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In memory of Evgenii Pavlovich Mazets

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On 2 June 2013 Evgenii Pavlovich Mazets, outstanding Russian scientist, Corresponding Member of the Russian Academy of Sciences (RAS), died at the age of 84. He was at the time Head of the Laboratory of Experimental Astrophysics at the Ioffe Physical Technical Institute (Ioffe Institute in short), widely known in the world of science for his research on gamma-ray astronomy and the physics of outer space.

Evgenii Pavlovich was born on 14 August 1929 into the family of a professional military man in the city of Kalinin (now returned to the ancient name of Tver). For his father, Pavel Stanislavovich Mazets, the Great Patriotic war ended when he was promoted to the rank of Major-General in Artillery. His father exerted considerable influence on Evgenii Pavlovich. In 1948, Evgenii Pavlovich graduated from high school and enrolled in the Physics and Mechanics Department of the Leningrad Polytechnic Institute, from which he graduated in 1954, majoring physics of isotopes, and began working at Ioffe Institute in the Laboratory of Nuclear Isomers headed by Lev Il'ich Rusinov. Having been promoted to L I Rusinov's deputy several years later, he took an active part in developing the program of scientific research at the VVR-M nuclear reactor, which at the time was being built at Ioffe Institute in Gatchina. During this time, Evgenii Pavlovich created one of the best prism beta-spectrometers in the country with an original system of automatic measurements. This spectrometer is still being used at PNPI to study decay schemes for radioactive nuclei.

In 1960, Academician B P Konstantinov involved Evgenii Pavlovich in astrophysical research using the space technology which had become available at the time. These studies were aimed at scrutinizing cosmic dust and cosmic gamma-ray emission. Evgenii Pavlovich supervised the development of high-sensitivity equipment for recording high-speed dust particles in space using piezoelectric sensors which were widely employed by that time in the experiments of this kind. During testing of the equipment at various temperatures, it was revealed that the equipment developed is also sensitive to acoustic noise generated at points, where sensors were mounted and on the sensitive surface as well. On Evgenii Pavlovich's initiative, the design of the Ioffe Institute experiment was drastically modified. One part of the piezoelectric sensors were mounted on special aluminum panels which were acoustically insulated from the housing of the satellite by using a 'sandwich' made of fluoroplastic plates. The second part of the sensors were placed directly on the housing of the satellite, as they were in all earlier experiments. The 1966–1967 studies with this equipment installed on the Kosmos-135 (also named a Cosmos-135) and Kosmos-163 satellites showed with high reliability that the flux of dust

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particles recorded by sensors on acoustically insulated panels is lower by a factor of 1000 than the flux of signals from sensors placed according to the older arrangement on the housing of the satellite and agrees very well with the available results of measurements for dust particles in interplanetary space. As a result, this was an experimental rejection of the hypothesis for the dust cloud surrounding the Earth, thus providing reliable data on the total influx of space material to Earth. These data were of fundamental importance for piloting space flights and for exploiting optical equipment on the orbits. The results of experiments with the Kosmos-135 and Kosmos-163 satellites coincided with the measurements of the puncture frequency of gas-containing cells on the American satellite Pegasus and laid the foundation for the model of the space distribution of micrometeorites, later accepted at the COSPAR session in 1970.

Evgenii Pavlovich and his colleagues carried out, with exceptional success, a project studying the dust coma of Halley's comet in the widest range of particle masses from 10^{-16} up to 10^{-6} g (in the framework of the international VEGA project in 1986). Two types of sensors were used in the equipment developed for the VEGA-1 and VEGA-2 stations:

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piezoelectric and ionization, with overlapping sensitivity ranges. As a result, as these stations were flying in the neighborhood of Halley's comet, a detailed pattern was recorded of the structure of the dust coma and the distribution of the cometary particles in mass, measurements were conducted of the angular distribution and intensity of ejection of dust from the comet's nucleus, and the characteristics of the dust jets were determined. These unique data exceeded in their completeness and reliability the quality of results reported by the European Giotto comet mission. For these results, Evgenii Pavlovich Mazets received the 1986 Lenin Prize. In 1990, Evgenii Pavlovich was elected Corresponding Member of the USSR Academy of Sciences.

Another field of Evgenii Pavlovich's research was low-energy gamma-ray astronomy. The research team supervised by him developed a scintillation gamma-ray spectrometer equipped with a multichannel amplitude analyzer with a block of RAM on an ultrasound delay line and a system of differential analyzers recording gamma quanta and charged particles. This was one of the first multichannel analyzers in the world with internal memory applied on board a spacecraft. On the Kosmos-135, Kosmos-163, and Kosmos-461 satellites, background effects were studied in great detail, accompanying measurements of cosmic gamma-ray radiation at energies between 30 keV and 4.1 MeV on near-Earth orbits, and an original method was developed for separating and identifying the cosmic component of radiation, using geomagnetic curves. In these studies, the intensity and spectrum of the diffuse background of cosmic gamma-ray radiation were scrutinized for the first time; a high degree of cosmic radiation isotropy was established, and thereby also its extragalactic nature. These results revealed the erroneousness of the data obtained earlier with the ERS-18 satellite and forced American colleagues to revise their results on the diffuse background reported in the course of the Apollo mission.

Owing to the experience accumulated by Evgenii Pavlovich's team, the latter proved to be best prepared to study a new astrophysical phenomenon, namely the cosmic gamma-ray bursts discovered with the American VELA satellites at the beginning of the 1970s. One of the first independent confirmations of this discovery was given by Evgenii Pavlovich on the basis of observations made by the Kosmos-461 satellite. A complex of a research equipment, KONUS, was developed, aimed at the comprehensive study of cosmic gamma-ray bursts and making it possible to autonomously localize these sources of gamma-ray bursts when observed from a single spacecraft. Utilizing the KONUS equipment with the Venera 11–14 stations in 1978–1983, fundamental results were obtained which formed the cornerstone of modern concepts of cosmic gamma-ray bursts. The study of light curves and energy spectra of cosmic events led to the discovery of a special class of short, hard gamma-ray bursts. The localization of about 200 gamma-ray bursts failed to identify a statistically meaningful concentration of their sources, either in the galactic plane or in the center of the galactic disk. This pointed to the extragalactic origin of the sources and, in turn, to the extreme energy scale of these events. The most important fundamental result of the KONUS experiments on the Venera stations was the discovery in 1979 of a new class of astrophysical objects known since then as soft gamma repeaters. All these results received confirmation in subsequent years, first of all when running the American experiment BATSE in orbit around Earth on NASA's Compton Gamma-ray Observatory.

The next exceptionally fruitful stage in a study supervised by Evgenii Pavlovich was the Russian–American KONUS–WIND experiment. The KONUS equipment designed and manufactured at Ioffe Institute was mounted on the American spacecraft Wind launched on November 1, 1994. Wind's orbit placed in the interplanetary space proved exceptionally efficient for studying gamma-ray bursts: two highly sensitive detectors of the KONUS instrument constantly survey the entire celestial sphere. As a result, not even one cosmic event has been missed among the important gamma-ray bursts and soft gamma repeaters in 18 years of uninterrupted surveillance. The equipment manufactured more than 20 years ago on a Russian-made elemental base continues to operate with a high yield as part of the American Wind spacecraft. Its data cover a wide range of energies, from 20 keV to 15 MeV, and are widely used in current all-wave studies of gamma-ray bursts synchronously with American space missions of Swift satellite and Fermi Gamma-ray Space Telescope and other gamma-ray burst registering apparatuses composing Interplanetary Network (IPN). The very experiment KONUS–WIND plays the role of the corner-stone of this network. An enormously large database has been accumulated over the time of observations of more than 3000 bursts and the activity of soft gamma repeaters. It should be only noted here that registering and studying the unique giant bursts of soft gamma repeaters SGR 1900 + 14 and SGR 1806-20 in our Galaxy and the priority discovery of giant bursts from repeaters in the neighboring M81/82 and M31 galaxies also deserve mentioning.

Evgenii Pavlovich initiated and implemented, making use of Ioffe Institute instrument, a number of experiments on studying gamma-ray bursts with Russian near-Earth spacecraft of the Kosmos and Koronas (Coronas) series in synchrony with the Wind observations. The most important of the results obtained was the registering of the giant bursts of the SGR 1806-20 gamma repeater, reflected from the Moon and recorded by the GELIKON instrument on board Koronas-F. The intensity of extreme fluxes of gamma-ray radiation in giant bursts is so high that spectrometric detectors reach saturation mode, and measuring the emission characteristics becomes impossible. In observations on 27 December 2004, the detector of the GELIKON instrument was found to be shielded by Earth from the direct illumination by the source, even though it recorded with high reliability the emission from the initial pulse of the giant burst reflected by the lunar surface. This made it possible to establish reliably, for the first time, the temporal profile of the initial pulse and to measure its energy characteristics. Location of the celestial body via fluxes of X-ray and gamma-ray radiation from a remote celestial source has been implemented for the first time in the practice of extraterrestrial astronomy.

The success of Evgenii Pavlovich's research was dictated by his incomparably high qualifications as experimental physicist and engineer, and by his ability to look deeply into the gist of the problem and to find optimal ways to solve it. He was an active participant at each stage of designing new research instrument, from developing mechanical structures to the most complex circuits of electronic units and details of measurements. Evgenii Pavlovich differed from others in his careful and comprehensive planning of the observational program and his ability to optimize the measurement schedule. He supervised the execution of 24 space experiments. Evgenii Pavlovich was a convinced supporter of the point of view that the instrument for conducting observations ought to be designed by the experimentalists themselves and that the data to be processed must be those gathered by the experimentalists with the instrument they designed. He was adamant that only in this case would the researcher know 'his gun' to a tee and correctly interpret the observational results. The program of future Russian observations of gamma-ray bursts was usually at the center of his attention. On his initiative and with the support of the RAS Council on Space Research, such studies were planned for the nearest future in the framework of the Spectrum-UV project and the program of small spacecraft designed by the Lavochkin Association.

Evgenii Pavlovich's exceptional personal standards, his adherence to the highest principles in everything, and his kindness vis-a-vis his colleagues were the basis of his unlimited authority among the staff of every generation at Ioffe Institute. He succeeded in creating a compact, well-coordinated team which worked with him all his life.

The achievements of the outstanding Russian scientist, RAS Corresponding Member Evgenii Pavlovich Mazets were rewarded with the Lenin Prize and the RAS A A Belopolsky Prize and many Russian orders. The warm memory of Evgenii Pavlovich will continue to live in the results of his work and in the hearts of his relatives, friends, colleagues, and students.

R L Aptekar, G S Bisnovatyi-Kogan, A A Boyarchuk,
A M Bykov, D A Varshalovich, A G Zabrodsky,
L M Zelenyi, A A Kaplyansky, K A Konoplev,
R A Suris, R A Sunyaev, D G Yakovlev