,6], N.T.X. Thai[2,3], N.T. Dinh[7], H.S. Than[7], V.N. Shvetsov[4], A.Yu. Dmitriev[4]

[1]*Institute of Fundamental and Applied Sciences, Duy Tan University, Viet Nam,*
[*]*leviethuy1@duytan.edu.vn*
[2]*Dzhelepov Laboratory of Nuclear Problems, Joint Institute for Nuclear Research, Russia*
[3]*Institute of Physics, Vietnam Academy of Science and Technology, Viet Nam,*
[**]*lhkhiem@iop.vast.vn*
[4]*Frank Laboratory of Neutron Physics, Joint Institute for Nuclear Research, Russia*
[5]*Phenikaa Institute for Advanced Study, Phenikaa University, Viet Nam*
[6]*Dalat University, Viet Nam*
[7]*Vietnam Atomic Energy Institute, Viet Nam*

Neutron self-shielding factors play a crucial role in accurately interpreting neutron activation analysis by accounting for neutron flux attenuation within specimens. While Monte Carlo (MC) methods perform reliably for well-characterized, simple, and predictable spatial/energy neutron sources (e.g., isotropic Am-Be, ^{252}Cf, Pu-Be sources), they face computational challenges when applied to complex systems involving indirect neutron generation like the Intense Resonance Neutron Source (IREN) at the Joint Institute for Nuclear Research (JINR), Dubna.

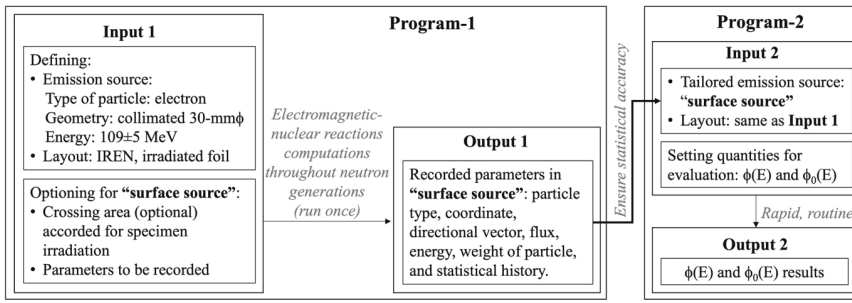

Fig. 1. Schematic workflow of "source-replay" framework for routine neutron self-shielding analysis in complex systems involving indirect neutron generation.

This study employs a "source-replay" framework (**Fig. 1**) to enhance the efficiency of MC simulations for evaluating the thermal and epithermal self-shielding factors for Au, Cu, W, and Zr activation foils irradiated at IREN. These factors are fundamental for upcoming researches conducted at IREN. The calculated results are validated through a cross-code validation using the Particle and Heavy Ion Transport Code System (PHITS) and Monte Carlo N-Particle Transport Code version 6 (MCNP6), confirming the validity of the approach. Some results are further compared with published benchmark data. The enhanced computational efficiency enabled by the proposed approach also make it possible to explore the sensitivity of self-shielding effect to specimen thickness and neutron flux variation. The demonstrated versatility of the "source-replay" technique supports its application in various sophisticated radiation transport problems involving complex geometries and source terms.

Development of PET/rGO Composites for Advanced Flexible Electronics

Sheimaa Ibrahim*

Faculty of Archaeology, Heritage and Archaeological Information Systems Program, Ain Shams University, Cairo, Egypt

*medahmed@yahoo.com

The surge in flexible electronics necessitates materials that are simultaneously mechanically flexible and electrically conductive. While Polyethylene Terephthalate (PET) offers an excellent flexible substrate, its insulating nature requires integration with conductive fillers, such as reduced Graphene Oxide (rGO). Traditional, time-consuming trial-and-error methods for creating these advanced composites are now being revolutionized by Artificial Intelligence (AI). AI-assisted techniques are emerging as a powerful solution, fundamentally accelerating the design, optimization, and scalable manufacturing of PET/rGO and other next-generation composites.

The AI-optimized PET/rGO composite is a prime candidate for applications including: Flexible Sensors: Creating durable, non-invasive sensors for continuously monitoring health metrics like heart rate, sweat composition, and blood oxygen levels. Flexible Circuitry: Serving as a low-cost, conductive substrate for flexible printed circuit boards (FPCBs) used in smart wearables and a new generation of smart devices. Bio-Signal Monitoring: Enabling non-invasive skin-contact medical devices for applications like pain relief and muscle stimulation. The integration of AI offers critical advantages: accelerated R&D, enhanced performance, significant cost reduction, and superior scalability, positioning these composites as the future backbone of flexible technology.

Quantum Diode-Like Behavior in Hydrated ZrO_2 Nanopowder Junctions under Neutron Flux and Humidity Control

Ibrahim M.A.[1,2*], Mezentseva Zh.V.[1,3], Doroshkevich A.S.[1,3]

[1]*Joint Institute for Nuclear Research, Dubna, Russia*
[2]*Division for Experimental Physics, National Research Tomsk Polytechnic University, Tomsk, Russia*
[3]*Institute of Materials Science, Academy of Sciences of Uzbekistan, Tashkent, Uzbekistan*
[*]*E-mail: ibragim@jinr.ru&im01@tpu.ru*

With the progress in nanotechnology, it is essential to understand the properties of nanoscale materials for their use in modern electronics. A significant focus of this research is on the interactions between nanoparticles of the same chemical composition but different sizes, as variations in their electronic properties and surface potential influence the formation of contact barriers.

This study investigates the electrical properties of contacts formed between ZrO_2 nanoparticles (400-400/700°C) stabilized with 3 mol% Y_2O_3 (3YSZ) under hydration and proton radiation conditions. Thin films were created using monodisperse Nano powders with particle sizes of 7.5, and 14 nm. The electrical behavior of these films was examined using DC voltammetry, with measurements taken within a voltage range of -2 V to +2 V, and electrochemical impedance spectroscopy, covering frequencies from -1 MHz to 1 Hz. To ensure electrical continuity, the films were subjected to hydration for eight hours under controlled humidity levels ranging from 65% to 85% after that they were irradiated by neutron with different fluxes.

Key Findings:

Rectifying Behavior: This study marks the first exploration of the rectifying properties of hydrated contacts formed between nanoparticles of the same composition (ZrO_2 – 3%Y_2O_3) but differing in size (7.5 and 14 nm) [1]. Distinct Electrical Responses: Notable differences were observed in the current-voltage (I-V) characteristics and electrochemical impedance between hydrated and fast neutron radiation systems with different fluxes. Humidity-Dependent Dispersion: Variations in electrical properties became more pronounced at humidity levels between 65% and 85% under both hydration and neutron radiation conditions. Role of the Hydration Shell: The observed dispersion in electrical properties was linked to charge transport processes occurring within the hydration shell. The electrical response varied depending on the ionic species present, indicating that charge transport at the nanoparticle interface is influenced by these ions. A clear hysteresis effect was observed, suggesting nonlinear electrical behavior, likely due to charge accumulation or diffusion processes within the hydration layer. Additionally, differences in current magnitude across various electrolytes highlight specific ion interactions with the YSZ surface, which impact overall conductivity. The nonlinear response in both positive and negative voltage regions points to rectifying behavior, likely driven by hydration dynamics with radiation and ion exchange mechanisms. A comparison of the electrical properties of 3YSZ (400-400/700°C) samples in H_2O and D_2O under varying humidity conditions reveals distinct effects of hydration and neutron radiation. In the H_2O environment, a stronger nonlinear response and greater current fluctuations suggest enhanced ion interactions and charge transport within the hydration layer. The presence of different electrolytes further influenced conductivity due to specific ion-surface interactions.

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Design and Application of PVA/Zn0/GO as a Promising Nanocomposite with Tunable Electronic Properties

A. Ibrahim[1*], M. Abd El Aal [1], H. El-Zahed[1], and A.F. Mabied[2]

[1]*Physics Department, Faculty of Women for Arts, Science and Education, Ain Shams University, 11757, Cairo, Egypt*

[*]*asmaa.medhat@women.asu.edu.eg*

[2]*X-ray Crystallography Lab., Solid State Physics Department, National Research Center, 33 Bohouth St., Dokki, 12622, Egypt*

The structural, electronic, and adsorption properties of the polyvinyl alcohol/zinc oxide/graphene oxide (PVA/ZnO/GO) as a promising nanocomposite were investigated using density functional theory (DFT) at the B3LYP/LanL2DZ level. Calculated infrared spectra indicated pronounced interfacial interactions and strong hydrogen bonding among the PVA, ZnO, and GO components, contributing to enhanced structural stability. The incorporation of ZnO and GO substantially alters the electronic structure of PVA, decreasing the energy gap (ΔE) from 7.334 eV to 1.075 eV and increasing the total dipole moment from 7.147 to 12.243 Debye. Adsorption analyses reveal significant interactions of PVA /OZn/GO with H_2O and CO_2, with adsorption energies of -0.306 and -0.381eV, respectively.

Among the examined configurations, PVA /OZn/GO-CO_2 exhibits the lowest energy gap (0.539 eV) and a markedly elevated dipole moment (14.264 Debye), suggesting enhanced electronic responsiveness. Molecular electrostatic potential mapping and reactivity descriptors further substantiate favorable charge redistribution and improved electronic behavior within the composite. The present DFT findings conclusively demonstrate that the electronic structure of PVA is optimally tuned by ZnO/GO integration, resulting in enhanced reactivity towards H_2O and CO_2. This validates PVA/ZnO/GO as a highly promising, sustainable material for advanced gas and humidity sensing applications.

Molecular Interaction of Trace Metals and PAHs with Fish Proteins: A Combined DFT and FTIR Spectroscopic Study

H. Elhaes[1] and M.A. Ibrahim[2,3,4*]

[1]*Physics Department, Faculty of Women for Arts, Science and Education, Ain Shams University, 11757, Cairo, Egypt*

[2]*Spectroscopy Department, National Research Centre, 33 El-Bohouth St., Dokki, Giza, 12622, Egypt*

[3] *Molecular Modeling and Spectroscopy Laboratory, Centre of Excellence for Advanced Science, National Research Centre, 33 El-Bohouth St., Dokki, Giza, 12622, Egypt*

[4]*Center for Converging Sciences and Emerging Technologies (CoSET), Benha National University (BNU), El-Obour, 13518, Egypt,*

[*]*ma.khalek@nrc.sci.eg*

Metal pollution along the Mediterranean coast is a growing environmental concern. In this study, the effects of trace metals and polycyclic aromatic hydrocarbons (PAHs) on fish were investigated using DFT:B3LYP/6-31G(d,p) computational modeling. Alanine (Ala) and phenylalanine (Phe) were utilized as model molecules for fish proteins. The interaction of Ala and Phe with metals resulted in a significant decrease in the HOMO-LUMO bandgap energy from 2.6647 and 1.5772 eV down to 1.2871 and 1.2675 eV, respectively reflecting increased reactivity and potential for further environmental interactions.

Furthermore, results indicated that the interaction of both metals and PAHs with these proteins led to structural alterations in amide groups, causing significant shifts in their vibrational band positions. Changes in the geometrical parameters of the proteins modified the energy required for functional group vibration, thereby altering the vibrational features of the COOH and NH_2 groups. FTIR spectra of fish gills, liver, and muscle tissues confirmed these computational findings, revealing alterations in protein secondary structures.

Prompt Neutron Emission from Spontaneous Fission of Superheavy Elements

A.V. Isaev[1,2,3*]

[1]*Flerov Laboratory of Nuclear Reactions, Joint Institute for Nuclear Research, Dubna 141980, Russia*
[2]*Dubna State University, Dubna 141980, Russia*
[3]*Institute of Nuclear Physics, Almaty 050032, Kazakhstan*
[*]*isaev@jinr.ru*

Experimental studies of spontaneous fission of superheavy elements ^{258,260}Sg (produced in ^{207}Pb + ^{52,54}Cr), and ^{260}Rf (^{238}U + ^{26}Mg) were performed using the SHELS velocity filter. For the first time, the prompt neutron multiplicities in spontaneous fission were measured, yielding average values of 4.9 ± 0.4 for ^{258}Sg, 5.03 ± 0.14 for ^{260}Sg, and 4.88 ± 0.24 for ^{260}Rf. The alpha-decay branching ratio of ^{260}Sg was determined to be 0.29 ± 0.03. Half-lives were measured as 2.2 (+2.4, -1.0) ms for ^{258}Sg, 7.0 (+2.6, -1.7) ms for ^{260}Sg, and 16.8 (+5.5, -3.8) ms for ^{260}Rf (95% confidence limits).

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Application of Artificial Neural Networks for Unfolding Problems Activation Measurements

Nikola Jovancevic[1], Strahinja Ilic[2], Dimitrije Maletic[3], Miodrag Krmar[1]

[1]*University of Novi Sad, Serbia*
[2]*Faculty of Technical Sciences, University of Novi Sad, Serbia*
[3]*Institute of Physics Belgrade, Serbia*

The determination of particle energy spectra from activation measurements represents a challenging inverse problem in nuclear physics, traditionally addressed using unfolding techniques such as MAXED and GRAVEL. These methods require an assumed initial spectrum and may exhibit sensitivity to both the choice of default function and the quality of experimental data, often leading to non-unique solutions. In this work, a data-driven alternative based on artificial neural networks (ANNs) is investigated for the reconstruction of energy spectra from activation observables.

A multilayer perceptron (MLP) model is developed to infer the underlying particle spectrum directly from normalized saturation activities, thereby eliminating the need for an initial spectral assumption. The approach is applied to two representative cases: reconstruction of the prompt fission neutron spectrum (PFNS) of Cf using neutron activation data, and determination of high-energy bremsstrahlung photon spectra from photonuclear reaction yields on Bi. In both cases, large synthetic training datasets are generated by combining Monte Carlo–simulated spectra using Geant4 with nuclear reaction cross sections calculated using the TALYS code or taken from evaluated nuclear data libraries. Variations of physically plausible spectral models are introduced to ensure sufficient diversity of the training data.

The trained ANN models are validated using experimental activation data and benchmarked against conventional unfolding methods and reference spectra. The results demonstrate that the ANN approach could provide stable reconstruction of spectral shapes and reduces dependence on initial assumptions. These findings indicate that machine-learning techniques offer a flexible and robust framework for solving inverse problems in nuclear spectroscopy.

Vertical (Re)Distribution of Radiocesium in Soil under Natural and Semi-Natural Areas of Vojvodina 40 Years after the Chernobyl Accident: A Case Study from the Bavanište Settlement (South Banat, Vojvodina)

K. Kalkan[1*], I. Čeliković[2], M. Đurašević[2], A. Samolov[2], J. Bogosavljević Lipovac[3], L. Kaluđerović[3], B. Kartalović[1], E. Pavlova[1], M. Kašanin-Grubin[4], I. Zinicovscaia[5], O. Chaligava[5], D. Grozdov[5]

[1] *BioSense Institute - RIITB, University of Novi Sad, Serbia, *kristina.kalkan@biosense.rs*
[2] *VINČA - INS, Department of Nuclear and Plasma Physics, Belgrade, Serbia*
[3] *Faculty of Agriculture, Department of Soil Management, University of Belgrade, Serbia*
[4] *ICTM, Department for Chemistry,University of Belgrade, Serbia*
[5] *Frank Laboratory of Neutron Physics, JINR, Dubna, Russia*

The SoilRadioTrace project examines the vertical redistribution of Cs-137 mostly in natural and semi-natural areas (according to the CORINE land cover, CLC 2018) in Vojvodina 40 years after the Chernobyl fallout. Site selection was performed using a Multi-Weighted Decision Index combined with K-means clustering. These methods were applied to normalized co-raster datasets, including soil activity concentrations of Cs-137 in soil (2010) and daily spatial fallout patterns (May 1986). The analysis also incorporated clay and soil organic matter distribution, as well as DEM-derived topographic parameters, all at a 10 m spatial resolution. Based on modeling results, as well as the available reports on the monitoring of artificial radioactivity in soil in Vojvodina, Southern Banat was identified as the optimal sampling region where ten representative sites on three different land cover classes (natural grasslands, natural pastures and forests) were investigated through excavation of 0-60 cm semi-profiles on different soil types. Undisturbed samples were collected at 5 cm intervals using Kopecky cylinders (100 cm^3), ensuring preservation of high sampling precision and soil stratification in accordance with ISO standards. All soil samples underwent gamma-spectrometric , physico-chemical (grain size analysis, pH, bulk density and soil organic matter), mineralogical analysis and energy dispersive x-ray spectroscopy. The influence of key soil properties on the current Cs-137 vertical (re)distribution within the upper 30 cm was assessed. The profile shape coefficient (h_0) was derived from the mass depth distribution and from the proportion of Cs-137 inventory above a given depth using the Profile Distribution Model. In addition, the diffusion coefficient (D) and migration rate (V) were calculated using the Diffusion and Migration Model. These two models were utilized to identify the soil profiles that best preserved the radiocesium original deposition pattern. The modeling results provide valuable insights into whether certain soil types exhibit a greater radiocesium absorption capacity and whether this absorption is influenced by the type of land cover. Currently, natural and semi-natural areas account for only about 10% of Vojvodina's total land area, which is predominantly agricultural and focused on food production. This fact justifies the need to extend future research on this topic to a larger number of sites, on arable land. At the same time, in light of the ongoing energy crisis, Serbia is considering a transition toward low-carbon energy systems, including the potential development of nuclear power plants. The potential shift to nuclear energy necessitates a more comprehensive and detailed monitoring of artificial radioactivity in the soil than currently exists, in order to enable the rapid implementation of effective remediation measures in the event of new potential Cs-137 fallout. The results are presented as a case study of Bavanište, the settlement area in Vojvodina with the highest Cs-137 contamination in arable land, according to the publicly available report from 2010.

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Status of the (γ, f) Reactions Research at the Microtron Beam in FLNR

D.V. Kamanin[1], Yu.V. Pyatkov[1,2], A.N. Solodov[1], V.E. Zhuchko[1], T.H. Vilane[1,3], Z.I. Goryainova[1], O.V. Strekalovsky[1,3], E.A. Kuznetsova[1], A.O. Zhukova[1], Yu.M. Sereda[1], P.Z. Ngcobo[4], B.A. Le[1]

[1]*Joint Institute for Nuclear Research, Dubna, Russia*
[2]*National Nuclear Research University MEPhI, Moscow, Russia*
[3]*University of South Africa, Republic of South Africa*
[4]*University of Zululand, Republic of South Africa*

The report is dedicated to summarizing the experimental activities of the FOBOS group on the microtron [1, 2], the motivation for upgrading the experimental setup, and the plan for the first day's experiments. A series of experiments dedicated to study of the (γ, f) reactions using $^{235,\ 238}$U, ^{232}Th, ^{242}Pu targets were performed. It was shown for the first time that some fraction of the fission fragments (FFs) is born in the shape isomer states with a life-time exceed 400 ns. Such fragments can undergo a break-up while path through a solid-state foil. At least one of the break-up products shows magic nucleon composition.

In order to decrease considerably the influence of the noise background onto measurement circuit the upgrade of the VEGA spectrometer is planning. According to the plan the measurement module and all electronics will be installed at the second floor under the microtron hall thus they will be shielded by a concrete slab two meters thick. A low-noise conditions will let us to continue our investigations of the shape-isomers in FFs using much lower measurement thresholds for revealing new ternary decay modes of actinides.

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Search and Analysis of the Double Hit Events in the Study of (γ, f) Reactions

D.V. Kamanin[1], Yu.V. Pyatkov[1,2], V.E. Zhuchko[1], A.N. Solodov[1], T.H. Vilane[1,3], Z.I. Goryainova[1], O.V. Strekalovsky[1,3], E.A. Kuznetsova[1], A.O. Zhukova[1], Yu.M. Sereda[1], P.Z. Ngcobo[4], B.A. Le[1]

[1] *Joint Institute for Nuclear Research, Dubna, Russia*
[2] *National Nuclear Research University MEPhI, Moscow, Russia*
[3] *University of South Africa, Republic of South Africa*
[4] *University of Zululand, Republic of South Africa*

The work focuses on the "double-hit" experimental approach in the registration and analysis of ternary decay events. The double-hit registration approach means that two fragments, with an open angle between them 5^0 or less, were detected in the same PIN diode during one registration gate of 200 ns. The experiments were performed at the beam of the MT-25 microtron, FLNR, JINR, using the VEGA (V–E Guide based Array) setup [1]. Fission fragments (FFs) from the (γ, *f*) reactions were captured by an electrostatic guide system (EGS). The guide is a cylindrical capacitor of four meters long with a thin wire as a central electrode. Some part of the ions emitted from the target at one end of the guide become involved in the spiral-like movement along the guide axis [2] thus transporting to the time-of-flight mass-spectrometer that consists of a microchannel-plates based timing detector and a mosaic of four PIN diodes.

The revealing of the double-hit events in the data stream, their kinematical analysis, restoring of the prescission configurations of the decaying system are discussed in the presentation.

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The Process Opposite to the Neutron Radiative Decay

Khafizov R.U., Semenov S.V.

NRC "Kurchatov Institute", Russia

The report discusses the process opposite to neutron radiation decay, which we discovered experimentally at the FRMII reactor of the Physics Department at the Technical University of Munich in 2005. At that time we were able to identify neutron radiation decay events using the triple coincidence method of three particles: beta electron, proton, and an additional particle − a radiation gamma quantum − and for the first time measure the relative intensity of neutron radiation decay B.R. = $(3.2\pm1.6)\cdot10^{-3}$ (where C.L. = 99.7% and the gamma-quantum energy threshold is 35 Kev) [1]. The experimental value we obtained is one and a half times higher than the theoretical value B.R. = $2.1\cdot10^{-3}$ [2], i.e. we registered additional gamma quanta. In this regard, it is interesting to study the process of reverse neutron radiation decay, namely electron capture by a proton in strong electromagnetic fields. The report presents calculations of the cross section for the capture of a high-energy electron by a proton, which is of the order of 10^{-38} cm^2 for electrons with the energy of 1 GeV [3].

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Nuclear Methods in Modern Geochemical Analysis: Some Observations and Trends

V.P. Kolotov

Vernadsky Institute of Geochemistry and Analytical Chemistry of Russian Academy of Sciences, Moscow, Russia

Progress in geochemistry dealing with investigation of chemical elements and isotopes involving in various processes of the Earth and planets is largely dependent on the capabilities of the available analytical methods. Their role in geochemistry and changing priorities over the time is considered. The most important breakthroughs in geochemistry and cosmochemistry associated with the development of trace elements determination methods (neutron activation analysis, atomic spectroscopy, mass spectrometry) and progress in local microanalysis (radiography, X-ray microanalysis, PIXE, SIMS and some other methods).

Neutron activation analysis started to develop actively in the fifties, when the first research nuclear reactors with high neutron flux appeared. It is this method provided breakthrough results in determining ultra-low concentrations of elements, including rare and rare earth elements, platinum group elements, etc. in geological rocks and minerals and in the samples of extraterrestrial origin. The role of the NAA in the certification of reference materials, including silicate samples, environmental samples, and biomedical facilities, is invaluable. This has led to progress in other methods of elemental analysis.

Since the 1980s, after appearance of advanced mass-spectrometric methods, primarily ICP-MS, the role of neutron activation analysis has steadily declined. Today, NAA plays a minor role in the overall flow of chemical analysis. However, this does not correspond at all to the potential of the method. The main problem is the reduction of the research reactors due to the widespread policy of denuclearization after 1986, the development of competing methods of analysis and some other reasons.

However, there are fields where the NAA still preserve the strong position. These are such areas as: analysis of samples of a larger mass (having representative sample mass is tens of grams); certification of new reference materials; non-destructive analysis of samples of certain value (historical artifacts, extraterrestrial matter, etc.); express non-destructive analysis of samples via short-lived radionuclides; application of the method in biomedicine and environmental sciences including imaging approaches and others. Some actions necessary to enhance the NAA visibility are discussed.

Macro- and Microelements in the Leaves of *Olea europaea* L. and Features of Their Extraction into Infusion

A. Kravtsova[1*], A. Pashtetskaia[2], I. Zinicovscaia[1,3**], A. Peshkova[1,4***], O. Shevchuk[2]

[1]*Joint Institute for Nuclear Research, 6 Joliot-Curie Str., 141980 Dubna, Russia*

[2]*Federal State Funded Institution of Science "The Nikitsky Botanical Gardens – National Scientific Center of the Russian Academy of Sciences", 298648, Republic of Crimea, Yalta, Nikita, Russia*

[3]*Department of Nuclear Physics, Horia Hulubei National Institute for R&D in Physics and Nuclear Engineering, 30 Reactorului Str., MG-6, 077125 Magurele, Romania*

[4] *Doctoral School of Natural Sciences, Moldova State University, M. Kogalniceanu Str., 75A, MD-2009 Chisinau, Moldova*

[*]*kravav@jinr.ru* [**]*zinikovskaia@mail.ru* [***]*peshkova@jinr.ru*

Olive leaves (*Olea europaea* L.) and their infusions are widely used in the pharmaceutical and food industries due to their antioxidant, anti-inflammatory and nutraceutical properties. The aim of this study was to determine the mineral composition of the leaves of six cultivars of *O. europaea* growing on the Southern Coast of Crimea. In addition, the features of extraction of macro- and microelements into tisanes under the influence of various factors (mass of leaves, brewing time, whole or crushed leaves) were studied. The concentrations of Al, Ba, Ca, Cd, Co, Cr, Cu, Fe, K, Mg, Mn, Ni, P, Pb, S, Sr, V, and Zn in leaves and tisanes were determined by inductively coupled plasma optical emission spectrometry.

The highest concentrations in olive leaves were observed for K and Ca (1–2%), followed by P and S (0.2%) and Mg (0.1%). The maximum extraction of elements into the infusion was achieved using 2 g of crushed leaves and a brewing time of 60 minutes. Among the analyzed elements, K showed the greatest transfer into the infusion, followed by P, S, and Mg. The extraction of Cu was observed only in the infusion of "Tlemcen" olive leaves, while its concentration in the infusions of the leaves of other olive varieties was below the detection limit. No extraction of Pb from dry leaves into tisanes was observed, and Cd content was below the detection limit both in dry olive leaves and in the infusion. Among six olive cultivars, the highest content of the most elements was found in the leaves of "Nikitskaya", "Lomashenskaya" and "Tlemcen" varieties, and in the infusions of "Nikitskaya", "Tlemcen" and "Coregiolo" varieties. It has been established that 100 mL of *O. europaea* leaf tisanes provided up to 3% of the daily requirement for K, 0.4-0.5% − for Mn and P, and 0.3% − for S, Mg, and Ca.

Atmospheric Deposition of ^{7}Be Measured Using Terrestrial Mosses: Seasonal Changes in Three Successive Years

Miodrag Krmar, Ilija Arsenić, Miloš Ilić, Nikola Jovančević, Dragan Radnović

Physics Department, University of Novi Sad, Serbia

Detection of ^{7}Be, produced in interactions of cosmic radiation with atmosphere, is one of the commonly used tools in studies of aerosol transport. The most common output of such measurements is the temporal variation of 7Be deposition or its concentration in the air at a single selected location. There are rare examples where the spatial distribution of atmospheric deposition of ^{7}Be has been measured, and its seasonal changes have not been the subject of research.

To study if some pattern in the ^{7}Be deposition in the selected area can be observed, a periodic moss sampling and measurement of ^{7}Be activity was carried out in spring and autumn, during three successive years. The mosses were regularly taken at 70 locations in the northern part of Serbia. Dried samples were measured in anti-Compton NaI detector adapted to serve as a high efficiency well-counter. Six maps of the spatial deposition of ^{7}Be have been created. The measured ^{7}Be activity concentrations (in Bq/kg) varied over a wide range: the smallest and largest values differ by an order of magnitude. It was also noted that slightly higher ^{7}Be activity was detected in moss samples in the fall, which is in good correlation with previous measurements. Based on the results obtained, it can be established that there is no correlation at all in the spatial distributions of ^{7}Be and that each of the six obtained maps shows a completely different pattern. It was also found that the resulting spatial distributions do not show any correlation with the spatial distribution of precipitation.

The Possibility of Producing Medically Significant Isotopes of Sn and Sc by Photonuclear Reactions Tested at the IREN Facility

Y.A. Bolatkazyyev[1,2*], M. Krmar[3], D. Maletić[4], N. Jovančević[3], Yu.G. Teterev[1], S.V. Mitrofanov[1], V.N. Shvetsov[1], A.Yu. Dmitriev[1], D.A. Murashko[1]

[1] *Joint Institute for Nuclear Research, Dubna, Russia,* [*] *bea@jinr.ru*
[2] *Gumilyov Eurasian National University, Astana, Kazakhstan*
[3] *Faculty of Science, University of Novi Sad, Serbia*
[4] *Institute of Physics, Belgrade, Serbia*

Photonuclear reactions are widely recognized as one of the promising routes both for diagnostic and therapeutic radionuclides production. However, with the exception of a few radionuclides, there is a significant lack of relevant experimental data.

The scandium isotopes ^{44}Sc and ^{47}Sc, as well as ^{117m}Sn, have demonstrated high potential for use in medical diagnostics and targeted radionuclide therapy. Natural antimony and titanium targets were irradiated with a 92 MeV bremsstrahlung beam at the IREN facility, followed by gamma-ray spectrometric measurements. The aim of the study was to determine the production yields and saturation activities ^{44}Sc, ^{47}Sc, ^{44}Ti and ^{117m}Sn. In addition, all other photonuclear reactions products to evaluate their impact on the radiochemical purity of the desired radionuclides when using targets composed of natural elements were analyzed.

The results indicate that several hours of irradiation can produce ^{44}Sc activities corresponding to several tens of diagnostic doses when an enriched ^{46}Ti target is used. After three days of irradiation at the IREN facility, several therapeutic doses of ^{47}Sc can be obtained using a natural titanium target. It is estimated that electron accelerators operating at beam currents on the order of 1 mA would be capable of producing commercial-scale quantities of ^{44}Ti and ^{117m}Sn.

Photoactivation Measurements of Natural Sn and Sb

Y.A. Bolatkazyyev[1,2*], T.M. Shneidman[1], M. Krmar[3], D. Maletić[4], N. Jovančević[3], Yu.G. Teterev[1], S.V. Mitrofanov[1], V.N. Shvetsov[1], A.Yu. Dmitriev[1]

[1]Joint Institute for Nuclear Research, Dubna, Russia, [*]bea@jinr.ru
[2]Gumilyov Eurasian National University, Astana, Kazakhstan
[3]Faculty of Science, University of Novi Sad, Serbia
[4]Institute of Physics, Belgrade, Serbia

Natural antimony and tin targets were irradiated in the 92 MeV photon beam at the IREN facility. Tin is known to have a larger number of stable isotopes, so that (γ,xn) reactions generally create products that are not radioactive. The largest contribution to the induced activity of the irradiated Sn target comes from the products of (γ,pxn) reactions. For these reactions there is not as rich experimental evidence as for the (γ,n) reactions, which are much better studied. Antimony in its natural composition has two stable isotopes and several active products of (γ,xn) reactions can be expected, while all other reactions with the emission of a proton and one or more neutrons give stable products. Possible (γ,α) and (γ,xnα) reactions will give indium isotopes. Since the cross sections for these reactions are significantly smaller than the cross sections for the (γ,xn) reactions, one of the tasks of this study was to determine the saturation activities and flux-averaged cross sections for these reactions from the weak gamma lines of the produced indium isotope.

After gamma spectroscopic measurements, the saturation activities and flux-averaged cross sections were determined for all reactions that yielded measurable activities of the Sb, Sn, and In isotopes. The obtained results were compared with the results of calculations using theoretically based cross sections of the observed photonuclear reactions.

Optimization of Fast Neutron Doses for Seed Priming in Triticale: Initial Physiological Effects and Prospects for Inducing Stress Tolerance

A.I. Kruglyak[1,2*], Yu.V. Aleksiayenak[1], P.Yu. Volkova[3], A.S. Doroshkevich[1], A.A. Soloviev[2,4]

[1]*Joint Institute for Nuclear Research, Russia,* [*]*a.kruglyak@nf.jinr.ru*
[2] *All-Russian Research Institute of Agricultural Biotechnology, Russia*
[3]*Independent Researcher, Belgium*
[4]*All-Russian Center for Plant Quarantine, Russia*

Amid the growing demand for climate-resilient plant varieties, research into radiation priming – the exposure of seeds to low-dose irradiation that activates plant defense systems – represents a promising approach [1, 2, 3].

This study presents the results of determining optimal priming doses of fast neutrons (EG-5 accelerator, JINR) for two spring triticale cultivars ('Khavr' and 'Botanicheskaya 4'). It was established that a dose of 5 Gy (for 'Khavr') and the range of 3–5 Gy (for 'Botanicheskaya 4') do not inhibit growth but create moderate stress sufficient to induce an adaptive response. A preliminary physiological effect of priming under saline (NaCl) and osmotic (PEG) stress conditions is demonstrated.

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Coincidence-Summing Effects and Positronium-Annihilation-Photon Lines Appearing in CNT-Enhanced NaI(Tl)-Detector Response to ^{60}Co- and ^{137}Cs-Decays

Halina V. Krylova, Andrei I. Timoshchenko

Faculty of Physics, Belarusian State University, Minsk, Belarus

Today, high-resolution gamma-detectors for registering (true) coincidence events from positronium-annihilation photons are in great demand. Revealing of both internal-conversion mechanisms and an internal structure of the positronium-anion rays is complicated by the smallness of the internal conversion coefficients. We offer a method for detecting internal energy conversion that is based on carbon-nanotube (CNT) enhancement of the beta-decay energy deposition to an intermediate-size detector NaI(Tl) crystal. Responses of this detector-system graphene CNT-wall/ NaI(Tl) crystal to gamma-rays of ^{60}Co and ^{137}Cs decays comprise the (true) coincidence-sum peaks from de-excitation. We investigate the generation mechanisms of (true) coincidence-summing effects in the decays and the creation of bound electron–positron pairs in electrical fields of atom-shell electrons. We propose that the energy of virtual gamma-photons in electrical fields of electrons which enter excited nuclei ^{60}Ni or ^{137m}Ba at that moment is converted into the energy of positronium anions. The resulting annihilation of these bound pairs leads to secondary emission (true) coincidence-sum lines at ~1192, 1210, and 1230 keV.

VCN Source at IBR-2: A Prototype of the Future of UCN Source

G.V. Kulin[1,2*], A.I. Frank[1,2], A.A. Popov[1,2], V.A. Kurylev[1,3], V.S. Shpilevskaya[1,2], V.N. Shvetsov[1], M.A. Zakharov[1,2]

[1]*Joint Institute for Nuclear Research, Dubna, Russia*
[2]*Dubna State University, Dubna, Russia*
[3]*Moscow State University, Moscow, Russia*

[*]*kulin@jinr.ru*

In the FLNP JINR at the IBR-2 reactor, it is planned to create an ultra-cold neutron (UCN) source. The source is based on deceleration of very cold neutrons (VCN) to energies typical for UCN by a magnetic resonance device, as well as on idea of pulsed filling of a UCN trap.

The report is devoted to the prototype source, a VCN source, which was decided to be created at the location of the future UCN source. This will make it possible to carry out methodical experiments essential for development of the future source. The report includes the design of the VCN facility and the current status of work on its creation. The expected neutron spectrum and the time structure of the VCN flux in the experimental area will be given.

A possible scientific program based on this source is also briefly discussed.

Study of Dynamical and Entrance Channel Effects in Heavy Ion Fusion Fission Reactions

Ajay Kumar

Banaras Hindu University, Varanasi, India

In heavy-ion fusion reactions, the energy of the projectile couples with the intrinsic degrees of freedom of the target during the collision process and this leads to a dissipative phenomenon. Consequently, the dissipation in the system causes the angular momentum hindrance during the fusion process. Here we have focused on the dissipative behavior of the fusing nuclei and its dependency on the incident energy. The dissipative evolution of the system depends not only on the entrance channel mass asymmetry but also on the incident energy, which was not mentioned in earlier studies. Moreover, the dissipative behavior of the fusing nuclei is also compared with respect to the entrance channel parameters like mass asymmetry α and the Coulomb interaction term ZPZT. The dissipation phenomenon decreases when the mass asymmetry increases and it increases when the Coulomb interaction term ZPZT increases.

Flipper Prototype of the UCN Source Decelerator

V.A. Kurylev[1,2*], G.V. Kulin[1,3], A.I. Frank[1,3], A.A. Popov[1,3], M.A. Zaharov[1,3]

[1]*Frank Laboratory of Neutron Physics, Joint Institute for Nuclear Research, Dubna, Russia*

[2]*Moscow State University, Moscow, Russia*

[3]*Dubna State University, Dubna, Russia*

*kurylev@jinr.ru

At the Frank Laboratory of Neutron Physics at JINR, on the IBR-2 reactor, it is planned to create a high-brilliance source of ultracold neutrons (UCN) [1]. The concept of the proposed source is based on the principle of pulsed neutron accumulation. To preserve the pulsed structure of the neutron flux during its transportation, which is absolutely necessary for implementation of the pulsed accumulation principle, it is proposed to obtain UCN by decelerating faster, very cold neutrons (VCN) directly before the trap using a magnetic resonance device, a gradient spin-flipper [1, 2], designed for fields on the order of $B_0 = 20$ T.

At the first stage of the project, a decision was made to create a prototype source, a VCN source, at the location of the future UCN source. In its main features, its design will have much in common with the design of the planned UCN source, allowing validation of the technical solutions proposed for the latter. In particular, it is planned to create a prototype spin-flipper designed for a significantly lower field of $B_0 = 2.5$ T. The creation of the latter will make it possible to demonstrate the very principle of VCN deceleration by such a device, as well as to gain necessary experience in working with similar devices.

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Investigation of Low-Lying Resonances of ^{79}Br, ^{81}Br and ^{35}Cl at the Modernized "Gamma" Installation

V.L. Kuznetsov[1,2], A. Yergashov[1,3], Yu.N. Kopatch[1], L.V. Mitsyna[1], N.V. Rebrova[1], A.D. Rogov[1], P.V. Sedyshev[1]

[1]*Frank Laboratory of Neutron Physics, Joint Institute for Nuclear Research, Dubna, Russia*
[2]*Institute for Nuclear Research of the Russian Academy of Sciences, Moscow, Russia*
[3]*Institute for Nuclear Physics, Almaty, Republic of Kazakhstan*

The "GAMMA" installation was partially modernized. Now measurements can be conducted simultaneously at the 11-meter and 16-meter flight paths, which allows us to measure with the nuclei under study both the (n,γ) reaction channel and the total cross section of neutron interactions. The neutron detector, installed at the 16-meter flight path, consists of a mixture of europium oxide, terbium oxide, and water to convert neutrons into γ-rays, which were detected by two BGO scintillation detectors. The detection efficiency for resonance neutrons was obtained.

Low-lying resonances of ^{79}Br, ^{81}Br, and ^{35}Cl were studied using the upgraded facility. The ^{81}Br and ^{35}Cl nuclei have the same spin (3/2) and different parities, and p-wave resonances at the 0.89 eV and 397.8 eV neutron energies, respectively. The first results of ^{79}Br, ^{81}Br and ^{35}Cl nuclei investigation are presented.

Assessment of Air Pollution in the Hai Phong City (Vietnam) Using Lichens as Biomonitors

Dai Nam Le

Graduate University of Science and Technology, Vietnam Academy of Science and Technology, Hoang Quoc Viet str.18, Ha Noi, Viet Nam
FLNP JINR, Russia

The lichen bag technique was applied in Hai Phong city to monitor air quality. Inductively Coupled Plasma–Optical Emission Spectrometry was employed to quantify the content of Al, Cd, Co, Cr, Cu, Fe, Mn, Ni, P, Pb, S, Sr, V, and Zn, while a direct mercury analyzer was used to determine Hg in the exposed samples. The Relative Accumulation Factor revealed enrichment of Al and Co in the exposed lichens, as well as a depletion of Hg and S. Correlation and principal component analyses identified the predominant sources of elements deposition. With an ecological risk index below 150, the study area was found to have a low potential for ecological risk. The lichen bag technique is considered a cost-effective and efficient biomonitoring method for application in Vietnam.

Determination of Magnesium and Aluminum by Neutron Activation Using the WWR-K Nuclear Reactor

Lennik S.G.[1,2], Silachyov I.Yu.[1], Bedelbekova K.A.[1], Dmitriev A.Yu.[2*], Philippova O.S.[2], Sokolenko E.K.[1]

[1]*Institute of Nuclear Physics, Almaty, Kazakhstan*
[2]*Joint Institute for Nuclear Research, Dubna, Russia*
[*]*e-mail: andmitriev@jinr.ru*

Magnesium and aluminum belong to non-ferrous metals, they are major elements and are present in various quantities and proportions in almost all natural samples: soils, ores, mineral raw materials, as well as in building materials. The determination of their mass fractions and proportions is important for geochemical and archeometric studies, soil science and metallurgy. One of the most attractive methods for Mg and Al determination is instrumental neutron activation analysis (INAA), which has high sensitivity, simple sample preparation, and does not require chemical decomposition of samples. INAA is also can be characterized as an express method to determine of Mg and Al, since nuclear reaction by neutron activation occur with the formation of short-lived radioactive isotopes: $T_{1/2}(^{27}Mg)$ is 9.5 minutes and $T_{1/2}(^{28}Al)$ is 2.2 minutes. These isotopes have high-yield analytical gamma lines that do not interfere with the gamma lines of other activated radionuclides. However, ^{27}Mg is not only a product of the $^{26}Mg(n,\gamma)^{27}Mg$ reaction, but is also formed by irradiation of aluminum in the nuclear reaction of $^{27}Al(n,p)^{27}Mg$. The contribution of the competing reaction to the formation of ^{27}Mg can reach significant amounts, so it must be taken into account.

This paper presents the results of the INAA to determine of Mg and Al in certified reference materials from the IAEA, NIST, OREAS, A.P. Vinogradov Institute of Geochemistry SB RAS (Irkutsk, Russia), and Centergeoanalyt LLP (Karaganda, Kazakhstan). The experimental results were obtained at the WWR-K nuclear reactor (water-water reactor, Kazakhstan) [1] using an automated pneumatic transmission system (PTS) for delivering samples to the irradiation position and back [2]. Methodological procedures for accounting of the contribution from the $^{27}Al(n,p)^{27}Mg$ nuclear reaction are considered, the results of the magnesium determination were corrected; algorithms for correction coefficients calculating during routine INAA at the WWR-K reactor using the specified PTS are determined.

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System of Thermal Stabilization of BGO Scintillation Detectors

A.N. Lihachev[1], R.D. Akmaletdinov[2], Yu.N. Kopatch[1], V.L. Kuznetsov[1,3], L.V. Mitsyna[1], N.V. Rebrova[1], P.V. Sedyshev[1], A. Yergashov[4]

[1]Frank Laboratory of Neutron Physics, Joint Institute for Nuclear Research, Dubna, Russian Federation

[2]Institute of Physics and Technology, Ural Federal University, Ekaterinburg, Russian Federation

[3]Institute for Nuclear Research of the Russian Academy of Sciences, Moscow, Russian Federation

[4]L.N. Gumilyov Eurasian National University, Astana, Republic of Kazakhstan

The amplitude and resolution dependences on a temperature have been investigated for BGO detectors. On a base of the obtained data the thermostabilization system for keeping of an optimal temperature regime was created.

Measurement of the ^{45}Sc(n, γ) Cross Section at the CSNS Back-n Facility

Zi Ang Lin

University of South China, China

The study of the neutron capture cross section of Sc is significant for understanding its role as a "neutron poison" in the s-process. Light elements in the mass region between C and Fe can absorb a large number of neutrons due to their relatively high abundances, thereby affecting the number of neutrons available for the synthesis of heavy elements. An accurate determination of the Sc(n,)Sc cross section is essential for quantitatively assessing its impact on the neutron balance, improving s-process nucleosynthesis models in stars, and refining the relevant nuclear data libraries.

In this study, an experimental measurement of the neutron capture cross section for an isotopically enriched Sc target was carried out at the back-streaming white neutron beam line (Back-n) facility of the China Spallation Neutron Source (CSNS). The neutron capture yield of Sc in the energy region from 400 to 10000 eV was obtained by combining the time-of-flight method with the pulse height weighting technique. The resonance parameters were extracted using the SAMMY code. Furthermore, the Maxwellian-averaged cross section (MACS) of Sc at a thermal energy of kT=30 keV was calculated to be 51±5 mb, which is lower than the recommended value in the KADoNiS database.

Attribution of the Ceramic Base of 17th–19th Centuries Stove Tiles Using Neutron Activation Analysis and Statistical Treatment

V.V. Lobachev[1], I.B. Markina[2], A.Yu. Dmitriev[1*], N.N. Chepurchenko[1]

[1] *Joint Institute for Nuclear Research, Dubna, Russia,* [*] *andmitriev@jinr.ru*
[2] *The State Museum-Preserve «The Kulikovo pole», Tula, Russia*

The study focuses on the attribution of 17th–19th centuries architectural ceramics based on their elemental composition. The research objects consisted of stove tiles fragments provided by the State Museum-Preserve «The Kulikovo pole». The studied stove tiles were divided into two groups. The reference group consisted of 23 18th-century stove tiles excavated from the Tula pottery settlement. The second group included 6 stove tiles dating back 17th–19th centuries, presumably of local production and originating from the Tula region.

Elemental mass fractions were determined by neutron activation analysis. Sample irradiation was carried out using the IBR-2 reactor and the IREN facility within the Frank Laboratory of Neutron Physics at the Joint Institute for Nuclear Research. The IREN facility was used for analysis by short-lived isotopes, whereas the IBR-2 reactor – by medium- and long-lived isotopes.

A suite of multivariate statistical methods was applied to treat the resulting data. Initial data visualization and outlier detection were carried out using principal component analysis and the local outlier factor algorithm. To verify the statistical homogeneity of the samples, permutational multivariate analysis of variance was employed. A key stage of the study involved calculating the Mahalanobis distance to test the hypothesis of membership of each unknown-group sample to the Tula reference group. The results demonstrate that the stove tiles of unknown origin are statistically indistinguishable from the Tula reference group in terms of elemental composition. This research supports the development of a reference database for the Tula production center, facilitating future comparative attribution of tiles with unknown origin.

Ultracold Neutron Source Based on Superfluid Helium for the PIK Reactor

A.P. Serebrov, V.A. Lyamkin*, A.K. Fomin, A.O. Koptyukhov, D.V. Prudnikov, G.O. Borodinov, P.A. Hazov, S.N. Ivanov

NRC «Kurchatov Institute» - PNPI, Russia

* *lyamkin_va@pnpi.nrcki.ru*

New ultracold neutron source based on superfluid helium is being constructing at the PIK reactor for researches in the field of fundamental interactions physics. The use of superfluid helium will allow achieving an UCN density in the source chamber of $3.4 \cdot 10^3$ cm^{-3}, which is an order of magnitude higher than the current UCN density in sources around the world.

To create this UCN source some important technologies has been developed and implemented: obtaining and maintaining superfluid helium at low temperatures under conditions of heat influx from the reactor, manufacturing neutron guides with a high UCN reflection coefficient, developing heat exchangers for ultra-low temperatures and obtaining isotopically pure helium-4.

The UCN source neutron guide system is designed for four scientific stations. During the first stage of the source's operation, it is planned to install an EDM spectrometer with a measurement sensitivity of 10^{-27} e·cm/year and two experiments to measure the neutron lifetime with an accuracy of 0.1 seconds using gravitational and magnetic traps.

The Signature of Neutron Fluences under Conditions of Artificial R-Process

V.I. Lyashuk

The Institute for Nuclear Research of the Russian Academy of Sciences, Moscow,117312 Russia
National Research Center "Kurchatov Institute", Moscow, Russia

Evaluation of neutron fluence in artificial explosive nucleosynthesis (rapid(*r*)-process) is an inverse problem of nucleosynthesis, requiring knowledge of the neutron flux under extreme process conditions: in the close-in zone of the thermonuclear process the fluences reach values ~ 10^{24} см$^{-2}$ during the short pulse ~10^{-6} с. The investigation used published experimental data of the USA (Mike, Anacostia, Par, Barbel, Kankakee, Vulcan и Cyclamen) [1−3] on the synthesis of transuranium isotopes under pulse (n,γ)-activation of the starting target – ^{238}U. In the most successful Par experiment, up to 19 neutrons were captured and the isotope ^{257}Fm was identified. The mechanism of artificial explosive nucleosynthesis is similar to the cosmological one, realized at neutron concentration > 10^{19} cm^{-3} in various scenarios of supernova explosions, in very massive stars, during the merger and stripping of neutron stars in binary systems.

The problem of modeling the yields of neutron-rich isotopes during multiple neutron captures is solved in the developed ABM model, which takes into account the drop in the temperature of the medium down to ~2 keV and the correction of cross sections during the expansion of matter with a linear velocity ~190 km/s [4−6]. It has been demonstrated that for each of the starting ^{238}U and ^{239}Pu isotopes, the dependence of the relations of yields in pairs of neighboring isotopes with atomic mass numbers A=245 and 244, A=246 and 245, A=247 and 246 depending on the neutron fluence is close to linear. The obtained result allows us to consider isotope relations as a sensitive functional in the inverse problem of fluence recovery. The achieved isotope relations are in good agreement with the all experimental ones in the scenario with a large injection of ^{239}Pu into the nucleosynthesis zone.

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Formation of Spin Distributions of Fragments in Collinear Ternary Fission of Actinide Nuclei

Dmitrii Lyubashevsky, Pavel Kostryukov, Yana Otvodenko, Stanislav Klyuchnikov, Larisa Titova

Voronezh State University, Voronezh, Russia

Experimental studies of collinear ternary fission were performed [1] at the FOBOS setup of the Laboratory of Nuclear Reactions, JINR. Despite confirmation of the existence of this phenomenon, its dynamical mechanism remains under discussion, and quantitative criteria for the realization of specific scenarios are practically absent.

Spin characteristics of the fragments are a sensitive indicator of the fission dynamics, since they are formed in the pre-scission configuration and reflect the partition of angular momentum between the prefragments. Analysis of spin distributions provides additional information on the sequence of fragment formation and the mechanism of system separation. To describe spin distributions in binary fission, an approach based on the excitation of zero transverse modes in the pre-scission configuration has been developed [2]. Within this method, the moments of inertia of the prefragments and the corresponding nonequilibrium quadrupole deformations are evaluated [3], allowing determination of the total angular momenta of the emerging fragments.

In the present study, this formalism is generalized to the case of ternary fission treated as a sequential two-step process. A collinear mechanism is considered in which, after the first act of binary fission, one of the fragments undergoes a second fission along the original separation axis. The contribution of the second act is taken into account through the emergence of a nonzero spin of the intermediate fragment, its inertial characteristics, and the excitation energy associated with its nonequilibrium deformation. The obtained estimates of the total angular momenta of the final fragments may serve as a diagnostic criterion in interpreting the mechanism of collinear ternary fission.

Analysis of currently available studies shows that there is no experimental data on the spin distribution of fragments in collinear ternary fission. Dedicated measurements, in particular using the methodology developed in [4], would provide an independent test of the proposed dynamical scenario.

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Distributions of Orbital Angular Momenta and Intrinsic Spins of Fission Fragments of Actinide Nuclei

D.E. Lyubashevsky, J.D. Shcherbina, S.V. Klyuchnikov, T.Yu. Shashkina, L.V. Titova

Voronezh State University, Voronezh, Russia

The theoretical analysis of the formation of orbital angular momenta and intrinsic spins of fragments in binary fission of nuclei is performed within the framework of the "cold" fissioning nucleus concept. It is assumed that at the pre-scission stage only zero transverse modes are excited, which determine the generation of the system's angular momentum and its partition between the pre-fragments.

Closed analytical expressions are derived for the distributions of relative orbital angular momenta L and intrinsic fragment spins within a consistent quantum-mechanical formalism that accounts for conservation of total angular momentum and axial symmetry of the system up to neck rupture [1]. The proposed approach does not require the introduction of phenomenological temperature parameters and makes it possible to analytically trace the relationship between the geometry of the pre-scission configuration and the resulting spin characteristics.

Comparison of the calculated orbital angular-momentum distributions with microscopic density functional theory calculations [1, 2] for spontaneous fission of ^{252}Cf and thermal-neutron-induced fission of ^{235}U and ^{239}Pu demonstrates good agreement at the pre-scission stage. At the same time, comparison of the predicted spin distributions with experimental data [3] reveals a systematic discrepancy.

It is shown that this difference arises because the theory describes primary fragment spins formed at the "cold" stage, whereas experimentally reconstructed values correspond to secondary fragments after thermalization and cascade neutron evaporation. The results emphasize the necessity of accounting for post-scission evolution in the interpretation of spin measurements and call for refinement of methods used to extract primary fragment characteristics.

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Description of Characteristics of Ternary Collinear Fission of Actinide Nuclei

Lyubashevsky D.E., Kostryukov P.V., Shcherbina Yu.D., Klyuchnikov S.V., Titova L.V.

Voronezh State University, Voronezh, Russia

The paper proposes a description of collinear ternary fission of atomic nuclei within the framework of the “cold” fission model as a two-step process consisting of two sequential binary fission events. The main attention is paid to the analysis of spin distributions of all three resulting fragments. The description employs methods that account for transverse zero-point oscillations (bending and wriggling modes) excited in the pre-scission configuration. At the first stage, the total spin of the compound system is assumed to be close to zero; at the second stage, one of the fragments, which already possesses a nonzero spin and excitation energy stored in its nonequilibrium deformation, undergoes a second binary fission.

On the Trapping of Cold Neutrons in Nano-Scaled Fabry–Perot Resonating Cavities & Neutron Lifetime Considerations

M. Maaza[1,2]

[1]*UNESCO-UNISA Africa Chair in Nanosciences-Nanotechnology, College of Graduate Studies, University of South Africa, Muckleneuk ridge, PO Box 392, Pretoria, South Africa*

[2]*Nanosciences African Network (NANOAFNET), Materials Research Dept., iThemba LABS-National Research Foundation of South Africa, 1 Old Faure Road, Somerset West, Western Cape 7129, PO Box 722, South Africa*

Relatively to the atomic constituents' counterparts, the neutron is singular as it is sensitive to the four fundamental interactions: strong, weak, electromagnetic, and gravitational. This multi-sensitivity makes neutron wave-matter optics a particularly versatile tool for testing quantum mechanics specifically and fundamental physics concepts in general. The lifetime of a free neutron defined via its beta-decay $\langle \tau_n \rangle$ is of a pivotal importance within the standard model & cosmology.

Indeed, the precision on the neutron lifetime is paramount as it regulates the precision of the 1st element of the Cabibbo–Kobayashi–Maskawa matrix, central to the standard model. The two major methods used to measure $\langle \tau_n \rangle$ while trapping free neutrons, namely, the beam and the bottle methods give different neutron lifetime values; $\langle \tau_n \rangle_{Beam} \sim 888.0 \pm 2.0$ s, that obtained by the bottle technique is smaller; of about $\langle \tau_n \rangle_{Bottle} \sim 879.4 \pm 0.6$ s. In addition of the persistent difference of ~10 s persists for years, even if the two methods have been modified to enhance the experimental accuracy. This latter was shown to be enhanced if one could trap cold neutrons in nanostructured Fabry-Perot resonators.

The de Broglie wave-particle duality coupled to the Fermi total reflection phenomenon in addition to the tunneling & trapping of cold neutrons in such nano-resonating cavities allow trapping times with a precision governed by the Heisenberg uncertainty of 10^{-12} s [1].

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SciFi Detectors for Science and Applications

Alexander Malinin

FLNP JINR, Russia

The scintillating microfiber detectors, directly readout with multichannel SiPMs, referenced as the SciFi detectors, are the new high spatial resolution large area detectors with a single photoelectron sensitivity. They feature a unique combination of properties, already appreciated in high energy physics and astrophysics with LHCb experiment new tracker, the GAMMA-400 space telescope main instrument projects and others. The SciFi detectors can be successfully employed in a large number of medical and industrial applications. The current status of the SciFi projects is presented, the new SciFi technique applications are discussed.

Application of INAA to Assessing Resource Potential and Environmental Risks of Industrial Sites: A Case Study of the Baley Gold Enrichment Tailings Dump

Nikita Markin[1], Sergey Ivannikov[1], Andrey Dmitriev[2], Olga Philippova[2], Valerij Lobachev[2]

[1]*Institute of Chemistry, Far East Branch, Russian Academy of Sciences, Russia*
[2]*Frank Laboratory of Neutron Physics, Joint Institute for Nuclear Research, Dubna, Russia*

The paper presents the results of analysis of tailings from the Baley Gold Extraction Plant "ZIF-2" (Baley, Zabaikalsky Region, Russian Federation) using instrumental neutron activation analysis (INAA). A representative set of the tailings samples confirmed the comparability of INAA results obtained using two facilities: the one based on Cf-252 neutron source (Institute of Chemistry FEB RAS) and the IREN facility based on a pulsed electron accelerator (Frank Laboratory of Neutron Physics, JINR).

Existing estimates of gold content in the tailings were found to be significantly underestimated: the average Au content determined by INAA was 1.15 ppm, almost twice the values obtained primarily by fire assay or chemical analytical techniques. The content of tungsten as a valuable component of complex ores was determined for the first time at this site, averaging 34 ppm. Assessment of toxic element contamination (arsenic and antimony) showed their content to be many times higher than regulatory standards, indicating significant environmental risk from long-term waste storage. This situation is exacerbated by unfavorable physical-geographical factors: the region's sharply continental climate (deep soil freezing, strong winds, and heavy summer rains) combined with the prevalence of easily transported silt fraction in the waste, promoting active dust formation and pollutant migration. The combination of the confirmed resource value of the tailings dump with its high level of As and Sb contamination makes its reprocessing economically and environmentally justified, ensuring the extraction of Au and W while simultaneously eliminating the source of long-term hazard.

Acknowledgement
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Disentangling Pre-Fission and Post-Fission Neutrons in ^{238}U(p,F) Reaction

Vladimir Maslov

Minsk, Belarus, Slobodskoj proezd 4, 220025

Pre-fission, (n,xnf)1,..x and (p,xnf)1,..x, and post-fission neutron contributions depend on the nucleon entrance channel. For the reactions ^{238}U(n,F) and ^{238}U(p,F) shape of prompt fission neutron spectra (PFNS) and strongly depend on the fissility of composite and residual nuclides, $^{238+1-x}$U and $^{238+1-x}$Np, respectively. For the ^{238}U(n,F) reaction only lumped contributions of pre- and post-fission neutrons to the observed PFNS are available, they were interpreted in [1]. Unique measured data on the pre-scission and post-scission neutron multiplicities and spectra [2] analyzed. Exclusive neutron spectra (p,xnf)1,..x are consistent with fission cross sections of ^{238}U(p,F) and ^{238}U(p,xn) up to E_n ~30 MeV. Lumped contributions of exclusive ^{238}U(p,xnf)1,..x pre-fission neutrons at E_p ~20.3 MeV are compatible with the measured data shape [2] up to the cutoff energy of ^{238}U(p,2nf)1 neutron spectrum. The evaporation spectrum approximation fails at $\varepsilon \gtrsim 4.5$ MeV. The relevant data of [2] normalized to the lumped contribution of pre-fission exclusive neutron spectra in the overlapping energy range $\varepsilon \sim 0.65 \div 9.5$ MeV (see Fig. 1). Lumped contribution of post-fission neutrons coming from ^{238}U(p,xnf) fission reactions is compatible with the post-fission neutron spectra [2], the former data are normalized at overlapping energy range $\varepsilon \sim 0.13 \div 9.5$ MeV. At $14 \lesssim \varepsilon \lesssim 19$ MeV the contribution of PFNS to the neutron emission spectra (NES) comes from the post-fission neutrons only. The major contribution to NES comes from inelastic scattering of protons with collective excitations of ^{238}Np in the continuous spectrum with excitation energy U~1÷6 MeV. The neutron emission spectrum of ^{242}Pu+p, E_p ~20 MeV [3] at angle of 107°, relative to the incident proton beam, is shown in an arbitrary scale. The neutron emission spectrum shape at $\varepsilon \gtrsim 14$ MeV is compatible with the exclusive neutron spectrum of ^{238}U(p,nγ)1 reaction. Data on pre- and post-fission neutron multiplicities of ^{238}U(p,F) are revisited.

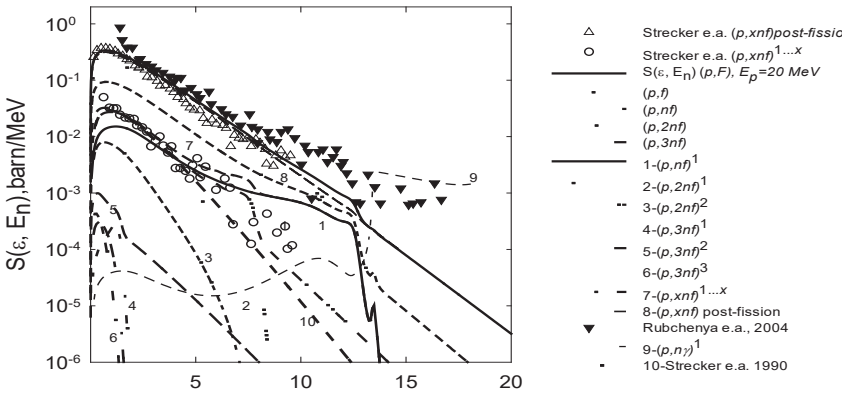

Fig. 1 PFNS of ^{238}U(p,F), Ep= 20 MeV.

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Exploring Double-Differential Neutron Scattering Cross Sections at CSNS Back-n

Min Xiao[1*], S. Feng[1], Y.H. Chen[2], R.R. Fan[2], S.Q. Tang[1], P. Luan[1], Y.C. Xiao[1], P.J. Cheng[1], B. Zheng[1]

[1]*University of South China, China, *minxiao@usc.edu.cn*

[2]*IHEP of Chinese Academy of Sciences and China Spallation Neutron Source Science Center, China*

A double-differential neutron scattering (DDNS) cross-section spectrometer has been designed for the Back-n facility at China Spallation Neutron Source (CSNS). The system consists of an array of dual-mode neutron detectors combined with modular shielding. A proof-of-principle experiment was conducted in parallel with the neutron total cross-section measurement of hydrogen. High-purity carbon and polyethylene (CH) targets were employed for detector calibration and design verification. A prototype detector with modular shielding was positioned at 45° relative to the incident neutron beam at ES#1. The DDNS cross section of hydrogen at 45° was measured over the energy range from 1 keV to 200 keV and compared with evaluated data from the ENDF/B-VIII.1 library. Good agreement was observed, validating the reliability of the measurement system and spectrometer design. In the future, a multi-angle DDNS spectrometer enabling simultaneous measurements of scattering neutrons will be constructed at the Back-n facility.

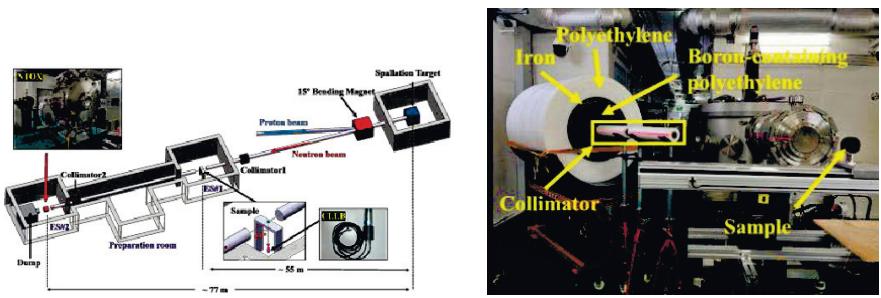

Figure 1: Layout of the proof-of-principle system for DDNS cross-section measurement at CSNS Back-n.

About a Possibility to Obtain the Forward-Backward Asymmetry of Gamma Emission Studying the ^{81}Br(n,γ) Reaction

V.L. Kuznetsov[1,2], L.V. Mitsyna[1], A.I. Oprea[3], C. Oprea[4], N.V. Rebrova[1], P.V. Sedyshev[1]

[1]*Frank Laboratory of Neutron Physics, Joint Institute for Nuclear Research, Dubna, Russian Federation*

[2]*Institute for Nuclear Research of the Russian Academy of Sciences, Moscow, Russian Federation*

[3]*Technical College "Alexandru Roman", Alesd, Bihor County, Romania*

[4]*Teoretical College "Lucian Blaga", Oradea, Bihor County, Romania*

Monte Carlo calculations were presented with a purpose to clear up a possibility of an obtaining of the forward-backward gamma-emission asymmetry studying the integral gamma spectra by the example of ^{81}Br(n,γ) reaction.

Empirical Systematics for Spontaneous Fission and Alpha-Decay Half-Lives of Heavy and Superheavy Nuclei

N.S. Moiseev[1,2], G.G. Adamian[1], N.V. Antonenko[1,2]

[1]*Bogoliubov Laboratory of Theoretical Physics, Joint Institute for Nuclear Research, 141980 Dubna, Russia*
[2]*School of Nuclear Science and Engineering, Mathematics and Mathematical Physics Division, National Research Tomsk Polytechnic University, 634050 Tomsk, Russia*

The accurate calculation of spontaneous fission and alpha-decay half-lives remains a significant challenge in nuclear physics, limiting our understanding of nuclear stability and decay mechanisms. In this work, we present a systematic analysis of the relationship between these two decay modes for ground-state actinides and superheavy nuclei.

A key finding is a linear correlation between the logarithm of spontaneous fission half-lives $\log_{10} T_{1/2}^{\mathrm{SF}}$ and the energy release Q_α of alpha decay for nuclei with a fixed neutron excess $N-Z$ in the range of atomic numbers $90 \le Z \le 102$. This observation leads to a semi-empirical formula that expresses $T_{1/2}^{\mathrm{SF}}$ as a function of Q_α and $N-Z$. The formula is extended to odd-A and odd-odd nuclei, as well as to the region $Z \ge 103$, and reproduces experimental data for 111 known nuclei with a mean absolute deviation of 1.00 order of magnitude.

Complementing this, a further analysis of the ratio of logarithmic half-lives reveals systematic, grid-like behavior with respect to proton Z, neutron N, and mass A numbers, remaining nearly constant along alpha-decay chains where the neutron excess is fixed. This systematic trend is captured by a separate semi-empirical formula that directly relates $T_{1/2}^{\mathrm{SF}}$ to the alpha-decay half-life $T_{1/2}^{\alpha}$ and the neutron excess $N-Z$. Using only three fitted parameters, this formula provides a unified description for nuclei of all parities without introducing separate hindrance factors. It reproduces experimental spontaneous fission half-lives for a dataset of 78 nuclei with a mean absolute deviation of 0.94 orders of magnitude.

Both approaches are compared with predictions from microscopic-macroscopic models, self-consistent microscopic calculations, and more complex empirical parameterizations, demonstrating competitive or superior accuracy. The established systematics allow for the prediction of spontaneous fission half-lives for experimentally unknown nuclei, including isotopes of elements 119 and 120, provide a quantitative criterion for determining the dominant decay mode between alpha decay and spontaneous fission, and offer a tool for identifying potential anomalies in experimental data or nuclear structure, such as the presence of isomeric states.

Since neutron excess is conserved along alpha-decay chains, the observed systematics underscores the importance of alpha-cluster formation and confirms a fundamental connection between spontaneous fission and alpha decay, supporting the interpretation of both processes as different manifestations of nuclear fission within the dinuclear system approach.

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Effect of High-Dose Gamma Radiation on the Nanolamellar Structure and Crystal/Amorphous Interface of PVDF

A.A. Nabiyev[1,2,3], O.I. Ivankov[2], I.I. Mustafayev[1,3], N.Sh. Aliyev[1], A.H.A. Elmekawy[2,4,5]

[1]*Ministry of Science and Education of the Republic of Azerbaijan, Institute of Physics, Azerbaijan*
[2]*International Intergovernmental Organization, Joint Institute for Nuclear Research, Russia*
[3]*Azerbaijan University of Architecture and Construction, Azerbaijan*
[4]*Experimental Nuclear Physics Department, Nuclear Research Center, Egyptian Atomic Energy Authority, Egypt*
[5]*Cyclotron Facility, Nuclear Research Center, Egyptian Atomic Energy Authority, Egypt*

Polyvinylidene fluoride (PVDF) is a semicrystalline fluoropolymer known for its excellent chemical and thermal stability, flexibility, and strong piezoelectric properties when in the electroactive β-phase [1,2]. In this study, the supramolecular structural changes of pure PVDF subjected to gamma radiation at doses of 0–700 kGy were systematically investigated using SAXS, XRD, and DSC methods.

Analysis of small angle X-ray scattering applying broad peak model [3], showed that, as radiation dose increased, the interlamellar distance (long period) consistently decreased from 9.57 nm to 8.33 nm, also according to the correlation function approximation [4], it decreased from 8.08 nm to 7.04 nm. The expected reason for these decreases is the densification of the amorphous layers (thickness decreases by ~16%), while the crystalline lamellar thickness changes slightly (~6% decrease).

The nature of the crystal/amorphous interface changes significantly: at low doses, the interface exhibits rough surface fractal characteristics (with Porod Exp. **3.21**, $D_s \approx 2.79$), while from 300 kGy onwards, it takes on a diffuse character (Porod Exp. reaching **4.25**). This indicates the formation of a gradual transition interface where electron density changes smoothly. The correlation length remains stable between 4.4 – 4.6 nm, indicating that short-range order between lamellae is preserved, while the increase in polydispersity suggests the structure becomes more heterogeneous. Due to the impact of radiation the degree of crystallinity increases in both XRD (36.2% → 44.6%) and DSC (36.4% → 48.9%) analyses. Pure PVDF demonstrates high structural stability against high-dose gamma radiation up to 700 kGy. Although radiation causes densification, increased crystallinity, and interfacial diffusion, the main structural features (interlamellar order, overall morphology) are preserved, and no degradation occurs.

The changes induced by can directly affect the material's mechanical strength, dielectric properties, and piezoelectric response. These characteristics can be optimized according to the material's end-use purpose (e.g., sensors, energy storage devices, or structural materials). Thus, radiation-controlled structural modifications enable the design of PVDF-based materials with tailored properties for various applications. These results provide an important scientific basis for the use of PVDF in radiation environments, particularly for predicting possible structural changes and evaluating material performance.

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GEANT4 Validation of a Dual-HPGe Coincidence Spectrometer Using the $^{35}Cl(n,\gamma)^{36}Cl$ Cascade

T.H. Nam[1*], N.V. Kien[2]

[1]*Dalat Nuclear Research Institute, Vietnam Atomic Energy Institute,1st Nguyen Tu Luc, Lam Vien, Da Lat 670000, Lam Dong, Viet Nam*
[*]*E-mail: thnam@dnri.vn*
[2]*Dalat University, 1st Phu Dong Thien Vuong, Lam Vien, Da Lat 670000, Lam Dong, Viet Nam*

We develop a Geant4 detector-response model of the Dalat Nuclear Research Reactor (DNRR) dual-HPGe (high-purity germanium) γ–γ coincidence spectrometer and benchmark it using the $^{35}Cl(n,\gamma)^{36}Cl$ prompt-γ cascade. Experimental data are acquired with a digitizer – FPGA coincidence data acquisition (DAQ) system; simulated energy deposits are folded with a data-derived resolution function and compared with measured singles spectra, $E_1 + E_2$ sum-energy spectra, and sum-peak-gated coincidence projections.

Photopeak centroids agree within ±3 keV over 72–8579 keV, and relative peak ratios for 39 lines (788–8070 keV) are reproduced typically within ±30% with a small overall bias (mean −5.8%). The inter-detector Δt distribution is used as a timing-quality check, and agreement in sum peaks and gated projections supports the modeled geometry, shielding, and cascade-source implementation.

The validated model enables coincidence-efficiency calculations and provides a baseline for optimizing future coincidence configurations and cascade-based metrology; remaining uncertainties are dominated by detector dead layers, unmodeled low-energy backgrounds, and neglected angular correlations.

Keywords: Geant4; HPGe; γ–γ coincidence; detector-response modeling; FPGA-based DAQ; neutron capture.

Neutron Activation Analysis Used to Monitor Air Polluting Agents in Egypt Using Active Moss Biomonitoring Techniques

N. Nassar[1*], P. Nekhoroshkov[2], M.M. Sherif[1], I. Zinicovscaia[2,3]

[1]*Department of Physics, Faculty of Science, Cairo University, Giza, Egypt*
[2]*Joint Institute for Nuclear Research, Dubna, Russia*
[3]*Horia Hulubei National Institute for R&D in Physics and Nuclear Engineering, Magurele, Romania*
*nohanassar59@gmail.com

This study represents the first comprehensive multi-elemental analysis of air pollution in Egypt, using neutron activation analysis (NAA) and active moss biomonitoring techniques. The study included wide range of major elements (Na, Mg, Al, Cl, K, Ca, Fe, Mn, Ti), trace metals (Sc, V, Cr, Co, Ni, Zn), metalloids (As, Sb, Br), alkali and alkaline earth elements (Rb, Sr, Cs, Ba), rare earth elements (La, Ce, Sm, Tb, Yb), high field strength elements (Hf, Ta, W), and actinides (Th, U). The results showed that there is a significant difference between lithogenic and potentially anthropogenic components as crustal tracers (Al, Sc, Ti, Fe, Th), which suggests that they came from mineral dust. The elevated levels of trace metals indicate different sources of their origin. Rare earth elements mainly reflect natural geological sources, while the presence of chalcophile elements indicates the presence of local human activities. The highest content of the majority of elements was found in sample 2 exposed near the industrial area in 10th of Ramadan city with values relatively higher than the world's average.

Generation of Angular Momentum in Spontaneous Fission of ^{252}Cf

Nejad Azam Rahmati*, Timur Shneidman

Bogoliubov Laboratory of Theoretical Physics, Joint Institute for Nuclear Research, Dubna, Russia

*a_rahmatinejad@theor.jinr.ru

Recently, a large set of experimental data on angular momenta of fission fragments has been obtained. This includes the absence of correlations between angular momenta of fission fragments, weak dependence of angular momentum on total kinetic energy, and, finally, the saw-tooth behavior of fragment's angular momenta on their masses. To investigate these phenomena, we propose a model describing the generation of angular momentum of fission fragments as due to the angular vibrations in scission configurations. It is assumed that, after tunneling through the fission barrier, the nucleus can be represented by a superposition of dinuclear systems (DNS). The angular motion in the DNS is treated quantum-mechanically, yielding the angular momentum distribution of DNS nuclei at scission configurations. We calculate the main fission observables in spontaneous fission of Cf-252, including mass, TKE, and neutron multiplicity distributions. The correlations between these observables and angular momenta of fission fragments are analyzed and explained.

Spatial and Temporal Patterns in Potentially Toxic and Other Elements in Wild Mussels from South Africa

P. Nekhoroshkov[1*], I. Zinicovscaia[1,2], N. Yushin[1], R. Le Roux[3], J. Bezuidenhout[3], V.I. Ryabushko[4]

[1]*Joint Institute for Nuclear Research, Dubna, Russia*

[2]*Department of Nuclear Physics, Horia Hulubei National Institute for R&D in Physics and Nuclear Engineering, 077125, Magurele, Romania*

[3]*Stellenbosch University, South Africa*

[4]*Department of Aquaculture and Marine Pharmacology, Kovalevsky Institute of Biology of the Sourthern Seas of RAS, Russia*

** email: nekhoroshkov@jinr.ru*

The neutron activation analysis was applied for determination of spatial and temporal variability of potentially toxic and other elements (Na, Mg, Al, S, Cl, K, Ca, Sc, V, Cr, Mn, Fe, Co, Ni, Zn, As, Br, Rb, Sr, Sb, I, Cs, U). During 2020−2022 the mussels from several sites along the coast of South Africa: Hospital Bay, Saldanha, Langebaan, Blouberg, Hermanus, Struis Bay, Mossel Bay, Plettenberg, Gqeberha, Durban, Richards Bay were studied. The data were compared with the previously studied for selected sites to demonstrate the temporal variability of accumulation of elements.

The Mytilus galloprovincialis from harbour Richards Bay (samples from 2020) stands out for having the highest concentrations of several elements, particularly heavy metals: Al (2280 mg/kg), Mn (28.8 mg/kg), Fe (2120 mg/kg), Co (2.02 mg/kg) and Sc (0.85 mg/kg). The high levels of V, Cr, Ni, and Cs were also detected. However, in the 2021, the mussels from Richards Bay demonstrated decreasing these elements. Mussels from the Durban demonstrated also the high levels due to the local sources of potentially toxic elements.

In general, the high levels of terrigenous non-volatile elements (Al, Sc, V, Rb, Cs) and connected with them potentially toxic elements (Cr, Mn, Fe, Co) of anthropogenic origin were found in mussels from the polluted ports on the east coast of South Africa (Richards Bay, Durban).

Keyword: mussels, Mytilus galloprovincialis, neutron activation analysis, potentially toxic elements

Requirements of Neutron Induced Nuclear Reaction Data for ADS Neutronics Study

Neng PU*, Yuan HE, Huan JIA, Xinyuan LUO, Xunchao ZHANG

Institute of Modern Physics, Chinese Academy of Sciences, China

*nengpu@impcas.ac.cn

The accelerator-driven subcritical system (ADS) is operated by utilizing high-energy proton bombardment of spallation targets to generate neutrons for driving a subcritical reactor, where a proportion of these neutrons is exceeding 20 MeV. ADS can be employed for the transmutation of long-lived minor actinide nuclides, nuclear fuel breeding, and power generation, it is rendering an indispensable component of nuclear energy systems. In the physical design, neutronics simulations, and analysis of an ADS reactor, nuclear data is a fundamental and pivotal factor. The energy limits of the main Evaluated Nuclear Data library (ENDL) are up to 20 MeV, with a few specialized libraries having higher energy limits but a few numbers of nuclides. Although the proportion of high-energy neutrons is relatively small, the significantly high efficiency of neutrons results in a considerable level of uncertainty in the beam estimation of the ADS, which will directly affect on final estimations of power and other important parameters in ADS design. The impact from high-energy neutron data on beam requirements and sensitivity and uncertainty of nuclear data for the effective multiplication factor has been investigated and analyzed for requirements of nuclear data for ADS study.

Isomeric Ratio in the $^{nat}Cd(n,\gamma)^{115m,g}Cd$ Reaction Induced by IREN Pulsed Neutron Source

L.T.M. Nhat[a,b,*], V.D. Cong[b,c] , L.H. Khiem[b,c,**], P.T. Thanh [b,c], T.N.Toan [b,c], T.H.B. Phi [b,c], N.A. Son[a], D.V. Trung[c], N.T. Binh[c], N.T.X. Thai [b,c], N.T. Dinh[d], V.N. Shvetsov[b], A.Yu. Dmitriev[b], V.V. Lobachev[b], and S.B. Borzakov[b]

[a]*Dalat University, Dalat, Lam Dong, Vietnam, 01 Phu Dong Thien Vuong, Dalat, Vietnam*
[b]*Joint Institute for Nuclear Research, Dubna 141980, Russia*
[c]*Institute of Physics, Vietnam Academy of Science and Technology, Hanoi, Vietnam, 10 Dao Tan, Ba Dinh, Ha Noi, Vietnam*
[d]*Vietnam Atomic Energy Institute, Hanoi, Vietnam, 59 Ly Thuong Kiet, Hoan Kiem, Ha Noi, Vietnam*
**E-mail: letranminhnhat@gmail.com*
***E-mail: lhkhiem@iop.vast.vn*

Isomeric ratio (IR) provides crucial information on nuclear structure and reaction mechanisms. This study reports the experimental determination of the isomeric ratio for $^{115m,g}Cd$ produced via the $^{nat}Cd(n,\gamma)$ reaction using the pulsed neutron source IREN (FLNP, JINR). IREN features a broad neutron spectrum, extending from thermal to several tens of MeV, differing significantly from conventional reactor spectra. The Cd-cover method was employed to separate neutron contributions. Two Cd samples (bare and 0.5 mm Cd-covered) were irradiated simultaneously. Gamma-ray spectra were measured using an HPGe detector, analyzing the 527.9 keV and 933.8 keV lines for ground and metastable states, respectively. Peak areas were corrected for self-absorption and coincidence summing to derive reaction yields.

The obtained isomeric ratios for different neutron components are:

Total: $IR^{total} = 0.0877 \pm 0.0052$

Epi-Cd: $IR^{epi\text{-}Cd} = 0.0952 \pm 0.0055$

Thermal: $IR^{thermal} = 0.0708 \pm 0.0066$

The $IR^{thermal}$ value is lower than several previous studies (Hue 2021, Gicking 2019) but consistent with some data (Pearlstein 2017). This discrepancy is discussed considering the broad IREN spectrum and potential systematic effects (e.g., neutron self-shielding, Cd-cover influence). This work provides new experimental data for $^{115m,g}Cd$ in a unique neutron field, contributing to nuclear data for astrophysics and reactor applications.

Keywords: Isomeric ratio, $^{115m,g}Cd$, IREN, neutron capture, Cd-cover method.

Current Status and Development Prospects of Deep-Buried Silicon Photomultipliers

S. Nuruyev[1,2], Z. Sadygov[1,2], G. Ahmadov[1,2,3,4], R. Akbarov[1,3], F. Ahmadov[2,3], A. Sadigov[2,3], D. Berikov[1,5], A. Madatzade[1,3]

[1]*Joint Institute for Nuclear Research, Joliot-Curie 6, 141980, Dubna, Russia*
[2]*Institute of Physics, Ministry of Science and Education, B.Vahabzade str. 9, AZ1143, Baku, Azerbaijan*
[3]*Innovation and Digital Development Agency, Nuclear Research Department, Gobu str., 20th km of Baku-Shamakhi Highway, AZ0100, Baku, Azerbaijan*
[4]*Innovative Electronics and Detectors LLC, Badamdard STQ-1, AZ1021, Baku, Azerbaijan*
[5]*Institute of Nuclear Physics of the National Nuclear Center of Kazakhstan, Ibragimova 1, 050032, Almaty, Kazakhstan*

This paper presents a comprehensive study of a new generation of micropixel avalanche photodiodes (MAPDs) featuring a deeply buried pixel structure. These detectors have become the primary solid-state alternative to vacuum photomultiplier tubes. We describe the structural modifications implemented in the new device versions, outline their modification steps, and characterize the resulting improvements in their operational parameters, such as photon detection efficiency (PDE), gain, temperature dependence of breakdown voltage and radiation hardness.

The new type photodiodes demonstrate high performance compared to earlier versions, achieving notable improvements in most of the key metrics evaluated. These enhancements enable their successful application in various fields, including spacecraft instrumentation, medical imaging, high-energy physics experiments, and security systems. The paper concludes with a discussion of proposed strategies for further performance improvements in future generations of MAPDs.

Monte Carlo Simulation Multi-Section Detector of a FISCO Facility

Nikita Olkhovich, Alexandra Tiagelskaia, Alexander Vorobyev

B.P. Konstantinov Petersburg Nuclear Physics Institute of National Research Center "Kurchatov Institute", Russia

The FISCO facility is designed for multiparametric correlation studies of the heavy nuclei fission process (major and minor actinides) by thermal neutrons. One of the three main detector systems of the facility is a multi-section neutron and gamma-ray detector. In this paper the detector system is modeled in different geometries of the experiment using Geant4 tools.

Optical Potential Analysis in Antiproton Elastic Scattering on ^{4}He Nuclei via Monte-Carlo Simulations

Cristiana Oprea[1], Alexandru Ioan Oprea[2]

[1]*Research-Development Center "Nuclear Matter in Extreme Conditions", Faculty of Physics, University of Bucharest, Romania*

[2]*"Alexandru Roman" Technical College, Aleșd, Bihor, Romania*

The present study investigates the antiproton elastic scattering on ^{4}He nuclei, a fundamental process for understanding the strong interaction at low and intermediate energies. This work employs experimental data generated through the Monte-Carlo method to determine the real and imaginary components of the optical potential governing this system.

Unlike protons, antiprotons exhibit a high probability of annihilation upon contact with the nuclear surface, rendering elastic scattering an extremely sensitive process for the nuclear periphery. The results obtained accurately reflect the nuclear matter distribution and nucleon density at the edge of the compact ^{4}He nucleus.

The analysis of the ratio between the real and imaginary components allowed for the evaluation of nuclear opacity. The successful modeling confirms the validity of the chosen optical potential and indicates the existence of a region of partial transparency. This finding suggests that the antiproton can probe the surface layers of the nucleus prior to the annihilation process, providing a new perspective on baryon-antibaryon interaction dynamics.

Keywords: antiprotons, ^{4}He, elastic scattering, optical potential, Monte-Carlo simulation, annihilation, nuclear physics

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Cluster States in Fission Fragments and Their Decay under the Influence of the Coulomb Field of Foil Nuclei

Otakhonov Farrukh Odilbek Ugli

Bogoliubov Laboratory of Theoretical Physics, JINR, Dubna, Russia

The phenomenon of delayed secondary decay of fission fragments passing through solid foils is investigated within the dinuclear system and trinuclear system models. Experimental observations show that some fission fragments are produced in long-lived cluster states, which live long enough (~400 ns). These fission fragments undergo secondary decay while traversing the foil material. We propose that such cluster states are formed during binary decay of a trinuclear system. When a dinuclear system passes near a foil nucleus, the external Coulomb field modifies the internal interaction potential, significantly lowering the decay barrier. This leads to a dramatic reduction of cluster state half-lives depending on excitation energy. Additionally, Coulomb forces induce collective vibrations, which are then damped due to friction forces into intrinsic excitation. The combined effects result in cluster half-lives becoming shorter than the foil traversal time, explaining the observed secondary decay.

Description of the Ternary Fission Characteristics of Actinide Nuclei with the Emission of Light Charged Particles

L.V. Titova, Ya.O. Otvodenko*, E.S. Belousov, Yu.D. Shcherbina, D.E. Lyubashevsky

*Voronezh State University, Russia, *otvodenko.yana@mail.ru*

Within the framework of the «cold» fission model, ternary fission of atomic nuclei is considered as a two-stage process with the formation of an intermediate nucleus in a virtual state. A study of the probabilities of light charged particle (LCP) formation in the neck region of the fissioning nucleus has been carried out. The work employs experimental energy distributions of LCPs and estimates of the neck radii of fissioning nuclei [1]. It is taken into account that at the maximum kinetic energies of the emitted particles, the Coulomb barrier penetrability factor is close to unity. Previous calculations performed within this approach demonstrated good agreement with experimental data on ternary fission accompanied by the emission of prescission α-particles [2], as well as for the induced fission of ^{233}U, ^{241}Pu and ^{249}Cf nuclei by thermal neutrons accompanied by LCP emission (He, Li, Be, B, C, N, O isotopes) [3].

In the present work, estimates of the probabilities of LCP formation have been obtained for a wide range of fissioning actinide nuclei: ^{233}U, ^{241}Pu, ^{249}Cf, ^{235}U, ^{239}Pu (induced by thermal neutron), ^{252}Cf (spontaneous fission), as well as ^{238}U and ^{232}Th (fission induced by threshold-energy neutrons). Using a method for estimating moments of inertia, nonequilibrium quadrupole deformations of the fragments in prescission configurations before the LCP emission were determined [4] and generalized for approximately 30 fragment pairs for each of the considered fissioning nuclei. Accounting for nonequilibrium quadrupole deformations made it possible to refine the form of the nuclear and Coulomb potentials in the prescission configuration of ternary fission. It is shown that the probability of light particle formation increases with increasing mass number of the fissioning nucleus for He, Li, Be, B, C, N, and O isotopes, confirming conclusions previously obtained in [3].

Thus, the proposed approach, combining the virtual mechanism of ternary fission within the «cold» nucleus model while accounting for nonequilibrium fragment deformations, enables a more accurate description of the LCP emission process and provides a basis for systematic analysis of ternary fission in a wide range of atomic nuclei.

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Development of Structured B_4C-Coated Cathodes for Thermal Neutron Detectors

A. Ovodov*, A. Kurilkin, A. Kolesnikov, A. Bogdzel, I. Gapon, O. Daulbaev, T. Enik, V. Milkov, V. Bodnarchuk

Frank Laboratory of Neutron Physics, Joint Institute for Nuclear Research, Dubna, Russia
*ovodovas@jinr.ru

This work discusses the development of structured cathodes with various geometrical configurations coated with $^{10}B_4C$ for use in thermal neutron detectors. The cathodes are fabricated from 50 μm thick aluminum foil and feature a Λ-shaped surface profile.

The feasibility and performance potential of structured cathodes were evaluated through calculations of the theoretical efficiency of a single-layer thermal neutron detector. The efficiency was analyzed as a function of the Λ-profile ridge height, apex angle, spacing between adjacent ridges, neutron wavelength, and $^{10}B_4C$ coating thickness.

The Geant4 software package was employed as a numerical simulation tool for modeling the detector response and estimating the neutron detection efficiency.

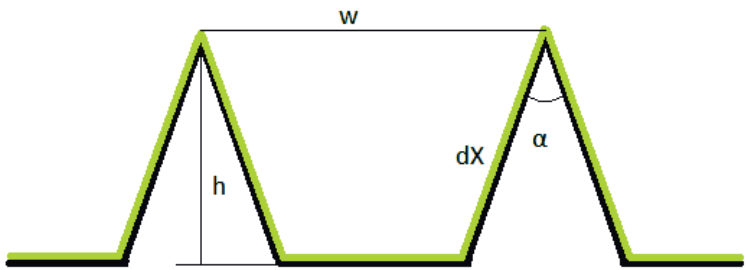

Figure 1: Schematic of the Structured Cathode in Profile View

Development of a Position-Sensitive Scintillation Detector Based on ^{6}LiF/ZnS Using SIPMs

A. Ovodov*, V. Milkov, V. Bodnarchuk

Frank Laboratory of Neutron Physics, Joint Institute for Nuclear Research, Dubna, Russia
*ovodovas@jinr.ru

This work is devoted to the development of a position-sensitive detector based on a ^{6}LiF/ZnS scintillator. An array of solid-state, high-sensitivity photodetectors (SiPMs) used as the photon readout device. Each element of the array generates a current pulse upon detection of scintillation photons.

Wavelength-shifting (WLS) fibers are arranged along both scintillator sheets in mutually perpendicular directions, enabling two-dimensional spatial reconstruction of the detected events.

The scintillation material is characterized by high thermal neutron capture efficiency and good gamma discrimination capability. At the same time, the material is optically non-transparent to its own emission, which limits light propagation but also contributes to localization of the interaction region. Owing to these properties, detectors with a spatial resolution on the order of 1–3 mm can be realized without the use of interpolation algorithms or additional segmentation between WLS fibers.

SiPMs offer several advantages, including compactness, low operating voltage, mechanical robustness, and insensitivity to magnetic fields up to approximately 4 T.

Simulation Study of Transport Differences between Neutrons and Protons in Solid D–D Fusion Targets and Their Impact on Measured Neutron Yield

H.G. Öztop*

Eskişehir Osmangazi University, Turkiye

*hasretgul.oztop@gmail.com

Deuterium–deuterium (D–D) fusion reactions produce neutrons and protons with comparable intrinsic branching ratios; however, their behavior inside solid targets differ significantly due to their neutral or charged nature. In practical neutron sources and experimental setups, these differences can strongly influence the measured neutron yield. In this study, we investigate how transport, stopping power, and escape probability of reaction products affect the observable neutron output from solid D–D fusion targets.

Monte Carlo–based radiation transport simulations are employed to model the propagation of neutrons and protons generated in low-energy D–D reactions within different solid target configurations, including bulk and porous metallic structures. The results show that protons experience strong energy loss and reabsorption within the target material, while neutrons are largely unaffected by the target environment and exhibit high escape probabilities. As a consequence, the detected neutron yield can differ substantially from expectations based solely on intrinsic nuclear reaction data reported in the literature.

In a focused discussion on nuclear data interpretation, established D–D cross-section and branching ratio data from the literature are considered together with transport and detection-related effects. The study highlights that discrepancies between literature values and experimentally measured neutron yields may arise from target-dependent transport phenomena rather than from modifications of intrinsic nuclear physics. These findings emphasize the importance of accounting for particle transport and target geometry when interpreting neutron yield measurements in applied and experimental D–D fusion systems.

Crystallographic Texture and Elemental Analysis of Missel Shell Minerals from the West Coast of South Africa

T.A. Lychagina[1], P.S. Nekhoroshkov[1], D.I. Nikolayev[1], A.V. Pakhnevich[1, 2*], I. Zinicovscaia[1]

[1]*Joint Institute for Nuclear Research, Russia*
[2]*Borissiak Paleontological Institute of RAS, Russia,* *alvpb@mail.ru*

The relationship between crystallographic texture and the elemental composition of mussel shells was being studied. The mussels of five different species (three alien and two–indigenous) were collected from the Saldanha Bay, West Coast of South Africa for analysis of shell texture and elemental composition. Mussels are an interesting and promising object for studying the crystallographic texture of calcium carbonate minerals. Phase composition and crystallographic texture were investigated by time-of-flight neutron diffraction at the spectrometer SKAT and elemental composition of shell samples were studied by using neutron activation analysis at the Regata facility. Both instruments are situated at the IBR-2 pulsed nuclear reactor (FLNP, JINR). The phase composition of representatives of different genera differs despite the fact that all mollusks studied belong to the same family Mytilidae. On the basis of neutron scattering it is shown that the shell of *Mytilus galloprovincialis* and *Mytilus edulis* consist of calcite and aragonite, while *Semimytilus patagonicus* and *Aulacomya atra* are predominantly aragonite, and *Choromytilus meridionalis* is predominantly calcite. Therefore, the pole figures of calcite for three species and aragonite for four species are comparable. Representatives of the genus *Mytilus* are characterized by a very sharp texture of calcite and moderate texture of aragonite. The pole figures of *Choromytilus meridionalis* and *Mytilus* calcite phase have similar maximum pole density and isoline distribution. The aragonite pole figures are similar for all studied species.

The higher levels of Na, Al, V, Zn, As, I in shells of indigenous *A. atra* indicate the intense ability to deposit the marine and terrigenous elements. The low levels of weight/length ratio for indigenous *C. meridionalis* demonstrate the biological ability of species for intense shell construction in comparison with the other species. This is confirmed with the higher levels of Mg, Mn, Sr in shells. The low levels of condition index for alien *S. patagonicus* is interlinked with Ca decreasing of shells in comparison with the other species. The higher levels of Mn/Ca ratios in indigenous *A. atra* and *C. meridionalis* corresponds to the better trophic mechanism of primary biomass utilization, in comparison with the alien *M. galloprovincialis* and *M. edulis* and *S. patagonicus*. The direct correlation between the crystallographic texture parameters and elemental content of mussel shells were not revealed for the studied species.

Experimental Approach for Studying the Energy Efficiency of Various Beams in Subcritical Reactors

M. Paraipan[1*], A. Abduvaliev[2], A. Balabekyan[3], O.V. Belov[1], F.H. Ergashev[2], V.M. Javadova[1], S.V. Korneev[4], L.K. Kostov[1,5], J.H. Khushvaktov[1], S.A. Kulikov[1], A.A. Solnyshkin[1], V.V. Sorokin[4], T.N. Tran[1,6]

[1]Joint Institute for Nuclear Research, Dubna, Russia, [*]paraipan@jinr.ru
[2] Institute of Nuclear Physics, Tashkent, Uzbekistan
[3]International Center of Advanced Studies, Yerevan State University, Yerevan, Armenia, 0025
[4]Joint Institute for Energy and Nuclear Research - Sosny, Minsk, Belarus
[5]Institute for Nuclear Research and Nuclear Energy, Tsarigradsko Shose Blvd. 72, Sofia, Bulgaria, 1784
[6]Institute of Physics of the Vietnam Academy of Science and Technology (IP VAST), Hanoi, Vietnam

A series of theoretical studies performed in the frame of E&T and ADSR (accelerator driven subcritical reactors) projects at JINR Dubna, underlines the advantages of subcritical reactors as efficient source of energy, with energy gain G>15. A value of the effective multiplication factor k_{eff} in the range 0.985−0.988, maintained during exploitation with control rods, is low enough to avoid reaching the criticality during unprotected transients and ensures a safer exploitation in comparison with fast reactors. The choice of larger configuration of the active zone give the possibility to realize the needed value of k_{eff} with lower enrichment, realizing longer cycle with deeper actinides burning (2−3 times more than in fast reactors). One of the most interesting conclusions concerns the possibility to use ion beams as ^{7}Li or ^{9}Be at low energy (0.25−0.3 GeV/n) instead of 1−1.5 GeV protons, with the same net electrical power but 2 times shorter accelerator, that improves the efficiency diminishing the costs for building and maintenance.

The analysis of possible experiments meant to check the results of theoretical work demonstrates that measurements of the neutron yield from the converters, or measurements of the fission distributions only on the surface of the converter cannot realize a correct comparison of the energy efficiency of different beams used in ADSR. The most reliable comparison is obtained by measuring the fission distribution inside an extended target. Based on these conclusions, the extended lead target LETASUR was designed. The target design, the experiment planning and expected results predicted by simulation for different beams and converter materials are presented.

Electrical Impedance Analysis of a ZrO_2-Based Nanopowder System under Neutron Irradiation Conditions

Perez M.A.C.[1,2*], Doroshkevich A.S.[1], Mezentseva Zh.V.[1], Ibrahim M.A.[1], Lyubashevsky D.E.[2], Oksengendler B.L.[3]
[*]anthonycpm@jinr.ru

[1]*Joint Institute for Nuclear Research, 141980, Dubna, Joliot Curie St. No. 6, Russia*
[2]*Voronezh State University, 394018, Voronezh, Universitetskaya pl., No. 1, Russia*
[3]*The Institute of Material Sciences SPA "Physics - Sun" AS RUz (IMS-Uz) 2 B, 100084, Chingiz Aytmatov str., Tashkent, Uzbekistan*

Yttria-stabilized zirconia (YSZ) nanopowder systems are promising materials for gas monitoring applications, particularly in high-humidity environments where the surface layer of adsorbed water is fundamental to the detection mechanism [1−2].

Previous studies have demonstrated that the functionality of these systems originates from the formation of a space charge region and an electrical double layer at the boundary between the nanoparticles and the surrounding medium. The integrity and dielectric properties of this interface critically determine the device's performance [3].

In the present work, we investigate and evaluate the influence of neutron irradiation as an external factor capable of modifying the surface microstructure and defect density of YSZ. Such modifications potentially alter its affinity for water adsorption, surface ion mobility, and, consequently, the electrical response of the double layer. Electrochemical impedance spectroscopy (EIS) was employed as the main technique to evaluate neutron-induced alterations in charge transport mechanisms and interfacial capacitance [4−6].

Electrical conductivity measurements were performed in order to obtain the main parameters of the equivalent electrical circuit of YSZ nanopowders under conditions of moisture adsorption, both before and after irradiation.

The appearance of a radiation-induced relaxation process, accompanied by a decrease in the reactivity of the nanoparticle surface, has been established.

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A Comparative NAA-Based Assessment of Elemental Composition of *Mentha spicata* L. Plants Exposed to Silver in Ionic and Nanoforms

Alexandra Peshkova[1,2*], Inga Zinicovscaia[1,3], Artyom Konakov[4], Vladimir Galustov[1], Konstantin Vergel[1]

[1]*Joint Institute for Nuclear Research, Russia,* [*]*peshkova@jinr.ru*
[2]*Doctoral School of Natural Sciences, Moldova State University, Republic of Moldova*
[3]*Horia Hulubei National Institute for R&D in Physics and Nuclear Engineering, Romania*
[4]*The Research Institute for Physical Chemical Problems of the Belarusian State University, Minsk, Belarus*

The effect of silver in ionic (as $AgNO_3$) and nanosized forms (AgNPs) on the accumulation of macro- and microelements in *Mentha spicata* L. plants was investigated. $AgNO_3$ and AgNPs (2–8 nm), stabilized either with polyvinylpyrrolidone (PVP) or sodium citrate, were applied for plants irrigation. The content of 32 elements, Na, Mg, Al, Cl, K, Ca, Sc, Ti, V, Cr, Mn, Fe, Co, Zn, As, Br, Rb, Sr, Mo, Ag, Sb, Cs, Ba, La, Ce, Sm, Tb, Yb, Hf, Ta, Th, and U in rhizosphere soil, roots, and aerial biomass was determined using instrumental neutron activation analysis at the IBR-2 reactor. The results demonstrated that treatment with citrate-stabilized AgNPs increased the content of most elements in roots and rhizosphere soil, and simultaneously reduced their content in aerial part of plants compared to the control. Application of PVP-stabilized AgNPs decreases the levels of elements in *Mentha spicata* L. These results indicate that nanoparticle surface coating is an important factor governing the transport and redistribution of elements in plants.

Phytoremediation Potential of *Eichhornia crassipes* for Heavy Metal Removal from Industrial Wastewater Assessed by TXRF

Pham Thi Ngoc Ha[1], Nguyen Thi Nguyet Ha[1], Nguyen An Son[1], Le Hong Khiem[2,3], Inga Zinicovscaia[3], Vu Duc Cong[2,3], Nguyen Thi Minh Sang[1,3*]

[1]*Dalat University, Lam Dong, Viet Nam*
[2]*Institute of Physics, Hanoi, Viet Nam*
[3]*Joint Institute for Nuclear Research, Dubna, Russia*

[*]*Corresponding author: sangntm@dlu.edu.vn*

Industrial wastewater often contains toxic elements that pose significant environmental and ecological risks. This study evaluates the phytoremediation potential of *Eichhornia Crassipes* (*E. Crassipes)* for the accumulation of harmful elements from industrial wastewater collected at the Tam Thang Industrial Park, Viet Nam. A static laboratory-scale experiment was carried out for 15 days, during which variations in physicochemical parameters (pH, TDS, temperature, and electrical conductivity), metal concentrations in water, and metal accumulation in plant tissues (roots, stems, and leaves) were monitored. Total reflection X-ray fluorescence (TXRF) technique was employed for multielements analysis. The results showed that the wastewater from the Tam Thang Industrial Park contained twelve elements (Si, S, Cl, K, Ca, Mn, Fe, Cu, Zn, As, Br, and Sr), with iron exhibiting the highest removal efficiency (82.5–87.2%). Elemental analysis of *E. crassipes* tissues revealed elements-specific and time-dependent, indicating active uptake and internal allocation processes. Bioconcentration factors (BF) for all analyzed elements exceeded unity, indicating effective uptake from the aqueous phase, while translocation factors (TF) revealed element-specific internal distribution strategies. These findings confirm that *E. crassipes* is a promising phytoremediation species for treating industrial wastewater.

MC-Calculation of the Duration of the VCN Bunch after Passing through the Various Neutron Guides of the UCN Source at the Pulsed Reactor IBR-2M

A.A. Popov*

FLNP, Joint Institute for Nuclear Research, Dubna, Russia

**aapopov@jinr.ru*

FLNP JINR is going to create an ultracold neutron (UCN) source at the IBR-2M pulsed reactor. The source design is based on Shapiro's idea about pulsed accumulation of the UCN in a UCN trap. A current concept [1] involves the deceleration of very cold neutrons with a wavelength of 200 angstroms (VCN) to UCN energies.

The UCN trap will be located at about 15 meters from the cold convertor and connected with it by a neutron guide. Due to the specifics of the project, the neutron guide cannot be straight. It is necessary to provide transportation of the VCN through the neutron guide with a minimal increase of the bunch duration. The report presents the results of MC-calculations of the VCN bunch transportation through neutron guides whose geometry meets the requirements of the project.

The neutron guide transmission and time structure of the VCN bunch after passing through the neutron guides have been presented. A model with specular neutron reflection and a model with scattering on micro-roughness with amplitude of 2 nm are considered. The calculations were performed using Geant4.

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Study of Contributions from Interaction Reactions of Fast Neutrons with ^{10}B

S.I. Potashev*, A.A. Kasparov, S.Kh. Karaevsky, E.A. Permyakov, V.N. Ponomarev

Institute for Nuclear Research of Russian Academy of Sciences, Moscow, Russia

*potashev@inr.ru

Contributions for various nuclear reactions for fast neutrons with energies above 1 MeV with emission of ^{4}He, ^{3}H, and other nuclei using data obtained at neutron sources based on up to 9 MeV electron accelerator and linear proton accelerator at 267 MeV in Institute for Nuclear Research of Russian Academy of Sciences are determined. The data were obtained using position-sensitive neutron detector based on a solid ^{10}B layer and multiwire gas-filled chamber.

To obtain nuclear reaction contributions kinematics were simulated and ionization losses of secondary ^{4}He, ^{3}H, and ^{2}H nuclei were calculated in two consecutive sensitive gas gaps of position-sensitive neutron detector. Then, ionization losses were compared with experimental data on correlation of signal amplitudes. Specifically, nuclear reaction contributions with emission of ^{3}H nucleus and ^{8}Be or ^{4}He nuclei were investigated.

Position-Sensitive Neutron Detector Based on Boron-10 Layers and Multiwire Gas-Filled Chamber

K.Yu. Burmistrov, Yu.M. Burmistrov, A.I. Drachev, S.Kh. Karaevsky, A.A. Kasparov, S.I. Potashev*, V.N. Ponomarev, V.M. Skorkin

Institute for Nuclear Research, Russian Academy of Sciences, Moscow, Russia

*potashev@inr.ru

Position-sensitive neutron detector with a 50×50 cm² sensitive area was created using solid ^{10}B layers and a multiwire proportional chamber. It features detection efficiency of ~0.0001% for fast neutrons and up to 5% for thermal neutrons. Multichannel detector electronics with differential output signals were developed for operation in conditions of high electromagnetic interference. The detector is used to study nuclear reactions of interaction of fast neutrons with energies above 1 MeV with the ^{10}B nucleus. The detector allows charged nuclear fragment identification by using correlation of signal amplitudes in two or more sensitive gas gaps.

Experimental possibility of using position-sensitive neutron detector in setup for obtaining shadow neutron images for investigation samples of geological rocks and archaeological artifacts in epithermal or slow neutron flux is also being studied.

New Measurement of Neutron Scattering Cross Sections at the GNEIS Spallation Facility

Pavel Prusachenko[1], Nikita Fedorov[1], Yuri Kopatch[1], Dimitar Grozdanov[1], Alexander Vorobyev[2], Oleg Shcherbakov[2], Alexandra Tiagelskaia[2], Nikita Olkhovich[2]

[1]*Joint Institute for Nuclear Research, Dubna, Russia*
[2]*NRC KI – PNPI, Russia*

Data on differential and integral elastic neutron scattering cross sections are important for solving a number of practical problems. For example, elastic and inelastic scattering reactions on certain elements (Li, Be, C, O, F, Na, Mg, Al, Cl, Fe, Ni, Pb, U, Pu) are among the key nuclear data influencing reactivity calculations for advanced reactor systems. Such data are also of interest for nuclear structure analysis, including the high excitation energies, and provide the initial information necessary for theoretical cross section calculations. However, some publications have shown that available experimental data for many key elements are contradictory and insufficient.

One widely used approach to measuring neutron scattering cross sections is the use of pulsed sources with a so-called "white" neutron spectrum, such as GELINA at IRMM, WNR at LANL, and others. In this talk the results of a test experiment conducted as part of a collaboration between the JINR Laboratory of Neutron Physics and the National Research Center "Kurchatov Institute" - PNPI will be presented. The experiment was performed at the neutron time-of-flight spectrometer GNEIS based on the 1 GeV proton synchrocyclotron of PNPI. The experimental setup consisted of 11 detectors based on EJ-309 liquid scintillators, positioned at angles of 15−165° relative to the neutron beam axis, and three detectors based on LaBr3(Ce), positioned at angles of 110, 125, and 150°. Graphite and polyethylene samples were used as test samples. A separate experiment without a sample was performed to assess the background. A unique feature of this study, compared to similar setups, was the simultaneous use of neutron and gamma detectors. During the experiment and subsequent simulation in GEANT4, the possibility of measuring neutron scattering cross-sections, background conditions, and the possibility of reconstructing the detector response function for subsequent cross-section determination were investigated, and work was also carried out on the computational optimization of geometry in order to reduce the background.

Thermal Neutron Detection with LiF(Ti) Single-Crystal Scintillators

A.M. Pshukov[1*], N.E. Pukhaeva[2]

[1]*Kabardino-Balkarian State University named after H.M. Berbekov, Nalchik, Russia*
[2] *Joint Institute for Nuclear Research, Dubna, Russia*

[*]E-mail: pshukov1959@mail.ru

LiF(Ti) single crystals are considered as promising scintillation materials for thermal neutron detection due to the presence of lithium nuclei capable of neutron capture and the favorable optical properties of the host crystal. In this work, *Ti*-activated *LiF* is analyzed from the viewpoint of its applicability to neutron-sensitive detector systems.

The neutron sensitivity of *LiF* is determined by the $^{6}Li(n,\alpha)^{3}H$ reaction, which is accompanied by a total energy release of 4.78 MeV. The charged reaction products deposit their energy directly in the crystal and generate a scintillation signal, providing the physical basis for thermal neutron registration. Experimental studies of *LiF(Ti)* crystals grown from the melt showed that the material demonstrates a detectable response under neutron irradiation and can be considered as a functional scintillator for neutron-sensitive applications.

A key result is the observation of amplitude spectra under excitation by a plutonium–beryllium neutron source. In the neutron-irradiation mode, a pronounced maximum corresponding to the energy release of neutron-capture products is observed, confirming the possibility of neutron registration in *LiF(Ti).* The measured scintillation signal indicates that Ti activation forms luminescence centers capable of converting the energy of neutron-induced charged particles into optical emission.

LiF(Ti) also exhibits properties important for detector implementation. Its radioluminescence maximum lies in the 400–415 nm region, which is well matched to the sensitivity range of conventional photomultiplier tubes. In addition, the crystal remains highly transparent in the region of its own emission, with low self-absorption losses. The possibility of obtaining large, optically homogeneous crystals is a substantial technological advantage for the fabrication of bulk neutron-sensitive scintillation elements.

Although the decay time of *LiF(Ti)* is relatively long, about 120–150 μs, this does not critically limit its use in low-flux neutron fields, background measurements, and experiments involving rare events. The combination of neutron sensitivity, optical homogeneity, radiation resistance, and suitable spectral characteristics makes *LiF(Ti)* a promising material for specialized thermal neutron detectors.

Keywords: *LiF(Ti)*, thermal neutron detection, scintillation detector, lithium fluoride, neutron-sensitive materials

First Results of New Experimental Setup ARFIM for Applied Research of NOSU

Nelli Pukhaeva

Veksler and Baldin Laboratory of High Energy Physics, Joint Institute for Nuclear Research, Russia

North Ossetian State University, Russia

New experimental setup ARFIM for applied research was tested and run during of new data taking at Nuclotron of NICA facility in 2026 year. The ARFIM includes two ionization chambers IK-2, IK-3 and phosphor chambers for measure profile and intensity of beam and two holders for samples under study. The chambers were calibrated with silicon detectors which gives us exact numbers of ions. At those chambers, the materials of electrodes are used different, at the IK-2 it is foil-clad fiberglass, for the IK-3 are taken foil-clad polyimide. By the ionization chambers we are measuring the integral current before irradiated samples and after. By the phosphor chambers were measuring profile of beam. The chambers have very good sensitivities, for each spill we are measure 5−6 values of current. The developed software allows us to observe the irradiation in an interactive mode.

All measurements and data are recorded in the database, which allows to create the required graphs and tables. By using the developed method, we are providing the precise determination of the fluence and absorbed dose for irradiated materials. Because the data is a sequence of intensity values per spill, we analyzing and calculating integral of all spills. The intensity is measured before sample and after for approximation of the intensity, which reaches a particular sample.

The one of most interesting samples for study are lead silicate glasses and microchannel plates. Two lead silicate glasses were irradiated with different doses and one microchannel plates. The all characteristics of the studied samples were measured before irradiation. Now they are under study after irradiation.

The study is performed within the ARIADNA Collaboration.

Experimental Evidences of New Modes of Collinear Cluster Tri-Partition (CCT)

Yu.V. Pyatkov[1,2], D.V. Kamanin[2], V.E. Zhuchko[2], A.N. Solodov[2], Yu.M. Sereda[2], Z.I. Goryainova[2], E.A. Kuznetsova[2], P.Z. Ngcobo[3], O.V. Strekalovsky[2], A.O. Zhukova[2], B.A. Le[2], T.H. Vilane[2,4]

[1]National Nuclear Research University MEPhI, 115409 Moscow, Russia
[2] Joint Institute for Nuclear Research, 141980 Dubna, Russia
[3] University of Zululand, Republic of South Africa
[4]University of South Africa, Republic of South Africa

In our previous publications [1−4], various manifestations of the multi-body decay channel of low excited heavy nuclei called collinear cluster tri-partition (CCT) were reported. The most pronounced effect discussed there is so called "Ni-bump". In the fission fragments two-dimensional mass-correlation plots obtained at different double-armed time-of-flight spectrometers used the group of fission events were observed showed ^{68,72}Ni magic isotopes as one of the partners while the mass of the second one changes in the range 128−150u. Thus, at least ternary decay of the mother nucleus was observed. In the data of our recent experiments, we revealed a whole sequence of the similar "bumps" based on heavier magic clusters from ^{82}Ge up to ^{113}Ru. The structures observed are almost background free what let us to analyze the corresponding prescission configurations.

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Physicochemical Characterization of the PM2.5 Aerosol by INAA and Complementary Techniques

Radenkovic M.B.[1], Zinicovscaia I.[2,3], Topalović D.[1], Ćujić M.[1], Peshkova A.[2], and Grozdov D.[2]

[1]Vinca Institute of Nuclear Sciences - National Institute of the Republic of Serbia, University of Belgrade, P. O. Box 522, 11001 Belgrade, Serbia, mirar@vinca.rs, dusan.topalovic@vinca.rs, cujicm@vinca.rs
[2]Joint Institute for Nuclear Research, Joliot-Curie 6, 141980 Dubna, Russian Federation, zinikovskaia@mail.ru (I.Z.)
[3]Horia Hulubei National Institute for R&D in Physics and Nuclear Engineering, 30, Reactorului Str., MG-6, Romania

Fine aerosol fraction (PM2.5) is considered the most harmful airborne pollutant for human health. [1] It consists of particles less than 2.5 μm in diameter which are multiphase conglomerates of various species and components (heavy metals, black carbon, PAH, VOC, water, etc) and a key of identification and quantification of original emission sources and health risk assessment.

In this study, one-year sampling campaign is conducted 2018/19 at suburban residential site Zeleno Brdo (Belgrade) with aim to characterize fine aerosol fraction. 24-hour PM2.5 samples were collected by reference low-level samplers on the PTFE filter media suitable for application of nuclear and complementary non-destructive analytical techniques which do not need chemical pretreatment. Loaded filters were successively analyzed by: micro-gravimetry, INAA, MABI and SEM, for PM2.5 total mass, elemental concentrations of 20 potentially toxic elements (Na, Mg, Al, Cl, K, Ca, Sc, Ti, V, Cr, Mn, Fe, Zn, As, Br, Rb, Sb, Cs, La, Sm, W, Th, and U), black carbon content and surface images of present physicochemical association, for selected samples. Results have shown a wide range of PTE's concentrations, different seasonal trends for heating and non-heating time intervals, and specific tracers of local and transboundary emission sources, such as domestic heating, heavy oil use, TPP's emissions, industrial sources, soil resuspension and biomass burning. Traffic was noticeable but not significant source of air pollution in the studied residential area. Secondary particulate matter formation was observed in both heating and no heating seasons due to a long resident time of particulates in the ambient air and presence of other gaseous compounds and solar irradiation as precursors. Black carbon concentrations were significantly higher during the cold season differing diesel origin from biomass burning. Typical size range of structures in PM2.5 aerosol deposit observed by SEM was between 100 nm to 2.5 μm thus posing significant health risk for long-term exposure to PM2.5 mass levels beyond the recommended reference levels [1].

Main advantage of the applied methodology is use of accurate, sensitive and fast nuclear and complementary techniques, giving enough high-quality information on elemental concentrations and uncertainties to be utilized for discussion of correlations, source apportionment modeling and health risk assessment.

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Software of Neutron Data Processing at CSNS

Rong Du, Fengyan Gu, Hao Wang, Junrong Zhang, Jiajun Zhong, Haoran Jiang

China Spallation Neutron Source, Dongguan, China

The China Spallation Neutron Source (CSNS) generates vast amounts of data from its instrument suite, necessitating efficient, scalable, and user-friendly processing software. This poster presents RZera, a dedicated data processing framework developed at CSNS to meet these challenges. RZera features a modular, plugin-based architecture that decouples core input/output and workflow management from specific data reduction algorithms. This design allows for seamless integration of new instruments and analysis techniques. We will showcase RZera's application in processing data from several CSNS instruments, such as the Small-Angle Neutron Scattering (SANS) and Powder Diffractometer beams lines. RZera provides a robust, flexible, and scalable foundation for the CSNS user community, enhancing data analysis capabilities and supporting the facility's growing scientific output.

Current Status and Experiments of the Back-n White Neutron Facility

Ruirui Fan

China Spallation Neutron Source, Dongguan, China

In 2025, the Back-n beamline delivered 4,625 hours of beam time, including 3,403 hours for user experiments and 1,222 hours for machine studies. The experimental program included on-beam tests of the GTAF setup, neutron beam profile measurements, neutron energy-spectrum measurements, and tests of the white-neutron polarization system. The energy-spectrum and beam-profile measurements corrected systematic errors caused by beam current in white-neutron nuclear data measurements. The on-beam GTAF experiments completed measurements of standard samples. Tests of the polarized-neutron system demonstrated polarization of the white neutron beam and carried out China's first parity-violation experiment in neutron–nucleus reactions. Going forward, the white-neutron beamline will continue building a high-purity germanium (HPGe) detector array and an upgraded time projection chamber (TPC) detector. This report will present these developments in detail.

Status of Neutrino4+ Setups at the SM-3 Reactor

A.P. Serebrov[1], R.M. Samoilov[1], Nikolay Voropaev[1], Anatolii Vasiliev[1], Viktor Fedorov[1], Andrey Gerasimov[1], Alexey Fomin[1], Viktor Golovtsov[1], Nikolay Gruzinsky[1], Sergey Volkov[1], Petr Neustroev[1], Ekaterina Shulgina[1], Vladimir Zinoviev[1], Mikhail Zaytsev[1,2], Dmitrii Yakimov[1], Alexey Izhutov[3], Alexey Petelin[3], Sergey Sazontov[3], Alexandr Tuzov[3]

[1]Petersburg Institute of Nuclear Physics, National Research Center "Kurchatov Institute", Gatchina, Russia
[2]Dimitrovgrad Engineering and Technological Institute MEPhI, Dimitrovgrad, Russia
[3]JSC "State Science Center — Research Institute of Atomic Reactors", Dimitrovgrad, Russia

The Neutrino-4 collaboration improved the detector in the first neutrino laboratory at SM-3 reactor. Also, we have been creating a new neutrino laboratory at the same reactor to study light sterile neutrinos. In the Neutrino-4 experiment, an oscillation effect was observed at a confidence level of 2.7σ, which is in good agreement with the gallium anomaly and the result of the BEST experiment, however, contradicts the latest constraints on the oscillation parameters obtained in the STEREO and PROSPECT experiments. The stages of the setup preparation and further prospects are presented.

Role of Odd-Parity α+t States in the ^{6}Li(n,t)^{4}He Reaction at 3–5 MeV

B. Usukhbayar[1,2], E. Sansarbayar[2,3], G. Khuukhenkhuu[3], Yu.M. Gledenov[2], I. Chuprakov[2,4], M. Odsuren[1]

[1]*School of Engineering and Technology, National University of Mongolia, Ulaanbaatar 14201, Mongolia*
[2]*Frank Laboratory of Neutron Physics, Joint Institute for Nuclear Research, Dubna 141980, Russia*
[3]*National Institute for Nuclear Science and Technology, National University of Mongolia, Ulaanbaatar13330, Mongolia*
[4]*The Institute of Nuclear Physics of the Agency of the Republic of Kazakhstan for Atomic Energy, Almaty 050032, Kazakhstan*

The ^{6}Li(n,t)^{4}He reaction in the fast-neutron energy region is closely related to the resonance structure of ^{7}Li. The measured excitation function exhibits broad structures in the neutron energy range between 3 and 5 MeV [1]. Within the present α+t cluster analysis, these structures are associated with negative-parity resonant states of ^{7}Li. These resonances originate from the relative motion between the alpha-particle and the triton. In this energy range, the ^{7}Li can be described within a two-body α+t cluster system. Negative-parity states arise from odd relative orbital angular momentum between the alpha-particle and the triton, and such states couple to the α+t channel. Consequently, they are expected to influence the ^{6}Li(n,t)^{4}He cross section. Even-parity states may also contribute, however, their coupling to the α+t configuration in this energy region is generally weaker. A quantitative interpretation of the measured excitation function therefore requires determination of the resonance energies (E_R) and decay widths (Γ) of the relevant negative-parity states, together with an appropriate treatment of continuum effects.

In the present work, resonance energies and decay widths are calculated within an α+t two-body cluster model using the Complex Scaling Method (CSM) [1−2]. The resonant states are identified as isolated complex-energy eigenvalues of the scaled Hamiltonian $E= E_R – iΓ/2$, where E_R is the resonance energy and Γ is the decay width. This approach enables a unified description of bound, resonant, and continuum states. The scattering phase shifts are calculated from the combined contributions of the resonance poles and the continuum states.

On the experimental side, high-precision cross sections for the ^{6}Li(n,t)^{4}He reaction were measured at the EG-5 Van de Graaff accelerator in the neutron energy range E_n = 3.3−5.3 MeV. The measurements were performed using a gridded ionization chamber, with absolute normalization provided by the ^{238}U(n,f) standard. In this energy interval, the measured cross section exhibits a gradual decrease with increasing neutron energy.

This study examines the correspondence between the measured excitation function of the ^{6}Li(n,t)^{4}He reaction and the calculated α+t resonance structure of ^{7}Li in the 3–5 MeV region. By comparing the theoretically derived resonance parameters and phase shifts with the measured cross section, we evaluate the extent to which odd-parity α+t resonant states contribute to the energy dependence of the measured cross section.

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Precise Research of Neutron Decay and the Need to Standard Model Extension

A.P. Serebrov

NRC "Kurchatov Institute" – St. Petersburg Nuclear Physics Institute, Gatchina, Russia 188300

1. An analysis of the latest, most accurate experimental neutron decay data has revealed evidence for the need Standard Model extension by introducing a right vector boson W_R, with a mixing angle with W_L: $\zeta = -0.039 \pm 0.014$ and a ratio of the squared masses of the W_1 and W_2 states: $\delta = 0.070 \pm 0.010$ (i.e., $M_{W_R} = 304^{+24}_{-20}$ GeV).
2. It is shown the result is consistent with collider experiments searching for the hypothetical vector boson.
3. Mixing with opposite angle signs for W^+ and W^- leads to CP violation in baryons and leptons. This is the nature of CP violation.
4. It is shown that it is possible to describe the effects of CP violation in neutral meson decays using the parameters of the extended left-right model: ζ and δ.

Baryonic and Lepton Asymmetries of the Universe

A.P. Serebrov

NRC "Kurchatov Institute" - Petersburg Nuclear Physics Institute, Russia

The formation of baryon and lepton asymmetries in the Universe is considered within the framework of the left-right weak interaction model with CP violation and parameters ζ and δ.

1. Calculations show that at cosmic plasma temperatures above 100 MeV, the oscillation process of neutral mesons is suppressed by the difference in the weak interaction potentials for particles and antiparticles, which is proportional to the asymmetry $A = -2\zeta\delta$.
2. At the same time, the process of meson annihilation is suppressed, and it is at this stage that lepton asymmetry arises, since CP violation causes the preferential decay of antimesons.
3. In the next stage, at temperatures below 50 MeV, the remaining mesons and antimesons annihilate, increasing the degree of lepton asymmetry.
4. The annihilation of neutral mesons is accompanied by the emission of neutrinos and antineutrinos, including sterile (right) neutrinos and antineutrinos, which form dark matter.

Current Status and Experiments of the CSNS and Its Upgrade Project CSNS-II

Sheng Wang

China Spallation Neutron Source, Dongguan, China

The China Spallation Neutron Source (CSNS) is a large-scale scientific facility that has been operational since 2018, providing a powerful tool for neutron scattering research. This extended abstract introduces the current status of CSNS, its nuclear physics experiments, and the upgrade project CSNS-II. CSNS currently operates at 170 kW with high availability and reliability. The upgrade project, CSNS-II, aims to increase the beam power to 500 kW and develop more neutron spectrometers, as well as muon and high-energy proton experimental stations. The abstract also discusses the research areas, user program, and scientific goals of CSNS and CSNS-II.

Nicotine and Minerals Content in Moldavian Tobacco Using UV-Vis, UHPLC and ICP-OES

M. Shvetsova[1*], A. Ciocarlan[2], A. Aricu[2], A. Peshkova[1], I. Zinicovscaia[1,3], M. Deleanu[4]

[1]*Joint Institute for Nuclear Research, 6 Joliot-Curie Str., 141980 Dubna, Russia,* [*]*mks@nf.jinr.ru*
[2]*Moldova State University, The Institute of Chemistry, 3 Academiei Str., 2028 Chisinau, Moldova*
[3]*Horia Hulubei National Institute for R&D in Physics and Nuclear Engineering, 30 Reactorului Str. MG-6, Bucharest - Magurele, Romania*
[4]*Institute of Cellular Biology and Pathology "Nicolae Simionescu" of the Romanian Academy, 050568 Bucharest, Romania*

In present study aimed the quantification of nicotine in ten tobacco varieties (*Molovata*, *Trapezond 209*, *Doina 210*, *Moldavschi 237*, *Virginia 263*, *Moldavschi 272*, *Burley 320*, *Virginia 401*, *Moldavschi 456*, *Jubileu M*) and in the *Nicotiana rustica L.* species of Moldavian origin by ultraviolet–visible spectroscopy (UV-Vis) and ultrahigh performance liquid chromatography (UHPLC), as well as determination of the mineral composition of tobacco samples by inductively coupled plasma–optical emission spectrometry (ICP-OES). Using ICP-OES analysis 14 chemical elements, including Al, S, V, Cr, Mn, Fe, Co, Ni, Cu, Zn, Sr, Cd, Ba, and Hg were identified in the tobacco varieties samples. Among the chemical elements, it is important to highlight the concentrations of cadmium (Cd) and mercury (Hg), due to their high toxicity even at low concentrations. The maximum content of Cd (1.7 mg/kg) was found in *Molovata 72* and the maximum of Hg (0.05 mg/kg) was found in *Moldavschi 237*. According to the UV-Vis and UHPLC analyses, the tobacco samples collectively exhibit a medium-to-low nicotine content. Principal component analysis indicated different sources for the elements determined in the tobacco samples (atmospheric deposition, pesticides, fuel combustion, road dust etc.).

Fabry–Pèrot Filters in Neutron Optics

V.S. Shpilevskaya[1,2*], G.V. Kulin[1,2], A.I. Frank[1,2]

[1] *Joint Institute for Nuclear Research, Russia*
[2] *Dubna State University, Russia*

[*] *shpilevskaya@jinr.ru*

The report is devoted to precision spectrometry of ultracold (UCN) and very cold neutrons (VCN), based on a quantum analogue of the Fabry-Perot optical interferometer, a neutron interference filter (NIF). In the simplest case, the NIF is a potential structure consisting of two barriers and a well between them. Such a structure will be characterized by a narrow sub-barrier transmission.

The creation and use of NIF in experiments with UCN has allowed to carry out a number of important neutron-optical experiments, a brief overview of which will be given in the report.

Additionally, the report discusses the possibility of creating an NIF for VCN and presents the design of such a structure. The key feature of this design is the use of a multilayer periodic structure, a Bragg mirror, as the potential barrier. This design choice is due to the low effective potential of matter compared to VCN energies.

Some Features of ADS, Comparisons, Limitations and Potential Place in the Nuclear Energy System

S.F. Sidorkin[1,*], E.A. Koptelov[1], L.V. Kravchuk[1], A.D. Rogov[2]

[1]*INR RAS, Moscow, Russia, 117312*
[2]*FLNP, JINR, Dubna, Russia*
[*]*sidorkin@inr.ru*

The report discusses the potential place of ADS in the nuclear energy system, the differences and specific features of ADS compared to fast reactors and hybrid fusion plants in the transmutation of minor actinides (MA) and the production of primary fissile materials for nuclear reactors (^{235}U, ^{239}Pu, ^{233}U), the characteristics of various types of neutron targets and optimal proton energy, and possible organizational and technical measures to overcome the main drawback of ADS—high energy consumption for its own needs. An estimate of the threshold ADS multiplication factor above which ADS becomes cost-effective in terms of energy production is presented, as well as the conditions for transmuting the annual production of minor actinides (Am and Cm) a single WWER-1000 reactor unit, with the results extended across multiple units. Possible measures to reduce accelerator requirements and proton beam power through the use of a cascaded ADS scheme are also considered. The possible ADS research facility based on the INR RAS neutron complex infrastructure is being discussed.

Keywords: ADS, cascade subcritical facility, accelerator, proton accelerator targets, transmutation of minor actinides

Simulation of Radiation Transport for Determining Efficiency and Crosstalk in the Multidetector Scintillation System ENGREN

Olga Sidorova, Shakir Zeynalov

Frank Laboratory of Neutron Physics, JINR, Dubna, Russia

The measurement of fast neutron yields in nuclear reactions plays a crucial role in studying fission processes, reaction dynamics, and their applications in nuclear energy and astrophysics. For such investigations, the ENGREN experimental setup was developed at the Joint Institute for Nuclear Research (JINR, Dubna). It consists of 32 EJ-309 liquid scintillator detectors arranged in a spherical configuration around a central fission ionization chamber. In this work, a detailed simulation of radiation transport within the system was performed using the Monte Carlo method. The simulation involves the complete tracking of photons within the Compton scattering energy range, registering events of Compton scattering and photoelectric absorption, and calculating the energy imparted to secondary electrons within the scintillator and detector housings. The main results of the study are the determination of the dependence of the detection efficiency on photon energy, as well as the level and spatial distribution of crosstalk signals between detectors. The obtained data are essential for interpreting future experiments with the ENGREN setup. Furthermore, the developed methodology for modeling and evaluating crosstalk can be applied in the design and analysis of other multidetector scintillation systems.

Single-Particle States of Nucleons in Iron Isotopes Based on Folded Yukawa Potential

D.A. Sitkov*, L.E. Trofimov

National Research Centre "Kurchatov Institute", Moscow, Russia

*sitkovdmitrij@ya.ru

There exist a number of models for nuclear structures allowing for descriptions of various nuclear properties [1]. One of such models is based on the idea of nucleons inside a given nucleus lying in the folded Yukawa potential, accounting for the spin-orbit and the Coulomb interactions [2, 3]. The model can be adapted for different nuclei properties calculations [4].

This work presents calculated single particle nucleon energies of selected even-even isotopes of iron (^{56}Fe, ^{58}Fe, ^{60}Fe) based on spherically symmetrical shape approximation for folded Yukawa potential. These energy levels are suitable to be used by a combinatorial approach of calculating level density of excited states of a nucleus in the frozen core approximation.

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Conversion of the Monte Carlo Neutron Transport Program Code "SHIELD" to Work Together with the 299-Group Cross Sections of Neutron-Nucleus Interactions "ABBN-93"

Sobolevsky N.M., Djilkibaev R.M., Khliustin D.V.*

Institute for Nuclear Research, Russian Academy of Sciences, Russia

**denhlustin@gmail.com*

In the Institute for Nuclear Research of the Russian Academy of Sciences continues work on conversion of the SHIELD Monte Carlo calculation code to work with the 299-group ABBN-93 system of neutron-nucleus interaction constants, the current standard of Rosatom.

In this paper, we calculate neutron leakage spectra and absorption spectra for uranium-238 metallic spheres of various radiuses with a central 14 MeV neutron source. The average neutron energy and lifetime are given for each spectrum. A comparison of calculation results, performed using the 28-group ABBN-78 system and the modern 299-group ABBN-93 system, is discussed.

The calculated spectra provide the opportunity to compare them with the experimental spectra, measured by the TOF method in corresponding integral experiments.

Correction of group constants based on the results of TOF spectrometry of integral experiments is a development of ideas, expressed in the 1980s by Yu.Ya. Stavissky and is one of the main project tasks of the Moscow Meson Factory. The correction can be performed, first of all, within the precision range declared by the authors of the constants, which for ABBN-93 is (+-)0.5%.

Modeling of the Neutron Beam Parameters of the Time-of-Flight Spectrometer GNEIS Using GEANT4

Alexandra Tiagelskaia, Nikita Olkhovich, Alexander Vorobyev

B.P. Konstantinov Petersburg Nuclear Physics Institute of National Research Center "Kurchatov Institute", Russia

The neutron GNEIS time-of-flight spectrometer and pulsed neutron source (intensity ~10^{14} neutrons/s in solid angle 4 π, flash duration about 10 ns, and repetition rate ~50 Hz) based on the SC-1000 proton synchrocyclotron with a beam energy of 1 GeV at NRC "Kurchatov Institute" – PNPI (Gatchina). The neutron beam parameters were modeled by Monte-Carlo method using GEANT4.

Combinatorial Approach to Level Density Modeling and Its Application to Estimate Nuclear Reaction Cross-Sections

L.E. Trofimov*, D.A. Sitkov

National Research Centre "Kurchatov Institute", Russia

*leonidtrofimov001@gmail.com

Nuclei with a moderate number of nucleons form a self-consistent mean field, resulting in appearance of single-particle states, characterized by series of quantum numbers [1, 2]. Current approach consists in the application of folded Yukawa potential [3, 4] as a basis for obtaining single-particle states, configurations of which yield many-body states. One could combinatorially calculate state density $\omega(E)$ as a function of excitation energy U, total angular momentum projection J_Z of a nucleus on the Z-axis and parity P

$$\omega(U, J_Z, P)=\frac{dN(U,J_Z,P)}{dU} \quad (1)$$

and level density, yielding the number of states with a particular angular momentum J:

$$\rho(U, J, P)=\omega(U, J_Z=J, P)-\omega(U, J_Z=J+1, P). \quad (2)$$

To compute nuclear cross section, TALYS software package [5] with the incorporation of calculated level density is used. Reaction ^{56}Fe(n,n'g)^{56}Fe is chosen to be studied due to recent experiment in TANGRA [6] collaboration. Comparison to cross sections based on other level density models is conducted.

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Atomistic Simulation of Neutron Primary Radiation Damage in V-5Cr-5Ti Ternary Alloy

Phuong H.S.M[1], Trung N.T.H[1,2*]

[1]*Dalat Nuclear Research Institute, Vietnam*
[2]*Frank Laboratory of Neutron Physics, JINR, Dubna, Russia*

[*]*trung@jinr.ru*

Vanadium alloys exhibit high resistance to radiation damage at elevated temperatures, making them promising candidates for fusion power applications with long operational lifetimes. Among the three primary alloy classes considered for fusion reactor first-wall applications: vanadium alloys, ferritic-martensitic steels, and austenitic stainless steels, V-Cr-Ti alloys have demonstrated the lowest swelling under neutron and ion irradiation.

In this study, we perform atomistic simulations of primary radiation damage in pure V and the V-5Cr-5Ti ternary alloy at primary knock-on atom (PKA) energies up to 30 keV using a machine-learning interatomic potential (DP-ZBL). Our results demonstrate that, at equivalent PKA energies, the V-5Cr-5Ti alloy produces significantly fewer Frenkel pairs throughout the cascade evolution, exhibits faster defect recovery, and maintains a smaller permanent defect zone than pure V. Notably, displacement cascades in V-5Cr-5Ti are symmetrically distributed, whereas those in pure V extend asymmetrically along specific crystallographic directions. This difference in spatial morphology provides a fundamental explanation for the superior radiation resistance of V-5Cr-5Ti, reinforcing its viability for long-lifetime fusion applications.

Synthesis of Sn-Doped CeO_2 Nanoparticles from Pineapple Leaf Waste for Perovskite Solar Cells

Zikhona Tywabi-Ngeva*

Department of Chemistry, Nelson Mandela University, P.O. Box 1600, Port Elizabeth 6001, South Africa

*zikhonatn@mandela.ac.za

The conventional synthesis of functional materials for energy applications often involves high economic and environmental costs, posing a significant barrier to sustainable technology development. Addressing this challenge, we report a novel, green, and cost-effective route for synthesizing cerium oxide (CeO_2) and tin-doped cerium oxide (Sn-CeO_2) nanoparticles. Utilizing aqueous extracts from pineapple leaf waste as natural reducing and capping agents, this approach not only eliminates the need for hazardous chemical reagents but also valorises agricultural by-products, embodying a true waste-to-resource strategy.

The as-synthesized nanoparticles were comprehensively characterized to evaluate their structural, optical, and thermal properties. X-ray diffraction (XRD) and electron microscopy confirmed the formation of highly crystalline nanoparticles with a cubic fluorite structure. UV-Vis spectroscopy revealed that the incorporation of Sn^{4+} into the CeO_2 lattice induces a significant widening of the optical bandgap from 2.36 eV to 2.98 eV. Furthermore, thermogravimetric analysis showed that Sn-doping markedly enhances the thermal stability of the material compared to pure CeO_2.

When implemented as electron extraction layers (EELs) in perovskite solar cells (PSCs), the Sn-CeO_2 films help more efficient charge transport, attributed to the optimized band alignment and improved material stability. This work presents a sustainable and economically workable pathway for the development of high-performance photovoltaic materials, showing that waste-derived precursors can yield device-grade components for next-generation solar technologies.

Keywords: Green synthesis; Cerium oxide nanoparticles (CeO_2); Tin-doped CeO_2 (Sn-CeO_2), Pineapple leaf waste; Perovskite solar cells (PSCs)

Assessment of Air Pollution in the Vicinity of Thermal Power Plants Using Active Biomonitoring

K. Vergel[1,2*], I. Zinicovscaia[1,3], N. Yushin[1]

[1]*Joint Institute for Nuclear Research, Dubna, Russia*
[2]*Doctoral School of Biological, Geonomic, Chemical and Technological Science, Moldova State University, Alexei Mateevici Str. 30, MD-2009 Chisinau, Republic of Moldova*
[3]*Department of Nuclear Physics, Horia Hulubei National Institute for R&D in Physics and Nuclear Engineering, 077125, Magurele, Romania*

** email: verkn@mail.ru*

Moss bags technique using Sphagnum girgensohnii was applied to examine potential toxic elements atmospheric deposition around the thermal power plants in Chisinau (Republic of Moldova) and Konakovo (Tver region, Russia). Moss Sphagnum was collected in pristine area in Tver region. In both locations the moss-bags were exposed during winter period while actively used central heating (November-March). The content of 24 elements in exposed and unexposed moss samples: Na, Cl, K, Ca, Sc, V, Cr, Mn, Fe, Co, Ni, Zn, As, Br, Rb, Sr, Sb, Ba, La, Ce, Hf, W, Th and U was determined using neutron activation analysis. Significant monthly accumulation of several elements in the exposed moss bags compared to the unexposed one was observed. Content of V, U and Th, tracers of combustion fuel in thermal power plants, increased up from 2 to 7 times. The accumulation level depends on the type of fuel used at the plants.

Keyword: moss bags biomonitoring, power plants neutron activation analysis

Some Features of the Development of High-Power Periodic Pulsed Reactors

A.E. Verhoglyadov*

FLNP, Joint Institute for Nuclear Research, Dubna, Russia

**verhoglyadov_al@mail.ru*

Periodic pulsed reactors are unique research neutron sources. They are used for research in solid state physics, nuclear physics and radiation research. A reactor of this type is a complex dynamic system with many feedbacks. The operating experience of the IBR-2M reactor and its predecessors (IBR-2, IBR-30) shows that in periodic pulsed reactors, under certain conditions, unstable dynamics of power pulses is observed. Several physical phenomena that cause feedback and can lead to unstable dynamics were discovered and described. To study the features of a periodic reactor and to design a new source, an adequate mathematical model of reactor's dynamics is required. The model is also need for safe operation of existing facilities.

The purpose of the review report is to examine the main stages of designing a pulsed reactor from the point of constructing a model of dynamics. To accurately reproduce the observed behavior of the reactor and predict different operating modes, the model must be based on precise data and complete understanding of all significant processes in the active zone. Nuclear and thermal properties of fuel, thermomechanics of the active zone, coolant hydrodynamics and burnout effects — all these factors should be investigated and included into the computational code. The model should calculate transient processes over small and large time scales within reasonable computing time. Models of dynamics used for previous-generation reactors are reviewed. The design of a new high-power periodic pulsed reactor and problems of constructing its model are discussed.

Analysis of the Power Feedback of the IBR-2M Reactor

V. Verhoglyadova*

Frank Laboratory of Neutron Physics, Joint Institute for Nuclear Research, Dubna, Russia

*zobrlkzak@yandex.ru

A sufficiently developed model of reactor dynamics is needed for the safe and reliable operation of the IBR-2M reactor, as well as for the design of a new neutron source. Feedbacks occur when any parameters change. They play an important role in a pulsed periodic reactor. The method of describing power feedback requires careful research. Some physical processes that occur in the reactor core and lead to feedback have been described. These processes are considered to be independent.

The purpose of this work is to build a model of fast (up to 30 sec) power feedback of a pulsed periodic reactor in terms of the theory of automatic control using the known physical processes, which are the source of feedback reactivity. To achieve this goal, a block diagram of a fast power feedback was constructed based on the three physical processes: fuel expansion, bending of the fuel assembly and expansion of the upper part of the active zone. For each block in the diagram, differential equations were written to describe the process corresponding to that block. The transfer functions for each block and the impulse response for the whole diagram were obtained.

Dr.Sai-RongZai: LLM Based Neutron Scattering Data Analysis Agent

H. Wang[1], Q.M. Li[2], D. B. Xiong[2], Z.D. Zhang[1], R. Du[1,2*]

[1]*China Spallation Neutron Source, China,* [*]*durong@ihep.ac.cn*
[2]*Institute of High Energy Physics, Chinese Academy of Sciences, China*

Neutron scattering serves as a "super microscope" for exploring the microscopic structure of matter, particularly suited for studying materials containing light elements, magnetic structures, and dynamic behaviors. The China Spallation Neutron Source (CSNS), China's first and the world's fourth pulsed spallation neutron source, is a large-scale platform for multidisciplinary research in cutting-edge fundamental studies and national strategic development fields. The high-flux neutrons generated by CSNS provide unique research tools for material science, physics, chemistry, and biology. However, the vast, multidimensional, and multimodal neutron scattering data heavily relies on researchers' experience and iterative trial-and-error for its standardization and in-depth analysis, becoming a critical bottleneck that constrains scientific discovery efficiency. CSNS is developing a multi-agent scientific research collaboration system integrating perception, analysis, modeling, and discovery—Dr. Sai-RongZai—aimed at becoming an efficient intelligent assistant for scientists. By enhancing analytical capabilities through human-machine collaboration and unleashing scientific creativity, it will jointly advance the frontier exploration of neutron science. Currently, the core development and validation of the Dr.Sai-RongZai neutron powder diffraction data refinement analyst have been completed. This intelligent agent utilizes the internationally recognized refinement tool GSAS-II as its tool, driven by a large language model (LLM) to facilitate task comprehension, parameter decision-making, and iterative optimization. Unlike traditional automated refinement tools that follow fixed procedural workflows, this agent dynamically adjusts optimization strategies by integrating domain knowledge with refinement feedback through LLM. Additionally, the deep synergy between tools and models preserves GSAS-II's high reliability in structural refinement while addressing the "decision-making deficiency" of conventional tools via LLM, creating a collaborative advantage of "intelligent decision-making + precise execution."

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First Extraction Neutron Capture Cross Sections for Unstable Nuclei ^{88}Y and ^{153,159}Gd

Wen Luo[1,2*], Shutong Zhang[1,2], Zhicai Li[1,2], Danyang Pang[3], Jing Feng[4]

[1]*School of Nuclear Science and Technology, University of South China, Hengyang 421001, Hunan, China*

[2]*Key Laboratory of Advanced Nuclear Energy Design and Safety, Ministry of Education, Hengyang, 421001, China*

[3]*School of Physics, Beihang University, Beijing, 100191, Beijing, China*

[4]*Key Laboratory of Nuclear Data, China Institute of Atomic Energy, Beijing, 102413, Beijing, China*

[*]Email address: wenluo-ok@163.com

Neutron capture (n,γ) cross sections of unstable nuclei are critical to astrophysics research, nuclear reactor designs and medical applications. However, the available (n,γ) data on unstable isotopes are scarce and direct measurement is challenging [1−3]. In this work, we propose an approach to infer the (n,γ) cross sections by constraining both the γ-ray strength functions (γSFs) and nuclear level densities (NLDs).

We first extract ^{88}Y(n,γ) cross sections using the (p, p'γ) surrogate reaction with proper treatment of the spin-parity distribution of the compound nucleus (CN) ^{89}Y [4]. Experimental data of both γ-decay probability and γSF are used to constrain the nuclear model parameters within a computational framework combining the Bayesian optimization (BO) and Markov chain Monte Carlo method. As a result, the ^{88}Y(n,γ) cross sections are successfully extracted with a narrow uncertainty of 7.6%−23.1% within neutron energy range of 0.01 to 3.0 MeV for the first time. Moreover, our method is verified with the ^{88}Sr(p,γ) reaction, of which the measured data are available for comparison.

Using neighboring stable-isotope data, we further extract the unstable ^{153,159}Gd(n,γ) data by constraining corresponding γSFs and renormalizing microscopic level densities through BO [5]. The resulting uncertainty is about 30%, which is significantly reduced by a factor of 5.5 compared to a large uncertainty of ~167% predicted with different nuclear models in TALYS. We then calculate the astrophysical reaction rates for the ^{153,159}Gd isotopes, and find that the ^{159}Gd(n,γ) rate is larger by a factor of ~2.9 than the JINA REACLIB recommendations [6], which increases the resulting ^{160}Gd abundance by a factor of ~2 in *s*-process nucleosynthesis simulations.

Our approach is promising for extracting (n,γ) data on a wider range of unstable isotopic chains, as well as for essential astrophysical reaction-network calculations and nuclear science applications. As surrogate reaction experiments are becoming widely available, it may open interesting perspectives on the matter of extracting (n,γ) reaction cross sections on more unstable nuclei of interest.

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Cross Section Measurements for the $^{19}F(n, \alpha)^{16}N$ and $^{20}Ne(n, \alpha)^{17}O$ Reactions in the MeV Region

Wenkai Ren[1], Yu.M. Gledenov[2], I. Chuprakov[2], E. Sansarbayar[2], Jie Liu[1], Zepeng Wu[1], Cong Xia[1], G. Khuukhenkhuu[3], L. Krupa[2], Wentian Cao[1], Tieshuan Fan[1], Guohui Zhang[1]

[1] *State Key Laboratory of Nuclear Physics and Technology, Institute of Heavy Ion Physics, School of Physics, Peking University, Beijing 100871, China*

[2] *Frank Laboratory of Neutron Physics, Joint Institute for Nuclear Research, Dubna 141980, Russia*

[3] *Nuclear Research Centre, National University of Mongolia, Ulaanbaatar, Mongolia*

The fluorine-lithium-berillium (FLiBe) is used for cooling in the Molten Salt Reactor (MSR), which is one of the Generation IV nuclear reactors. The F element is present in large quantities in the reactor, so accurate $^{19}F(n, \alpha)^{16}N$ cross sections are important for the development of the reactor technology. The cross sections of $^{20}Ne(n, \alpha)^{17}O$ reaction are key to improve the nuclear reaction theory. In this work, gas samples and a twin gridded ionization chamber (GIC) were used to measure the cross sections of the $^{19}F(n, \alpha)^{16}N$ and $^{20}Ne(n, \alpha)^{17}O$ reactions. Measurements were performed based on the Van de Graaff accelerator EG-5 at the Frank Laboratory of Neutron Physics, Joint Institute for Nuclear Research. Quasi-monoenergetic neutrons were produced by a deuterium gas target via the $^{2}H(d, n)^{3}He$ reaction. The GIC was used as charged particle detector to measure the (n, α) reaction events. The 99%Kr + 1%CF_4 gas and 89%Kr + 10%Ne + 1%CH_4 gas were used for the measurement of the two reactions. The cross sections of the $^{19}F(n, \alpha_{0\sim3})^{16}N$ reaction were obtained in the neutron energy from 3.8 MeV to 5.5MeV (12 energy points), which were consistent with the previous measured results. The cross sections of the $^{20}Ne(n, \alpha_0)^{17}O$, $^{20}Ne(n, \alpha_1)^{17}O$ reactions were obtained in the neutron energy from 3.8 MeV to 5.5MeV (11 energy points).

Progress in Neutron Capture Cross Section Measurement at University of South China

Xinxiang Li

University of South China, China

Understanding the formation of elements beyond iron is a central goal of nuclear astrophysics. As a primary nucleosynthesis pathway, the s-process produces about half of the universe's heavy elements. We review the systematic measurements of heavy-element neutron capture cross-sections performed by the group of University of South China at the CSNS Back-n facility over the last 7 years, followed by an introduction to upcoming research initiatives.

Neutron Leakage Spectra Benchmark of Spherical Iron Sample with a CF-252 Fission Source

Kuo-Zhi Xu[1,2], Chang-Lin Lan[1], Yu-Ting Wei[1], Yang-Bo Nie[2], Xiao-Dong Pan[1], Yan-Yan Ding[2], Shi-Yu Zhang[1,2], Hao-Nan Li[1], Bo Gao[1], Shi-Hao Kang[1], Jiang-Long Pan[1], Xi-Chao Ruan[1], Shi-Long Liu[1]

[1]*School of Nuclear Science and Technology, Lanzhou University, Lanzhou, 730000, China*
[2] *Key Laboratory of Nuclear Data, China Institute of Atomic Energy, Beijing 102413, China*

High-accuracy neutron nuclear data are essential for neutron transport calculations, radiation shielding design, and advanced reactor development. Iron (Fe), as an important structural material in nuclear systems, plays a significant role in neutron transport and shielding analysis [1]. However, discrepancies still exist among the evaluated nuclear data libraries, especially in the fast neutron energy region. In this work, shielding integral benchmark experiments were carried out using spherical natural iron samples with diameters of 12 cm, 24 cm, and 36 cm based on a ^{252}Cf spontaneous fission neutron source. The neutron leakage spectra were measured using the time-of-flight (TOF) method. EJ-309 and CLYC detectors were employed to cover neutron energy ranges of 0.80–8.00 MeV and 0.15–0.80 MeV, respectively. The measured neutron leakage TOF spectra were compared with Monte Carlo simulations performed using the MCNP code with cross-section data from four major evaluated nuclear data libraries: ENDF/B-VIII.1, CENDL-3.2, JEFF-3.3, and JENDL-5 [2−5]. The calculated-to-experimental (C/E) ratios were analyzed over the energy region of 0.80–8.00 MeV. The results show that the JENDL-5 library provides the best agreement with experimental data, followed by ENDF/B-VIII.1, while JEFF-3.3 and CENDL-3.2 exhibit relatively larger deviations. The discrepancies are mainly related to differences in elastic and inelastic scattering cross sections in the evaluated libraries. This work provides valuable benchmark data for the validation and improvement of evaluated nuclear data libraries for ^{nat}Fe in the fission neutron energy region and demonstrates the effectiveness of ^{252}Cf-based shielding integral experiments for nuclear data benchmarking.

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The History of the Development and Use of Neutron Activation Analysis in Medical and Biological Research in the USSR and Russia

V. Zaichick*, M. Frontasyeva, I. Zinicovscaia

Frank Laboratory of Neutron Physics, Joint Institute for Nuclear Research, Dubna, Russia
**e-mail: vzaichick@gmail.com*

The year 2026 marks exactly 100 years since György de Hevesy, a professor of physical chemistry at the University of Freiburg, used radioactive phosphorus in experiments on rats. Using a radioactive tracer, he measured the accumulation of phosphorus in bones and teeth and determined the rate of tumor growth. This research method, known as the "tracer method" gave rise to a new field of science—nuclear medicine. For this discovery György de Hevesy received the Nobel Prize in Chemistry in 1943. The year 2026 also marks the 90th anniversary of another discovery by this great scientist, which also made a significant contribution to the arsenal of nuclear medicine methods. In 1936, György de Hevesy, working at the Niels Bohr Institute for Theoretical Physics in Copenhagen, discovered with Hilda Levy that stable chemical elements (ChE) become radioactive when exposed to neutrons. They concluded that the gamma radiation's energy and half-life could be used to identify the presence of a chemical element in a substance, and its quantity could be determined from the radiation intensity. This method was called neutron activation analysis (NAA).

Given György de Hevesy's enormous contribution to the emergence and development of nuclear medicine methods and the scope of the ISINN-32 seminar, this review will focus on a historical overview of the use of NAA in biomedical research conducted in the USSR and the Russian Federation. Biomedical research was defined as work that used NAA to determine the ChE content in fluids, tissues, organs, and throughout the body of humans and animals, as well as in the cells, subcellular structures, and biomolecules of these organisms, for medical purposes.

In the USSR, the first NAA research was conducted at the heavy-water research reactor (HWR), which was commissioned at the Institute of Theoretical and Experimental Physics (ITEP) in 1949 and, after reconstruction in 1955, had a capacity of 2.5 MW. In the mid-1950s, at the insistence of Professor A.P. Alexandrov, a member of the USSR Academy of Sciences, the government decided to build 20 research reactors of the VVR and IRT types. By the mid-1960s, all planned reactors had been built and commissioned. In addition, in 1959, the BR-5, Europe's first fast neutron research reactor, was launched at the IPPE in Obninsk, and in 1960, the IBR-1, Europe's first pulsed reactor, was launched at the JINR in Dubna. NAA laboratories were established at many research centers based on these reactors. In the USSR NAA were most intensively used in biomedical research at the Institute of Medical Radiology of the USSR Academy of Medical Sciences (IMR) in Obninsk, the Moscow Engineering Physics Institute (Moscow), and the Nuclear Physics Institutes of the Uzbek SSR (Ulugbek), the Georgian SSR (Tbilisi), the Kazakh SSR (Alma-Ata), and the Latvian SSR (Salaspils). After the Chernobyl disaster, and especially after the collapse of the USSR, many research reactors were closed. In the Russian Federation, the use of NAA in biomedical research continued primarily at the JINR Laboratory of Neutron Physics. The review will present the main achievements obtained with the help of NAA in biomedical research.

Absolute Yield Measurement of the Long-Range Alpha Particles in Ternary Fission of ^{235}U Induced by 3.2 MeV Neutrons Using a Twin-Gridded Ionization Chamber

Zepeng Wu[1,2], Jie Liu[1], Haofan Bai[1], Cong Xia[1], Wenkai Ren[1], Guohui Zhang[1*], Quanlin Shi[2], Yu.M. Gledenov[3], E. Sansarbayar[3,4], G. Khuukhenkhuu[4], I. Chuprakov[3, 5]

[1]*State Key Laboratory of Nuclear Physics and Technology, Institute of Heavy Ion Physics, School of Physics, Peking University, Beijing 100871, China*

[2]*National Key Laboratory of Intense Pulsed Radiation Simulation and Effect, Northwest Institute of Nuclear Technology, Xi'an 710024, China*

[3]*Frank Laboratory of Neutron Physics, Joint Institute for Nuclear Research, Dubna 141980, Russia*

[4]*Nuclear Research Centre, National University of Mongolia, Ulaanbaatar, Mongolia*

[5]*The Institute of Nuclear Physics, Ministry of Energy of the Republic of Kazakhstan, Almaty 050032, Kazakhstan*

*Corresponding author: guohuizhang@pku.edu.cn

The absolute yield of the long-range alpha particles in ternary fission of ^{235}U by 3.2 MeV neutrons was measured using a twin-gridded ionization chamber. The experimental result shows that the long-range alpha particles can be separated obviously in the cathode amplitude vs anode amplitude two-dimensional spectrum. However, there is also interference from thermal neutrons, epithermal neutrons, and low-energy fast neutrons. The liquid scintillation detector and the CLYC6 scintillation detector were used to determine the fraction of thermal neutrons, epithermal neutrons, and low-energy fast neutrons. Finally, the absolute yield of the long-range alpha particles can be obtained, which is $(1.88 \pm 0.11)\times10^{-3}$. The result is discussed and compared with previous measurements.

Recent Parity Violation Measurement Using the GTAF BaF_2 γ-Spectrometer on the CSNS Back-n Beamline

Mofan Zhang*

China Spallation Neutron Source Science Center, China

*zhangmf@ihep.ac.cn

The NOPTREX collaboration, focusing on parity violating and time-reversal violating measurements in the neutron-nucleus interaction, performed an experiment testing the upgrades to the Back-n beamline in October of 2025 aiming to prepare for the precise measurement of future parity violation in the compound nucleus reaction. The upgrades include an adiabatic spin flipper for neutron spin manipulation, spin transport coils added to existing vacuum pipes and collimator #2 along with the placement of an existing ^{3}He neutron polarization device utilizing existing neutron shielding materials to reduce scattering background into the GTAF BaF_2 γ-spectrometer. This experiment tested this upgraded setup by measuring the system's spin transport efficiency of the two spin flip states and neutron polarization near target sample position. This experiment also performed a preliminary parity violating longitudinal asymmetry (A_L) measurement on natural La sample. The resulting $A_L$value is $7.8\% \pm 2.4(stat.) \pm 0.3(sys.)\%$ for the 0.74eV p-wave resonance of ^{139}La. The spin transport efficiencies, neutron polarization and A_L values are reported in a paper submitted to Science China (preprint: https://doi.org/10.48550/arXiv.2602.17742).

A novel A_L analysis method based on multiplicity information of (n, γ) events will be discussed along with details of this experiment and future upgrade plans.

Shielding Integral Experiments of Bismuth Slabs and Spheres for Nuclear Data-Library Validation under Multi-Spectrum Sources

Shi-Yu Zhang[1,2], Zheng Wei[2], Yan-Bo Nie[1,2], Yan-Yan Ding[1]

[1]*Key Laboratory of Nuclear Data, China Institute of Atomic Energy, Beijing 102413, China*

[2] *School of Nuclear Science and Technology, Lanzhou University, Lanzhou, 730000, China*

Bismuth is a critical material for advanced nuclear systems, particularly in lead-bismuth eutectic (LBE) cooled reactors and accelerator-driven systems (ADS). To systematically evaluate and validate current evaluated nuclear data for Bismuth, a comprehensive series of shielding integral experiments was conducted, utilizing multiple neutron sources and geometric configurations.

The experimental campaign consists of three distinct components designed to isolate specific scattering mechanisms and cover a broad energy range. First, slab-geometry experiments driven by a 14 MeV D-T neutron source were performed to measure angular neutron leakage spectra. Second, spherical-geometry leakage experiments under both D-T and 3 MeV D-D neutron sources were conducted to minimize lateral leakage effects. These accelerator-based experiments were carried out at the China Institute of Atomic Energy (CIAE) using the time-of-flight (TOF) technique. Finally, to extend the macroscopic validation to the spontaneous fission spectrum, a spherical integral experiment driven by a Cf-252 source was performed at Lanzhou University.

The measured TOF leakage spectra across all configurations were compared with Monte Carlo simulations using the MCNP code and several major evaluated nuclear data libraries worldwide. The integrated analysis reveals clear energy and angle dependent discrepancies between the experimental data and the simulations. For instance, under the 14 MeV D-T irradiation, predictions for elastic scattering show acceptable agreement at forward angles but exhibit pronounced discrepancies at larger scattering angles. Furthermore, the results highlight that across the investigated spectra, there is still significant room for improvement in the current evaluated data regarding the angular distribution of inelastic scattering and the secondary neutron energy spectrum of the (n,2n) reaction.

By combining D-T, D-D, and Cf-252 neutron spectra with both slab and spherical geometries, this systematic dataset provides robust and high-fidelity feedback for the future refinement and optimization of Bismuth evaluated cross-sections.

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Key Technologies for Mono-Energy and High-Intensity Neutron Source Based on HV-RF Linear Accelerator

Zheng Wei

Lanzhou University, China

The accelerator-based D-D/D-T fusion neutron source, with mono-energy and high-intensity, is the key equipment to carry out the advanced research of neutron physics and neutron application technology, which has important significance in serving the major strategic needs of the country and the national economy. This project put forward the technical proposal of mono-energy and high-intensity neutron source based on HV-RF linear accelerator, with high neutron yield (more than 5.0E+12 n /s), multi-mono-energy neutrons (providing more than 10 kinds of neutrons with energy less than 20 MeV), etc., which is a neutron science facility scheme with international advanced level. This project intends to carry out the physical design of the HV-RF linear accelerator and development of key components, research on the preparation process of high deuterium-titanium ratio adsorption target, research on the magnetic fluid vacuum sealing technology of high power water-cooled rotating target, experimental measurement and evaluation of neutron radiation fields of D-D/D-T neutron source, etc., which will lay a solid foundation for the engineering construction of mono-energy and high-intensity D-D/D-T accelerator neutron source. This research project will also provide reliable neutron source for basic research of neutron physics, new nuclear energy utilization system research and development, strategic nuclear device research and development, fusion device research and development, nuclear technology application, etc., which has greater scientific value and application prospect.

Investigation of the Elemental Composition of the State Standard Samples SChS-1 and SLg-1 according to the Certification Program of the A.P. Vinogradov Institute of Geochemistry SB RAS by Neutron Activation Analysis at the IBR-2 Reactor and IREN Facility (JINR, Dubna), and the WWR-K Reactor (INP, Kazakhstan)

E.A. Zhukova, N.V. Lobacheva, A.Yu. Dmitriev*, O.S. Philippova

FLNP, Joint Institute for Nuclear Research, Dubna, Russia

*andmitriev@jinr.ru

Within the framework of an interlaboratory program initiated by the A.P. Vinogradov Institute of Geochemistry SB RAS, the re-certification of the elemental composition of the State materials of rocks SChS-1 (shales) and SLg-1 (leucogranite) was carried out. A wide range of laboratories using various analytical techniques was involved in the work. Several laboratories used neutron activation analysis (NAA), one of the most sensitive and accurate technique, which is recognized as a reference one.

The Sector for Interdisciplinary Investigations of Cultural Heritage at the Frank Laboratory of Neutron Physics of the Joint Institute for Nuclear Research participated in this study. To carry out NAA, the studied samples were irradiated at three research facilities: the IBR-2 pulsed reactor and the IREN facility (JINR, Dubna, Russia), as well as the WWR-K reactor (Institute of Nuclear Physics, Almaty, Kazakhstan). Using three independent experimental facilities data were obtained providing a reliable basis for verifying the results, as well as for improving the statistical reliability of the final certification characteristics of the reference materials.

Neutron Activation Analysis at the IBR-2 Reactor

I. Zinicovscaia[1,2*]

[1]*Joint Institute for Nuclear Research, 6 Joliot-Curie Str., 141980, Dubna, Russia*
[2]*Horia Hulubei National Institute for R&D in Physics and Nuclear Engineering, 30 Reactorului Str., MG-6, Bucharest - Magurele, Romania*
[*]*e-mail: zinikovskaia@mail.ru*

Neutron activation analysis due to its high accuracy, reproducibility and nondestructive nature is a technique widely used in the environmental, material, archeological, geological and nanotoxicological studies. Favorable features of neutron activation analysis will be highlighted in the presentation and the principal of its realization on the installation REGATA of the IBR-2 reactor will be presented. Examples of application of neutron activation analysis as well as complimentary technique for the assessment of heavy metal deposition using active and passive moss biomonitoring, water biomonitoring and development of the approaches for wastewater treatment, medicinal plants analysis will be given. Besides, the effects of metal nanoparticles on different living organisms will be discussed. The information is addressed to researchers interested in the applications of neutron activation analysis or to those who are searching for an analytical technique suitable for environmental, biomedical, geological, etc. studies.

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Abstracts

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E-mail: publish@jinr.ru
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