Meetings and Conferences

JOINT SCIENTIFIC SESSION OF THE DIVISION OF GENERAL PHYSICS AND ASTRONOMY OF THE USSR ACADEMY OF SCIENCES AND OF THE DIVISION OF NUCLEAR PHYSICS

(28—29 October 1970)

Usp. Fiz. Nauk 104, 167-172 (May, 1971)

A scientific session of the Division of General Physics and Astronomy and of the Division of Nuclear Physics of the USSR Academy of Sciences was held 28 and 29 October 1970.

The following papers were delivered:

1. S. S. Polikanov. Isomerism of Nuclear Shapes.
2. V. M. Lobashov. Weak Nucleon-nucleon Interactions.
3. A. A. Abrikosov and S. D. Beneslavskiĭ. Possible Existence of Substances Intermediate between Metals and Dielectrics.
4. R. A. Zhitnikov. Research on Optical Orientation of Atoms and Its Use for the Development of Quantum-electronics Devices.
5. V. B. Anzin, M. S. Bresler, V. G. Veselago, Yu. V. Kosichkin, G. E. Pikus, I. I. Farbshteĭn, and S. S. Shalyt. Experimental Observation of Magnetic Breakdown in Semiconductors.
6. L. A. Artsimovich. The problem of Controlled Thermonuclear Fusion.
7. M. S. Rabinovich. Stellarator Program.
8. O. N. Krokhin. Use of Lasers for Plasma Heating.
9. L. I. Rudakov. Use of Powerful Electron Beams for the Problem of Controlled Thermonuclear Fusion.

We publish below the brief contents of some of the delivered papers.

S. M. Polikanov. Isomerism of Nuclear Shapes.

More than 20 spontaneously-fissioning isomers have been synthesized by now. Experimental investigations of the properties of these isomers have shown that the energy of the isomers is quite large (~ 3 MeV) and the spin is small (does not exceed several times h).

These results have made it possible to advance the hypothesis that spontaneously-fissioning isomers are shape-dependent. This assumption is additionally confirmed by experimental results of a study of the radiative capture of neutrons, leading to the formation of the spontaneously-fissioning isomers ^{242}Am and ^{244}Am.

Calculations with account taken of shell effects and large deformations, carried out by Strutinskiĭ, led to the appearance of an additional minimum of the potential energy at large nuclear deformations.

Within the framework of this model, the isomer states are interpreted as lower states in the second potential well.

Further experimental investigations of spontaneously-fissioning polymers should be aimed mainly at obtaining spectroscopic information. Great interest attaches also to searches for new regions of existence of shape-dependent isomers.

[1] S. M. Polikanov, Usp. Fiz. Nauk 94, 43 (1968) [Sov. Phys.-Usp. 11, 22 (1968)].

[2] V. M. Strutinsky and S. Bjornholm, Dubna Symposium, Nuclear Structure, p. 431 (1968).

[3] S. M. Polikanov and G. Sletten, Nucl. Phys. **A151**, 656 (1970).

R. A. Zhitnikov. Research on Optical Orientation of Atoms and Its Use for the Development of Quantum-electronics Devices.

Optical pumping (optical orientation of atoms), discovered by A. Kastler in 1949, has now become an independent rapidly growing field of radio spectroscopy[1,2]. In addition to a large number of new scientific results, optical pumping has contributed much to quantum electronics (quantum frequency standards, quantum magnetometers, quantum gyroscopes).

The communication is devoted to the results of research on optical pumping, carried out at the A. F. Ioffe Physico-technical Institute of the USSR Academy of Sciences, and also to work on the use of optical pumping for the development of new quantum-electronics devices.

One of the trends in this research was the study, with the aid of optical pumping, of the nature of interactions of excited alkali-metal atoms with inert-gas atoms[3-5]. These investigations were carried out by observing the behavior of resonance signals of the ground state of optically-oriented alkali-metal atoms as functions of the pressure and nature of the inert gas. The use of a rotating radio-frequency magnetic field has made it possible to separate the hyperfine-structure component in the magnetic-resonance signal[5]. A reversal of the sign of the optical-pumping resonance signal was observed with increasing pressure of the inert gas, owing to the mixing phenomenon (collision relaxation) in the excited state of the alkali-metal atoms. Investigations carried out on rubidium isotopes have made it possible to assess the role of nuclear spin in collision relaxation. The cross sections of such relaxation and the constants of the Van-der-Waals interaction between rubidium atoms and atoms of different inert gases were determined[5]. A theory of the observed phenomena was developed[4].

During the course of the study of optical orientation of helium-4 atoms, new phenomena were observed, consisting of an influence of the spin orientation of the metastable helium atoms on the intensity of all the optical lines emitted by the atoms of the helium gas-discharge cell, and on the electron density in the plasma of this cell[6].

The explanation of these phenomena possibly lies in the fact that the main process of production of electrons in a helium plasma is ionization of the metastable atoms as they collide with one another[9]. The electron yield in such processes depends on the mutual spin orientation of the colliding metastable atoms. There-