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PERSONALIA

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Yurii Nikolaevich Pariiskii (on his 80th birthday)

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Yurii Nikolaevich Pariiskii was born in Moscow on May 23, 1932 into the family of a well-known scientist, geophysicist and astronomer Nikolai Nikolaevich Pariiskii, Corresponding Member of the USSR Academy of Sciences, and Lidiya Viktorovna Pariiskaya, who for a long time worked in the Theory Department of Lebedev Physical Institute (FIAN) in close contact with Andrei D Sakharov. There were close ties of friendship between Pariiskii's family and those of I E Tamm and M A Leontovich (they were next-door neighbors in their country houses, organized joint country walks, enjoyed evening parties with charades for entertainment). Such a close relationship with brilliant personalities helped Yurii Nikolaevich formulate the fundamental principles that would guide him in life and shape his attitude toward science.

Yu N graduated from Moscow State University in 1955 majoring in astronomy (he was also a student of the Moscow Institute of Mechanics in 1950–1951, and of the Moscow Electrotechnical Institute of Communications in 1951–1952). Among his teachers we should single out I S Shklovskii, who immensely influenced his young students and who in 1953 pioneered radio astronomy lectures to third-year students of the university. N S Kardashev, V G Kurt, and N S Soboleva, who later became prominent astronomers, were in the same student class with Yu N. When doing his graduation thesis at FIAN in M A Leontovich's department under A E Salomonovich's supervision, in 1954 he built, on his own, a radiometer for the observation of the solar eclipse at the wavelength of 8 mm (Novomoskovsk), and used the results of his observations for getting more accurate data on the structure of the solar chromosphere. After graduation from the university, he was assigned a position at the Main Astronomical Observatory at Pulkovo (Leningrad) and there joined the just organized Department of Radio Astronomy, which was headed at the time by S E Khaikin, the founder of experimental radio astronomy in the USSR. Yurii Nikolaevich's entire subsequent career in science developed in both creative and family union with Nataliya Sergeevna Soboleva.

S E Khaikin suggested that Yu N Pariiskii start high-resolution studies of continuously emitting radio sources in the centimeter wave range (resolution of 1 arcminute at a wavelength of 3 cm) using a novel VPA (variable profile antenna) type radio telescope — the Large Pulkovo Radio Telescope (BPR in *Russ. abbr.*), where observations first began in December 1956. This work required high-sensitivity radiometers. Since this radio telescope is a transit instrument, a generation of high-sensitivity broadband radiometers with traveling-wave tube amplifiers at the wavelengths of 8 mm, 3.2 cm, and 6 cm were built, in contrast to designs of telescopes abroad based on narrow-band radar radiometers;

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Yurii Nikolaevich took a very active part in the work of building these devices.

The first test of the new high-sensitivity radiometers mounted on the BPR made it possible to carry out high-resolution observations: it therefore became possible to test the hypothetical explanation of the heating of certain details (discovered on the Sun by astronomers brought up by the Pulkovo scientific school of radio astronomy) in terms of micropulsations of magnetized plasma over solar spots; some theoretical groups were working on the theory of these pulsations. The reality of this phenomenon was not confirmed, which limited the number of possible theories. As a result, an alternative model of magnetized plasma in such very hot 'bags' above sunspots was developed (together with N S Soboleva and D V Korolkov).

The very first high-resolution survey of the Milky Way (1961) gave interesting results. For example, the fine structure of a radio source less than 1 arcmin in size was found at the center of the Galaxy. This work was presented at international symposia and caused great interest — and not only in the scientific world. Journalists were writing at the time that Yu N Pariiskii discovered a 'blazing bonfire' at the center of our galaxy.

Many radio sources that had been discovered by that time in the Netherlands but observed with low resolution at a wavelength of 21 cm (the so-called Westerhout catalog) were now being thoroughly studied using the BPR at a wavelength of 6 cm with high resolution. Better spectra were obtained, and it was shown that part of them belong to supernova remnants, not heated H II regions.

In 1962, Yu N Pariiskii published an interesting paper on the distribution of radio brightness over the disc of Venus, from which it was possible to evaluate the physical conditions on the surface of the planet. Two competing models were available at the time: a cold surface with a hot ionosphere, and a hot surface with a cold atmosphere, each of which should manifest an essentially different shape of the surface distribution of radio brightness (the edge getting darker in one, and brighter in the other). A radio telescope with the desired sensitivity did not exist anywhere, and Yurii Nikolaevich proposed improving the quality of the BPR reflector surface for observations on a wavelength of 8 mm (shorter than the design specifications). The designers had to change drastically the quality of the reflecting elements and to improve the methods of adjustment of the BPR. The entire Pulkovo school of radio astronomy (mechanics, laboratory assistants, technical staff, engineers, researchers) participated in this work, and observations were carried out successfully. It was concluded that the hot-surface model was in better agreement with the observational data. This model predicted that the pressure on the surface of the planet should be enormous, around 100 atm. S E Khaikin immediately informed the USSR Academy of Sciences President M V Keldysh, who had been directing the organization of space mission to Venus. Keldysh invited Yu N Pariiskii to report these results, finding them to be important; alas, the information came too late: the missile was equipped for normal pressure conditions. It was certainly incapable of withstanding the pressure of 100 atm and, of course, it failed. The high pressure prediction was corroborated several months later by data transmitted from the American mission Mariner II on its flyby of Venus.

In 1962, Yurii Nikolaevich submitted and defended his PhD thesis, "A study of some radio nebulae using their continuous radio emission" (supervised by S E Khaikin). In the mid-1960s, S E Khaikin's health problems forced him to resign as head of the radio astronomy department, and Yurii Nikolaevich was promoted to this position.

Yurii Nikolaevich also published papers of a methodological nature, on matters such as a detailed evaluation of the role of 'saturation' due to the noise of background radio sources, which limits the functionality of radio telescopes at meter wavelengths. The work showed the expediency of the passage to shorter centimeter-range wavelengths.

An important part of Yurii Nikolaevich's activities in the 1960s–1980s was a search for methods to construct very large radio telescopes. Thus, he was a coauthor of the pioneering project of an international radio telescope 5 km^2 in area with a resolution of 1 arcsecond; he presented this project (involving the longest possible VPA for Earth) on behalf of the Pulkovo school of radioastronomers at a meeting of the International Astronomical Union (IAU) in 1964. Larger versions of the BPR were prepared for scientific and defense purposes and for constructing new telescopes in the USSR.

As a result of this work, the RATAN-600 radio telescope was built, with a ring antenna 600 m in diameter; the first observations were carried out on July 12, 1974. Yu N Pariiskii was an active participant in Russia's very long base radio interferometric network project (RSDB-network) (project KVAZAR KVO), which was later supervised by A M Finkelshtein.

In 1969, Yu N Pariiskii submitted and defended his Habilitation thesis, "Results of the investigation of one-dimensional images of bright radio sources in Pulkovo and the prospects of two-dimensional and three-dimensional radio astronomy".

Ever since 1969, Yu N Pariiskii has tied his life in radio astronomy to RATAN-600 and the Special Astrophysical Observatory (SAO) in Nizhny Arkhyz, Caucasus. He personally supervised and took active part in the first observations with the radio telescope, as well as in starting the operation of each successive section of the radio telescope; during nearly 40 years of operation, the main parameters of the radio telescope were improved by several orders of magnitude. Yu N Pariiskii gathered around himself a team of like-minded colleagues. Every avenue of research on the radio telescope was launched under his guidance.

The team conducted a study of radio emission from all Galilean satellites of Jupiter; radio emission was recorded for the first time in radio astronomy from the smallest Jovian satellite (Europa), and from the satellite closest to Jupiter (Io). This study established the unique properties of the Io satellite — confirmed by direct observations a decade later.

Yu N Pariiskii paid special attention to studying the early Universe. The first observations of the fluctuations of the microwave background from the primary galaxies at redshift $z = 1000$ were conducted with the BPR in 1968. The predicted fluctuations were not detected. This area of research is still one of the central items for RATAN-600-based studies in the framework of the project, The Genetic Code of the Universe, approved by the RAS Presidium in 1998 and still continuing at the time of this writing.

The analysis of data from many months of observations with RATAN-600 using a multielement focal matrix made it possible to significantly refine the contributions from the synchrotron and thermal emission of the Galaxy, as well as to confine more precisely the frequency range which is especially attractive for ultimately deep space research into cosmic microwave background (CMB) radiation. A significant increase in the intensity of variations of the background radiation was found on scales corresponding to the 'oscillations' predicted by Sakharov. A comparison with the data of observers in other countries confirmed the black-body nature of their spectra. The optical thickness of the Universe derived from Thomson scattering was evaluated, and it was shown that a deep space study of anisotropy by ground equipment up to the recombination era is rather tangible. The boundary position of the secondary ionization epoch was refined. Also for the first time, variations in the spectral index of the Galactic background on cosmologically significant scales were studied in detail. It was shown that the data of the WMAP (Wilkinson microwave anisotropy probe) experiment need correction, and polarization of the sky with a resolution of 0.1 arcminute was measured. Statistically significant information on the spectral properties of weak radio sources in the centimeter wave range was gathered, which made it possible to evaluate their impact on experiments measuring the cosmic microwave background radiation, including observations made on the PLANCK and Surveyor space missions.

The data obtained allowed the team to achieve the ultimate depth of surveying the sky with the RATAN-600 at all wavelengths in the range 1.38–55 cm on scales important for cosmology; the bounds are imposed by the noise of background radio sources. It proved possible to learn much better the role played by Galactic noise (synchrotron radiation, free–free radiation, noise due to dust) and to reinterpret the role of noise generated by unknown background radio sources in the range between the decimeter-wave NVSS and infrared IRAS sky surveys.

Estimates obtained using RATAN-600 were found to be more accurate than those reported by other groups; they also yielded the value of the important cosmological parameter ns (the slope of the CMB spatial power spectrum). New data were obtained for the Universe noise on the scales inaccessible for WMAP and PLANCK space missions ($3000 < l < 5000$, at a wavelength of 1 cm which is limiting for RATAN-600). First attempts were made to evaluate the role of 'strings' (predicted by a number of theories) created during the inflation epoch and causing deformation of the cosmic microwave background.

At the beginning of the 1980s, Yu N Pariiskii supervised a RATAN-600-based program to study the microwave background anisotropy: a deep survey of a strip in the sky of $\delta \approx 5$ deg declination at a wavelength of 7.6 cm (Cold experiment). The result of the survey was a catalog of radio sources in the centimeter wave range (RC catalog). From the catalog, a sample of 104 sources with steep and ultrasteep spectra was selected. To study the objects in this sample, an international program, Big Trio (RATAN-600–VLA–6-m optical telescope BTA SAO RAS), was set up. A unique feature of this project was the use of the specifics of FRII type radio galaxies. A complete atlas of images of radio galaxies resulting from implementation of the Big Trio program was first published in the monograph *Radio Galaxies and Cosmology*. One of the achievements of this program was the discovery of one of the most distant galaxies in the Universe, RCJ0311+0507, with redshift $z = 4.515$. The uniqueness of the object lies in its ultimately high radio luminosity and large ratio of radio luminosity to optical luminosity, a feature pointing to the presence of a giant black hole at the center of the host galaxy. Its mass is very close to the ultimate mass in the observable part of the Universe ($> 10^{10} M_{\odot}$). The age of the stellar population of the host galaxy was estimated as ~ 0.8 billion years.

The many years of creative activity are summarized by Yu N Pariiskii's numerous publications, which include two monographs: *Radio Telescopes and Radiometers* (in co-authorship with N A Esepkina and D V Korol'kov, 1973), and *Radio Galaxies and Cosmology* (in co-authorship with O V Verkhodanov, 2009).

Yu N Pariiskii actively participates in all international radio astronomy congresses and workshops. In 1979, Yurii Nikolaevich was elected Corresponding Member of the USSR Academy of Sciences, and in 1992 became Full Member of the RAS. He is a member of the Radio Astronomy Council and of the IAU, and was elected Chair of the IAU Commission 40 on Radio Astronomy, and Chair of the Commission on Radio Astronomy of the International Union of Radio Science (URSI). For his immense contribution to the development of radio astronomy in the country and for his fruitful scientific activity, he was awarded the medal, For Labor Valor in 1970, Order of the Badge of Honor in 1975, Order of Lenin in 1978, and Order of Merit for the Fatherland, Fourth Class in 1999.

The employees of the St. Petersburg Branch of the Special Astrophysical Observatory and the SAO RAS team, together with the staff of other branches of the RAS, wish Yurii Nikolaevich good health and a long creative life.

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