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Two-year program to upgrade Bear Lakes RT-64 for EVN membership

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Abstract. An upgrade of the 64-m dish radio telescope which was erected at Bear Lakes near Moscow, Russia in 1979 is planned under INTAS-IA-01-02. This antenna was fruitfully used for astronomical goals for a long period of time, but currently it does not have EVN-compatible VLBI equipment. The project proposes verification of the antenna construction and infrastructure, and the equipping of RT-64 with new radio astronomy receivers, a GPS-receiver, a FS computer, baseband converters and a PC-disk based recording terminal. Test VLBI experiments, including trial co-observing with the EVN, will be arranged during the two-year project.

1. Introduction

A unique, fully-steerable 64-m dish radio telescope (see Fig. 1) was erected at Bear Lakes near Moscow, Russia in 1979 and put into operation in 1983. This first large antenna of the former Soviet Union was fruitfully used for goals in Astronomy, Deep Space Communication, Space Navigation and Education of students from the Moscow Power Engineering Institute over a very long time period. Bear Lakes RT-64 was constructed by the Special Research Bureau of the Moscow Power Engineering Institute. It has a quasi-parabolic, axially-symmetric Gregorian mirror system with a sub-reflector of 6-m diameter and a multi-band feed horn system. The dish is equipped with a system for phase compensation of gravitational deformations by means of programmed sub-reflector movement. Pointing ranges are ±220 degrees in azimuth, and 1 - 89 degrees in elevation; tracking velocities are from 1.5 arcsec/s to 0.75 arcmin/s in both coordinates and the tracking accuracy is about 15 arcsec. The effective area was about 2000 square meters at 18 cm, with the possibility, in principle, of the main mirror operating up to 1.35 cm. Operation of Bear Lakes RT-64 has been stopped since 1996 after cessation of government financing (because of a lack of Russian Deep Space Missions in the near future) and its state is rapidly changing for the worse, so that it may be lost for World Science in the near future. At the same time, the absence of space work provides a very good opportunity to redirect the antenna to radio astronomical goals in the interests of large groups of scientists. The 64-m antenna may be extremely useful for solving a large spectrum of scientific problems.

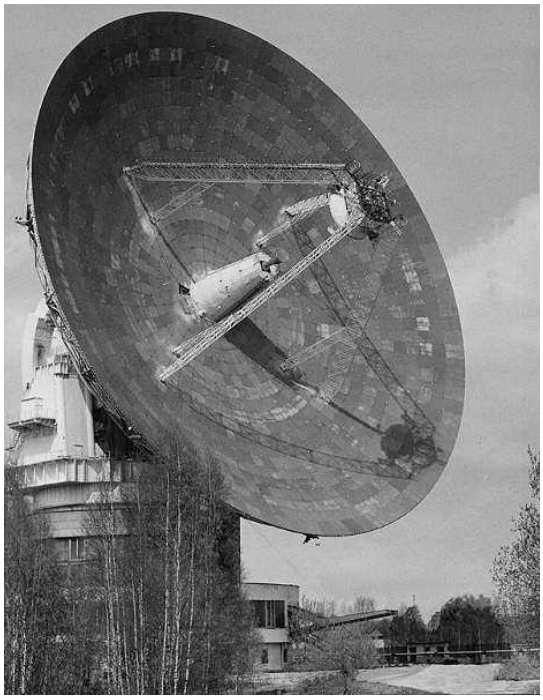

Fig. 1. Bear Lakes 64-m antenna

2. Program of upgrading

In the first instance, the Bear Lakes RT-64 should be involved in VLBI observing, which is a very powerful radio astronomy tool and has numerous applications in Astronomy, Astrometry, Geodynamics and Space Navigation. For a long time, Bear Lakes RT-64 was one of the best Russian VLBI facilities that regularly participated in international VLBI programs using a Mk-2 terminal. One of these results (Britzen et al., 1999) is presented (see Fig. 2). Since 1996, Bear Lakes has participated in LFVN observations with both Mk-2 and S2 terminals (see Molotov, these Proceedings). This activity allowed a grant (NTAS-IA-01-02) to be obtained under a program of Infrastructure Actions in 2002. It is proposed to establish Bear Lakes Radio Astronomy Observatory as a facility for general use which will provide observations at the request of NIS and INTAS scientists and institutions. As a priority, the very old idea of the Bear Lakes RT-64 regularly co-observing with the EVN will be realized. The high sensitivity and intermediate geographic

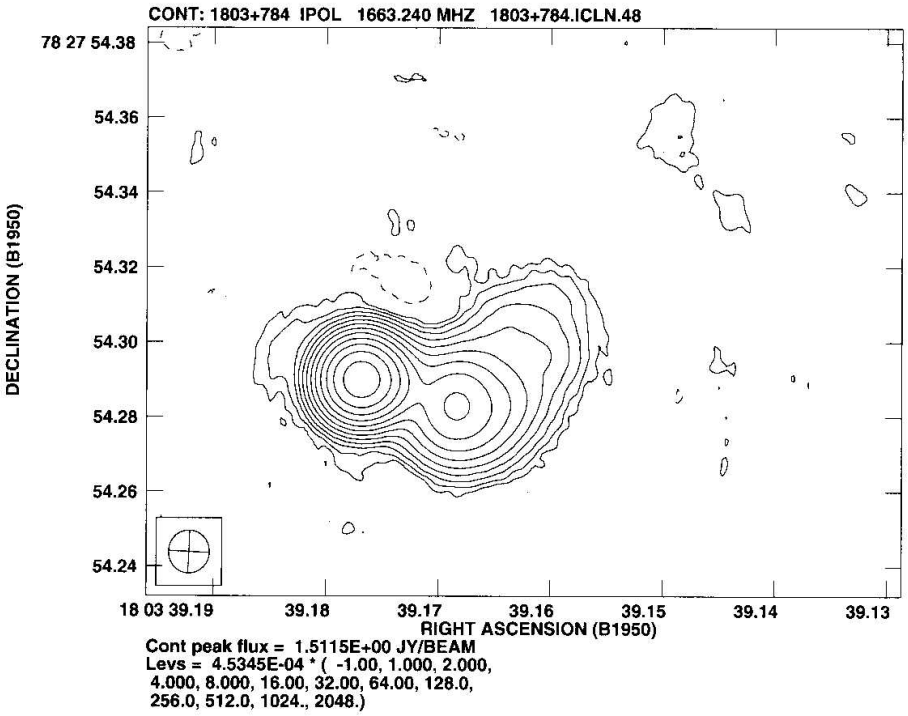

Fig. 2. 18 cm band radio image of 1803+784

location of the antenna would improve the EVN performance. Another important side of VLBI activity may be the participation of RT-64 in European and domestic geodetic VLBI programs. Another direction of work will be the promoting of the Low Frequency VLBI Network (LFVN) project which was started under INTAS96-1083, having as a goal the involvement of Russian radio telescopes in VLBI observations. It is planned to form a special administrative structure for project coordination and arranging economic and high-quality exploitation of the antenna complex, to establish an International Scientific Advisory Council for providing easy access to observing time for scientists and regulating the scientific activity of the observatory. The upgrade program foresees the production of multi-channel baseband converters and a set of low-noise astronomical receivers (49-cm, 33-cm, 18-cm, 13-cm, 6-cm, 3.6-cm wavelengths), purchasing of a GPS receiver for improving the time service of the observatory, a computer with FS software for the antenna pointing system and a PC-disk-based VLBI recording terminal to be compatible with the EVN. The performance of the antenna must be measured for its dependence on azimuth and elevation angles in different seasons including intra-day variations. Other planned work includes the verification and rehabilitation of the antenna construction and mechanisms, repairing the antenna building and rooms, testing and recovering existing scientific apparatus and cable networks, examination and adjustment of H-maser frequency standards and organization of Internet access. In the final stage of the project, first test co-observing with the EVN will start the process of integration of RT-64 into the EVN in order to adjust the interaction between the observatory and the EVN, and demonstrate the quality VLBI performance of the radio telescope. This work will be undertaken by a joint team from the Special Research Bureau of Moscow Power Engineering Institute, the Radiophysical Research Institute and the Astro Space Center of P.N. Lebedev Physical Institute. The project will be supported by the Joint Institute for VLBI in Europe, the Institute of Radio Astronomy of the National Academy of Sciences of Ukraine and the Astronomical Institute of the University of Latvia. The main sponsor is the International Association for the promotion of cooperation with scientists from the New Independent States of the former Soviet Union.

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