Istituto Di Radioastronomia

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TITLE

LFVN annual observations: developing the e-VLBI technique to investigate the solar system bodies and to research the solar wind

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Is this a resubmission of a previous proposal ? no○ yes● – proposal number(s): 11-06 (partially).....

Is this a continuation of (a) previous proposal(s) ? no○ yes● – proposal number(s): 11-06, 13-05, Radar VLBI, INTAS

Is this part of a Ph.D. project ? no● yes○ – Student's Name: .....

Hours requested for this period: **70**

LST range(s): from: July 28 to: August 5 number of intervals: 5
from: Nov. 8 to: Nov 14 number of intervals: 4

Number of hours foreseen for full completion of this proposal: 70 of which [ ] were already allocated

Receivers:

primary focus: 2.3 GHz ○ 8.3 GHz ○ 12 GHz ○ 32 GHz ○

secondary focus: 1.4 GHz ○ 1.6 GHz ● 5.0 GHz ● 6.6 GHz ○ 22 GHz ○ 43 GHz ○

Backends:

continuum backend ● ARCOS ○

guest instrument ○ specify: .....

ABSTRACT

LFVN team of radio telescopes in Italy, Russia, Ukraine and China carries out the VLBI observations each year since 1997 for few scientific directions: measuring the coordinates and rotation parameters of the Earth group planets, the near-Earth asteroids, space debris objects and spacecrafts with differential VLBI radar method; researching the interplanetary medium irregularities using VLBI radio raying of the solar wind and solar corona; adjusting e-VLBI technique. The interesting results in all mentioned fields were obtained in series of earlier experiments (VLBR 02.1, 03.1, 04.2, 05.1, 06.1). It is planned to arrange two sessions during 2007: 1) VLBR07.1 at 5 GHz in July 29-August 6 for radiolocation of asteroid 2007 DT103 (it will approach to the Earth on distance of 0.02353 AU), Venus (it will approach on 0.35 AU) and small space debris fragments at Geostationary ring (inside of observing campaign of the Inter-Agency Space Debris Coordination Committee directed on better understanding of the properties of the fragments with high area to mass ratio). Radio sounding of objects will be provided with Evpatoria RT-70 transmitter. 2) LFVN07.2 at 1.6 GHz in November 8-14 to obtain the new data on interplanetary medium. Noto RT-32, Evpatoria RT-70, Kalyazin RT-64, Urumqi RT-25, Simeiz RT-22, Puschino RT-22 and Ventspils RT-32 would participate in these experiments using e-VLBI NRTV and Mk-5 recording terminals. The VLBI data will be correlated in RRI, N. Novgorod, and in IRA, Noto, Italy.

join to this form: scientific aims ≤ 2 typed pages and ≤ 2 of Figs., Tables and list of related publications

The LFVN observations sessions in 2007

The project of Low Frequency VLBI was started in 1996 in order to arrange the international VLBI cooperation with participation of former USSR radio telescopes, and the Istituto di Radioastronomia (IRA) participates in the project from start point [1]. Traditionally the LFVN goals are developments of new VLBI methods and techniques including the investigations of the Solar system bodies by VLBI radar (VLBR) technique and the studying of the solar wind plasma by the method of radio raying [2]. The learning of the near-real-time VLBI (NRVT) through Internet using dedicated NRTV terminals d esigned in the IRA was begun in 2004 [3].

The VLBR combines the radar sounding of planets, asteroids and space objects with the Evpatoria RT-70 (C band) or the Goldstone RT-70 (S/X band) transmitters and the VLBI receiving of the reflected echo-signals with LFVN in order to obtain the 3-D measurements: the radar has the resolution for range and radial velocity, and the VLBI provides the angle and angular rate. Such new scientific instruments can measure the variations of proper rotation of the Earth group planets; determine the trajectories of planets and asteroids at Radio Reference Frame, to obtain the data on the object sizes and structure of surface [4]. During earlier experiments, the strong radar echoes of Mars and Moon were recorded and the VLBI fringes for echo-signals of Moon were obtained for three baselines Bear Lakes-Noto-Simeiz. The radar echoes of asteroid 2004 XP14 were obtained at C and X bands in the previous VLBR06.1 experiment and the precise Doppler shifts were measured [5]. Since 2001 the capacity of VLBR to investigate new space debris problem was studied. The echoes about 150 space objects at Geostationary, highly-elliptical and circular half-day orbits were detected [6] and the procedures of measurements of the precise Doppler shift, fringe rates, rotation periods of objects and orientation of rotation axis, the sizes of objects and its main constructions were adjusted [5].

The first measurements of Doppler shift and rotation period for small fragment of space debris at geostationary orbit (GEO) were received in previous VLBR06.1 experiment [7]. This is very topical goal due to ESA and Russian optical facilities fixed thousands GEO-fragments of 10-50 cm, but their orbits were not reconstructed. These fragments are almost invisible from the Earth and therefore are very dangerous for operational satellites. Also it is necessary to clarify the sources of small fragment releasing in order to preserve GEO for future usage [9]. During first LFVN sessions of 2007, VLBR07.1 at C band, it is planned to carry out the radar observations of the 2007 DT103, which will approach to the Earth on distance $\sim$3 mln km in July 29, Venus that will be very close ($\sim$50 mln km) in the beginning of August, and to participate in action of the Inter-Agency Space Debris Coordination Committee (IADC) directed on better understanding of the properties of the fragments with high area to mass ratio [7,8]. The large campaign of the optical observations is arranged now in order to provide continuous tracking of such fragments and the VLBR experiments will be conducted out for the fragments with more precise orbits (possibly with participation of the MERLIN and Effelsberg).

Second session, LFVN07.1 at L band will be devoted to the investigation of solar wind plasma by the method of radio raying developed by LFVN team [9]. During the observations, VLBI complex receives the radio emission of extragalactic source, located at different angular distances from the Sun (4-40 degrees). Radio emission passes through the turbulent plasma of solar wind and carries information about solar wind plasma. LFVN with various orientations of baseline projections allows to obtain information about spatial structure of solar wind plasma parameters. The series of experiments on VLBI radio probing of solar wind plasma was carried out at C, L and P bands during 1998-2005 [10] allowed to adjust the measuring procedure of the value of a solar wind velocity V and an index of spatial spectrum of electron density fluctuations p by a spectral analysis of the correlated signals. Distribution of large-scale intensive irregularities of electron density is derived from the variations of spectrum's width, and the properties of the weak small-scale irregularities may be understood from the spectrum "wings" shapes [11]. The L-band INTAS00.3 experiment (Bear Lakes RT-64, Noto RT-32, GMRT-45, HartRAO RT-26, Shanghai RT-25, Puschino RT-22) allowed to measure the values of V and p from observations of 6 sources on 3 baselines: Bear Lakes – HartRAO, Bear Lakes – Noto, Noto – HartRAO [11]. It is planned to continue these experiments in 2007 because of dedicated LFVN session of 2006 was canceled (two Russian LFVN antennas having L band were stopped for repairing).

Additional goal of two proposed sessions will be further development of the NRTV terminals, checking of new performances of the improved LFVN correlation processing center in Radiophysical Research Institute in N. Novgorod, and tests of the Ventspils RT-32 at C band.

Noto RT-32, Evpatoria RT-70, Bear Lakes RT-64, Urumqi RT-25, Simeiz RT-22, Puschino RT-22 and Ventspils RT-32 would participate in these experiments using e-VLBI NRTV and Mk-5 recording terminals. The obtained data will be correlated in RRI, N. Novgorod, Russia and in IRA, Noto, Italy.

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