Working symposium on investigations of nuclei by means of neutrons, March 12–14, 1991, Dubna

Yu. P. Popov, V. P. Furman, and Yu. M. Gledenov

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The annual Working Symposium on Investigations of Nuclei by Means of Neutrons took place during March 12–14, 1991 at the Laboratory of Neutron Physics of the Joint Institute for Nuclear Research at Dubna. About 50 scientists from more than ten institutes in the USSR and also scientists from the USA, China, Japan, Czechoslovakia, and Poland took part.

The symposium was opened by V. L. Aksenov, director of the Laboratory of Neutron Physics. He emphasized the great importance of collaboration in science, especially under modern conditions.

Yu. P. Popov gave an invited talk entitled "Design of a high-resolution neutron source." There is in operation at Dubna one of the best spectrometers of resonance neutrons in the world. It is based on a combination of the linear electron accelerator LUÉ-40 and the low-power (10 kW) pulsed reactor IBR-30 and has a well-developed infrastructure of measurement pavilions and flight bases from 10 to 1000 m with varied measuring apparatus in seven neutron beams. Investigations with these facilities are made by many institutes of the USSR and participating countries of the JINR, and also scientists from other countries. The speaker demonstrated the need and value of the construction at the Laboratory of Neutron Physics of a new high-precision neutrino souce with optimally high energy resolution (NIVR project), the realization of which in the next few years will permit physicists at the JINR to maintain leading positions in the field of neutron nuclear physics; the speaker also proposed the idea of using the new source as the basis of an international center for research on resonance and slow neutrons. This idea is also attractive on account of its cheapness, since it proposes replacement of the old injector, a linear electron accelerator, by a new accelerator without any construction work and without change of the flight bases and other infrastructure of the existing neutron spectrometer.

The program of the symposium also included reports on topical fields of neutron nuclear physics—radiative capture of resonance neutrons, fission physics, study of *P*-even and *P*-odd angular correlations of products of reactions induced by neutrons, the interaction of fast neutrons with nuclei, and the fundamental properties of the neutron. Both methodological and physical results were presented.

V. A. Khitrov (JINR) reported rich new experimental possibilities of multidetector systems in study of complicated cascade γ decay. The Dubna group that he represented has already obtained first results from investigation of the radiative strength function for dipole γ transitions between highly excited nuclear states. The new method makes it possible for the first time to carry out a systematic test, for a large number of nuclei, of the Axel–Brink hypothesis of the identity of giant electric dipole resonances formed from states of different natures.

In an interesting paper "Capture of thermal neutrons," S. Raman (USA) reviewed modern methodological possibilities in γ spectroscopy based on thermal neutrons and presented the systematics of γ transitions from compound states of light nuclei, in which direct capture plays an important part.

The collaboration formed by the I. V. Kurchatov Institute of Atomic Energy and FÉN (USSR), the Institute of Nuclear Research of the Bulgarian Academy of Sciences, and the Laboratory of Neutron Physics of the JINR presented first results of investigation of variations of the multiplicity distributions of the γ rays from radiative capture in neutron resonances of ^{147}Sm and ^{148}Sm.

O. A. Shcherbakov (Leningrad Institute of Nuclear Physics) reported measurements of the (n, γ) reaction in ^{238}U resonances made with the spectrometer GNEĬS at Gatchina. Analysis of these measurements has led to advance in the understanding of the nature of these states, which in recent years have been the subject of interest of many investigators.

A. V. Murzin (Institute of Nuclear Research, Ukrainian Academy of Sciences) reported new results and plans for the investigation of radiative capture of filtered neutrons.

Various problems were considered in papers on fission. A. A. Goverdovskiĭ (Physics and Power Institute, Obninsk) reviewed recent studies made at Obninsk using a beam of fast ($E_n \approx 1$–2 MeV) neutrons. An original formulation of the experiments made it possible to obtain unexpected results on the influence of nuclear viscosity in below-barrier fission of actinides. Several reports from the Laboratory of Neutron Physics of the JINR (N. A. Gundorin and U. Gos) and also of the collaboration between the Physics and Power Institute (USSR), the Darmstadt Technische Hochschule (Germany), and the Laboratory of Neutron Physics of the JINR were devoted to investigation of fluctuations of various characteristics of neutron-induced fission in isolated compound states. For the first time, spectrometry based on prompt fission γ rays has made it possible to measure fluctuations of the independent fragment yields at ^{239}Pu resonances and the multiplicities

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of γ rays at ^{235}U and ^{237}Np resonances. Analysis of these results confirms the model proposed at the Laboratory of Neutron Physics, which explains the coupling between the channels and fission modes.

Results that are very important for understanding the fission mechanism and for applied problems were presented by I. A. Ivanin (All-Union Institute of Power Physics). A pulsed neutron source at Arzamas was used to measure with high accuracy for some actinide nuclei the mean number of prompt neutrons of fission induced by neutrons with energy in the interval from 0.5 to 12 MeV.

V. E. Sokolov (Leningrad Institute of Nuclear Physics) reported an observation made by means of the forward–backward angular correlation of fission fragments of energy irregularities in the cross section of the (n, f) reaction. These could be interpreted as the manifestation of strong p-wave neutron resonances. It is planned to continue these experiments at the Laboratory of Neutron Physics at the JINR, where more accurate results can be obtained by virtue of the high intensity of the beam of resonance neutrons.

Bao Shan Lian (Chinese People's Republic) reported a beautiful experiment to measure the angular distribution of inelastically scattered neutrons in the reaction $^{7}Li(n, n', \gamma)$ (478 keV) from an analysis of the shape of the Doppler shift of the spectrum of γ rays at 14.9 MeV. The experiment was made at the University of Peking.

Several papers [O. T. Grudzevich (IATÉ), G. Khuukhénkhuu (Laboratory of Neutron Physics at the JINR, Yu. V. Porodzinskiĭ (Institute of Nuclear Power), and Yu. L. Parfenov (Institute of Nuclear, Physics Moscow State University] were devoted to theoretical and experimental investigations of the interaction of fast neutrons with nuclei.

S. S. Parzhitskiĭ (Laboratory of Neutron Physics at the JINR) described a 48-section detector for measuring the P-odd angular correlation in capture of polarized thermal neutrons with emission of charged particles; it has been successfully used in joint experiments with the Leningrad Institute of Nuclear Physics.

A clear analysis of the situation with regard to P-odd effects in nuclei and with regard to neutral currents was given by V. A. Vesna (Leningrad Institute of Nuclear Physics).

A. B. Laptev (Leningrad Institue of Nuclear Physics) reported an estimate of the electric polarizability of the neutron made on the basis of a measurement of the energy dependence of the total cross section for interaction of neutrons with the ^{208}Pb nucleus in a joint experiment of the Laboratory of Neutron Physics at Dubna and the Leningrad Institute of Nuclear Physics.

S. B. Gerasimov (Laboratory of Theoretical Physics at the JINR) gave a talk on theoretical estimates of the possibility of using bremsstrahlung in the scattering of fast neutrons by nuclei. In principle, measurement of its characteristics can yield values of the nuclear polarizability of the neutron.

K. D. Tolstov (Laboratory of High Energies at the JINR) considered the currently popular problem of the transmutation of fission products and concluded that this possibility of eliminating waste products of nuclear power is still far from practical realization.

After a general discussion, the participants of the symposium adopted an Appeal (see the following News Item) to the leading organs responsible for financing fundamental and applied science.

The next symposium is planned for April 1992 at Dubna.

Translated by Julian B. Barbour

Appeal of working symposium on investigations of nuclei by means of neutrons (Dubna, March 12–14, 1991)

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The symposium on the study of nuclei by means of neutrons demonstrated a number of original scientific results and new methodological approaches in the study of fundamental nuclear interactions, the mechanism of nuclear reactions, and the structure of highly excited states, and it demonstrated the good prospects and the scientific and practical importance of investigations by means of neutrons.

Bearing in mind the difficult financial situation in the coming years in the Soviet Union and other participating countries of the Joint Institute for Nuclear Research, the participants of this Symposium believe it is expedient to concentrate their efforts on the most promising directions of research and to cooperate in order to make the best use of the minimal financial possibilities of the individual institutes in order to make a better claim for support from the state fund for fundamental research and other funds.

There is in operation at Dubna one of the best resonance neutron spectrometers in the world. It is based on an original combination of a linear electron accelerator and a pulsed nuclear reactor, and it possesses a very rich infrastructure of measurement pavilions with varied and often original detecting and analyzing apparatus in seven neutron beams. Many institutes of the USSR and participating countries in the JINR take part in investigations with these facilities.

In view of the difficult situation for experimental research with neutrons, especially in the Moscow region (closing of research reactors), it would be very timely and promising to develop at the Laboratory of Neutron Physics at the JINR the cheap (10 million roubles at 1990 prices) high-precision, high-resolution neutron source (NIVR project), in which scientists from nuclear institutes of various authorities are interested. The Symposium believes it is necessary to support this project and appeals to the Nuclear Physics Section of the USSR Academy of Sciences, the MAÉP, and State Committee of the USSR Council of Ministers on Science and Technology with the request to participate in the financing during 1991–94 of this project, which will make it possible to create a source of resonance neutrons with record parameters and unique possibilities not only in the USSR but also in Europe and Asia.

The Symposium requests the directors of the Joint Institute to do everything possible to implement the NIVR project, which will make the Joint Institute more attractive for the participating countries.

Signed on behalf of the Symposium by: P. A. Krupchitskiĭ (Institute of Theoretical and Experimental Physics), G. V. Danilyan (Institute of Theoretical and Experimental Physics), A. V. Ignatyuk (Physics and Power Institute), and Yu. P. Popov (Joint Institute for Nuclear Research).

Translated by Julian B. Barbour

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