
PUSHCHINO RADIO ASTRONOMY OBSERVATORY
and its participation in FP6

Pushchino Radio Astronomy Observatory (PRAO)

is a part of the

Astro Space Center (ASC)

that is one of scientific divisions of the

Lebedev Physical Institute

PRAO is in a small academic town Pushchino by the Oka-river that is settled down ~120 kms to south from Moscow

There are 9 biological institutes in Pushchino now, but radio astronomers were the first at this place (in 1956)

Pushchino Radio Astronomy Observatory is the main radio astronomy center in Russia.

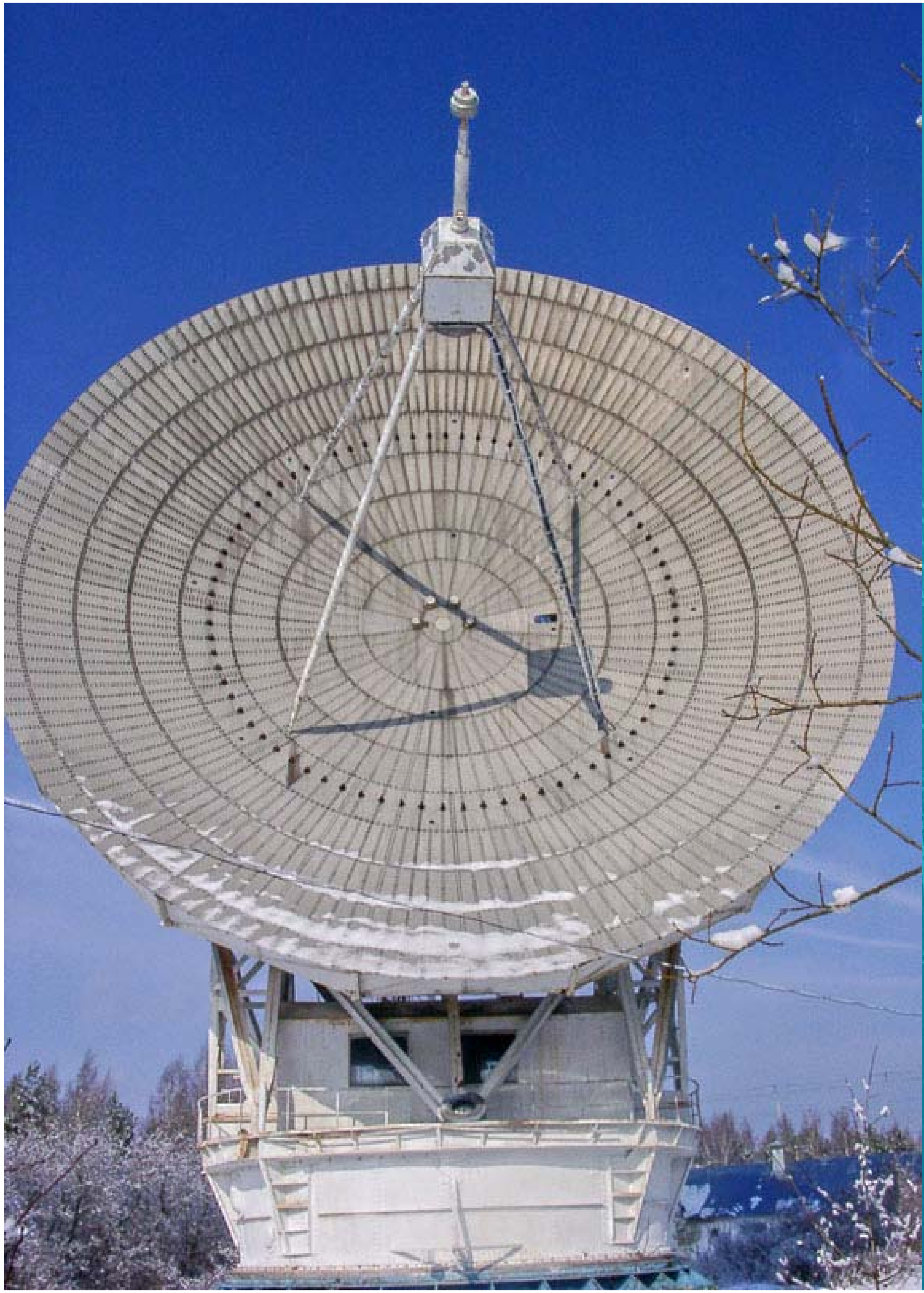
45 astronomers and over 60 engineers and technicians are working in PRAO these days.

There are three large radio telescopes in PRAO:

RT-22 is 22-meter full-steerable dish λ_{min}=8mm

DKR-1000 is a wide-band (30-120 MHz) Cross-type Meter- wave-lengths Radio Telescope.
Two arms of 40m x 1 km.

BSA is a large phased array of 16384 full-wavelength (λ = 2.7 m) dipoles. Total size is 187mx384m



RT-22 LPI Radio Telescope is a parabolic reflector with its main dish of 22 m in diameter. Accuracy of the main dish surface provides telescope's effective operation up to mm wavelengths. The telescope's receivers have the latest cooled low noise preamplifiers. The major scientific programs deal with star formation regions research by observations of atomic and molecular radio lines, and investigations of compact radio sources structures using interferometer technique with the resolution of hundredth and thousandth part of arcsecond.

Wide-Band Cross-type Radio Telescope DKR-1000 is a meridian instrument consisting of two arms: East-West and North-South. Each arm represents a parabolic cylinder with the width of 40m and is 1km long. Wide-band feeds allow to observe in the range from 2.5 up to 10 meter band are situated along the focal line of both arms. The DKR-1000 radio telescope provides unique possibilities for pulsar investigations, observations of spectral radio lines corresponding to transitions between levels with principal quantum numbers near 750(!), and studies of the radio sources flux density variations.

BSA LPI Radio Telescope - is a phased array comprising 16384 dipoles and covering an area of 18 acres. Its operating wavelength is ~3 m, and the telescope is world's most sensitive instrument in the range. BSA LPI is an indispensable one for the whole series dynamic processes in the near-Sun and interplanetary plasma, studies of pulsar radio emission, and analysis of the compact radio sources structure in the meter range of wavelengths by observations of interplanetary and interstellar scintillations.

PUSHCHINO RADIO ASTRONOMY OBSERVATORY

- *Total staff of around 160 persons includes 45 scientists and 61 engineers and technicians*
- *There are 5 scientific departments:*
  - *- astrophysical plasma*
  - *- Galaxy spectroscopy*
  - *- pulsar physics*
  - *- pulsar astrometry*
  - *- extragalactic radio astronomy*
- *5 technical laboratories*
- *mechanical shop, etc.*

The main fields of scientific activities:

- *Pulsar physics*
- *Pulsar astrometry and Pulsar time scale*
- *Solar super corona, interplanetary plasma, solar wind (solar-terrestrial connections)*
- *Physics of interstellar plasma (via observations of pulsars and spectral radio lines)*
- *Extragalactic radio sources*
- *Searching of the transient radio sources and the bursts-like events (radio counterpart of gamma-ray bursts, detection of SHE cosmic rays, etc.)*
- *RADIOASTRON project*

Some of the outstanding results

- *Discovery of the solar super corona and elongated in radii magnetic field inhomogeneties (V.V.Vitkevich)*
- *Discovery of polarization of the Crab nebula radio emission (A.D.Kuzmin and V.A.Udal'tsov)*
- *Discovery of the first radio recombination lines (R.L.Sorochenko et al.)*
- *Determination of the landing position for the Soviet space vehicles of the "Luna" series.*

Some of the outstanding results

- *First estimate the age of the radio galaxy (A.D.Kuzmin).*
- *Determination of temperature and pressure at the Venus surface (A.D.Kuzmin)*
- *Measurements of the solar wind velocity (V.V.Vitkevich)*
- *Cosmological evolution of the quasars and radio galaxies radio spectra (R.D.Dagkesamanskii)*
- *Pushchino pulsars (Yu.P.Shitov)*
- *Unusual pulsar glitches (T.V.Shabanova)*
- *The new astronomical time scale - PTS (Yu.Ilyasov)*
- *Radio emission of Geminga, magnetars and AXPs (Yu.Shitov, V.Malofeev)*
- *Giant pulses of pulsars (A.Kuzmin)*
- *Radioastronomical methods of SHE particles detection (R.Dagkesamanskii, I.Zheleznykh)*

Scientific collaboration inside Russia

- ***Sternberg Astronomical Institute of MSU (spectral lines)***
- ***Physical Department of the MSU (magnetic fields of galaxies)***
- ***Institute of the Earth magnetizm and propagation of radio waves (IPP)***
- ***S-Petersburg University (extragalactic astronomy)***
- ***Ural State University (spectral line observations)***
- ***Institute of Nuclear Researches (SHE cosmic neutrinos)***
- ***Nizhni Novgorod Radio Physics Institute (evolution of SNRs)***
- ***S-Petersburg IAA (VLBI)***

Scientific collaboration with outside of Russia colleagues

- ***Max-Plank Radio Astronomical Institute, Germany (pulsars, extragalactic magnetic fields)***
- ***Bonn University (interplanetary plasma physics)***
- ***Radio Astronomy Institute, Italy (spectral line observations)***
- ***“ASTRON” (pulsars)***
- ***JIVE (VLBI)***
- ***Jodrell Bank Observatory, ManUn, GB (pulsars, radio spectroscopy)***
- ***International Pulsar Net (pulsars physics)***
- ***Cork University, Irelands (extragalactic astronomy)***
- ***European SKA consortium (SKADS project)***
- ***NRAO, USA (pulsars, radio spectral line observations)***
- ***Vermont University, USA (pulsars)***
- ***Kansas University, USA (SHE neutrino)***
- ***CRL Laboratory, Japan (pulsars physics and pulsars VLBI)***

What is SKA ?

- **SKA is the international radio telescope for the 21st century (its construction is planned for 2012-2020)**
- Some of zero-level tasks: new developments in astronomy, like dark matter and dark energy, fundamental physics and particle astrophysics, origin and evolution of the Universe as a whole (study of the Epoch of Reionization).
- With a million square metres of radio-wave collecting area, the SKA will be 50 times more sensitive, and be able to survey the sky 10,000 times faster, than any existing radio telescope
- Recent, innovative technological developments in both computing and radio frequency devices have made it possible for the SKA to be built before 2020
- Total cost of SKA should be around 1 billion Euros (or USD). For this we need in big progress in technologies.

International SKA Community

- *International SKA Steering Committee (ISSC) that makes the all important decisions*
- *ISSC membership: 6 USA SKA consortium members,*

  6 ESKAC members, 6 members from other countries
- *ESKAC joins around 30 institutions from European Union, Australia, Canada, South Africa and Russia*
- *ESKAC delegates representatives to ISSC*
- *There are ISPO and several working groups under ISSC.*

ESKAC defined European SKA concept and the main DS tasks (scientific simmulations, engineering simmulations, construction of the future radio telescope prototypes, etc.) that is the main body of the SKADS project supported by European Commission.

Why we are interested in participation in SKA community and in SKADS project ?

We have large radio telescopes and we have to upgrade them, to improve their parameters.
For this we use new ideas and new technologies. These ideas and technologies are very close to those that used for SKA.
And we hope that our experience in some field (for example, two multi-beam pattern of BSA) could be useful for our European colleagues, too.
And we are also thinking (and not only thinking) about the New Generation Meter-wavelengths Radio Telescope.

And what are we doing now as the participant of SKADS project ?

- According to distribution of the tasks, we should work with scientific simulations, and we do it.
- During January 2007 SKADS Board meeting the decision was made to organize the Scientific simulation meeting by the end of July 2007 at PRAO, and we are planning to prepare several presentations to the meeting.
- Our engineers work out the digital beam-forming system for our cross-type radio telescope (and may be for NGMR). I think, it could be useful for SKA too.