OBITUARIES

Igor Nikolaevich Golovin

Igor Nikolaevich Golovin, one of the world's pioneers of fusion research, died of a stroke in Moscow on 15 April 1997.

Golovin was born in 1913 in Moscow. After graduating in 1936 from Moscow State University, he started working under Igor Tamm on his candidate degree in theoretical physics (approximately equivalent to a PhD), which he finished just before Germany invaded the Soviet Union in 1941. He spent one year at the front, before being recalled to work on various military R&D programs.

In 1944, Golovin joined what is now known as the I. V. Kurchatov Institute of Atomic Energy in Moscow, and, in 1950, he became Igor Kurchatov's first deputy. Over the next decade, Golovin took an active part in the Soviet nuclear program. In 1945, he participated in a mission to collect information (in the Soviet occupation zone in Germany) about Germany's wartime A-bomb project.

In 1955, Golovin's interests turned to research on controlled thermonuclear fusion. His creative contributions helped to start a number of early research projects at the Kurchatov Institute. In particular, he built the first toroidal device for plasma confinement, following a scheme suggested in 1952 by Igor Tamm and Andrei Sakharov. In this device, magnetic field lines stay inside the toroidal volume, never hitting the wall. The mechanical equilibrium of the plasma is maintained by the plasma current, which is inductively generated in a plasma ring. The hot fusion plasma thereby becomes isolated from the walls. It was Golovin who invented the word "tokamak" to designate this type of device.

In 1956, he initiated the construction of a large mirror facility. The idea of mirror confinement was proposed a few years before that by Andrei Budker in the Soviet Union and Richard Post in the US. It is based on the observation that, if the magnetic field has a minimum along the field lines, a considerable group of charged particles can be confined near this minimum, bouncing between the regions of a higher magnetic field called mirrors. Golovin named this device "Ogra," the Russian abbreviation for the term meaning one gram, which was the amount of neutrons expected to be produced in the facility during one day of operation. As it turned out, the plasma in Ogra (as in almost all devices built in that period) was strongly unstable and never achieved its design parameters. Of the possible ways of mitigating the problem, Golovin's group chose an active feedback stabilization: Information about the small plasma displacements would be collected by properly situated gauges and then amplified and transmitted to active elements (like, for example, the magnetic loops) that would suppress initial perturbations. In a series of publications in the 1960s, the group laid the groundwork for this technique, which is now used in fusion devices of various kinds.

For the plasma heating and fueling in mirror devices, Golovin's group chose injection of atomic beams with the energies of tens of kilo-electron-volts. Accelerated in the ionized state, the atomic particles are then neutralized by a charge-exchange process in a neutralizing chamber and leave the source as a beam of neutral particles. If their energy is properly chosen, they reach the plasma core and get trapped there by ionization and charge-exchange processes. To many, this technology seemed infeasible because of a number of challenging engineering problems. Now, 30 years later, it has became the workhorse of plasma heating experiments.

Over the last decade, Golovin came to the conclusion that the traditional deuterium–tritium version of the fusion reactor probably would not meet future environmental standards, primarily because of the large amounts of highly radioactive tritium involved in the deuterium–tritium fusion cycle and the large amount of radioactive isotopes created by the neutron flux from the reactor core in materials that surround the core. He envisaged a gradual shift of interest to cleaner fusion cycles based, in particular, on the use of deuterium and helium-3. As a division leader at the Kurchatov Institute, he spent the last years of his life tirelessly working to gather the support of the fusion community for the cleaner (although more demanding from the viewpoint of physics and technology) versions of fusion reactors.

Golovin was a very modest person, and very reluctant to appear as a coauthor of even those scientific papers in which his role was decisive. Consequently, his name is not often encountered in the pages of scientific journals. Golovin had a good sense of humor, and displayed an artistic touch in his lectures and writings. He spoke English and German.

In the early 1990s, when he could attend international meetings outside Russia, Golovin became one of the best recognized and most persuasive advocates of clean fusion reactors. He will be remembered by his colleagues in the international fusion community for his outstanding contributions to the development of a clean and unlimited energy source for future generations.

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Gaspar Rodolfo Valenzuela

Gaspar Rodolfo Valenzuela, who pioneered in the study and interpretation of oceanographic and related geophysical phenomena using microwaves, died on 21 September 1997 in Baltimore after a prolonged bout with cancer. He was 64 years old.

Born in Coelemu, Chile, Gaspar went to the US in 1953 to study electrical engineering at the University of Florida, where he received a BS in 1954 and an MS in 1955—again in electrical engineering.

Moving to Baltimore in 1955, he worked for Westinghouse Electric Corp for two years and then for the Applied Physics Laboratory (APL), in Laurel, Maryland, for two years.

Remaining in Maryland, Gaspar then became a staff assistant at Johns Hopkins University's Carlyle Barton Laboratory, where he took part in the development of millimeter electromagnetic wave systems. At the same time, he performed additional research through the Johns Hopkins doctoral program, which led to his earning a PhD in electrical engineering in 1965.

Between 1964 and 1968, Gaspar again worked at APL. At that point in his career, he changed the focus of his research to working on the scattering of electromagnetic radiation from statistically rough surfaces.

In 1968, Gaspar moved to the Naval Research Laboratory (NRL) in Washington, DC, where he worked until 1993 in remote sensing of the ocean and land.

Along with John W. Wright, he pioneered in the study of electromagnetic backscatter from the ocean and used theoretical and experimental results that were derived from wave-tank measurements. Their work included the first applications of Bragg resonant scattering of microwaves from a slightly rough surface, as well as the development and application of a composite two-scale model that generalized the Bragg resonant scattering model to encompass microwave scattering from the ocean. Their general model has been widely used and has provided