

Institute of Applied Astronomy Technology Development Center

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Abstract

Our Institute was organized as a main research institute in the geodetic VLBI field of Russian Academy of Science, especially for scientific development and constructing Russian technical facilities for Quasar project. This report describes the IAA activities in this direction.

1. General

Technology Development Center is responsible for all parts of the Russian VLBI network and consists of separate laboratories, which develop hardware and software for this project. Now the 32 m radio telescope in Svetloe is under preparing to take part in international VLBI network observations, radio telescope in Zelenchukskaya is under testing and in Bodary – under construction.

2. Technical/Scientific

Dish metal constructions. This group is responsible for dish, electrical drive, main reflector and subreflector quality, and geodesy adjustment.

Antenna tracking control system. The IAA developed software allows control the antenna TNA-400-1 by the computer Field System on the base of own exchange protocol.

Table 1. Technical characteristics of antenna tracking control system radio telescope TNA-400-1.

Characteristic	Azimuth	Elevation
speed in the “low speed” mode	not more than 3’/sec.	not more than 50”/sec.
speed in the “high speed” mode	not more than 1°10’/sec.	not more than 55’/sec.
Tracking error	not more than 10”/sec.	not more than 10”/sec.

Receivers. Receivers on the 32 m telescope are installed in the secondary focus and can be interchanged as required. Changing a receiver from standby to operation requires only changing position of subreflector. At the present there are five receiver systems (10 channels) providing observation R and L circular polarisations simultaneously.

Table 2. Receivers Parameters.

Band, cm	Input Noise temperature, K
18/21	10
13	10
6	10
3,5	17
1.35	60

Our hardware staff is continuing investigations of new dish in Svetloe station. It has performed: adjustment and main parameters measurement of radio telescope in Svetloe Network Station, the quality Investigations of cryogenically cooled receivers installed on antenna in Svetloe, determine calibration noise signals for the receivers of all bands. Observation of the references sources, maintenance receivers and cryogenic equipment in Svetloe Network Station, assist and training station staff for routine operations on service receivers and refrigerators equipment.

The new radiometric registration device was designed. This design was implemented for providing of single dish observations in four wide band channels simultaneously, antenna performance and pointing measurements. It is connected to IF outputs of cryoelectronic receivers and controlled by Mark IV Field System program.

Table 3. Data of the module.

Frequency band, MHz	100 ÷1000
Channels Number	4
Radiometer type	switching or compensation
Quantizer capacity	13
Cumulation time, s	0.1 or more

It was elaborated the software integrated into the Field System environment for control of this device. The software permits radiometer data recording into the special file during VLBI observations in coordination with the experiment schedule or the using of Field System for single dish observations scheduling. The software makes the standard Field System programs “fivpt” and “onoff” workable with radiometric registration. This was implemented using new Field System feature: station specific detectors support. The software for the control of antenna and radiometric registration was complemented with operator interface programs. The programs work in the XWindow environment on the FS computer and provide the possibility of visual graphical monitoring of antenna position and radiometer data in real time. The operator programs also permit control of antenna and other equipment with graphical interface.

DAT. Four-channel data acquisition rack with Canadian recording terminal S2 was worked out and installed at the Svetloe observatory and is using for VLBI experiments (on baselines Svetloe–Bears Lake–Pushino, Svetloe–Evpatoria–Bears Lake).

Frequency and Timing System. The active hydrogen masers CH1-80 are used at the network station Svetloe. Frequency stability of this maser is presented in Table 5.

IAA found in 1998-1999 years the local Frequency and Time Standard at Technology Development Center for metrology supporting of the VLBI observations. This Frequency and Time

Table 4. Data of the system.

Frequency band, MHz	100 ÷ 600
Frequency tuning step, kHz	10
Number of down converters	4
Bandpasses, MHz	0.25, 2, 8 and 16
Using of clipping levels	2, 3 or 4
Recording terminal	S2-RT
Format of output data	S2 or MarkIII

Table 5. Frequency stability of maser.

Sample time interval	$(AllanVariance)^{1/2}$
1 sec	$3 \cdot 10^{-13}$
10 sec	$3 \cdot 10^{-14}$
100 sec	$1 \cdot 10^{-14}$
1000 sec	$5 \cdot 10^{-15}$

Standard includes active hydrogen maser CH1-70, passive hydrogen masers CH1-76, cesium and rubidium quantum clocks. Passive hydrogen maser CH1-76 may be used as mobile clock.

Time and frequency calibrations are provided by mobile clock, TV calibration facility, GPS receiver 4000 SST Trimble Navigation and GLONASS receiver A-724M.

Microwave holography equipments. In the years of 1997-98 the original microwave holography measuring system was created in the Institute of Applied Astronomy. The accuracy of holography measurements in one scan is of 0.12 mm. In February of 1999, after preliminary geodetic adjustment, the first session of the microwave holography measurements was carried out.

Seven scans with resolution of 0.75 m were used for measure the phase errors and amplitude distribution on the aperture. The holography adjustment of the dish at Svetloe station will be made during this summer.

Communication and Calculation Systems. The project VLBI network Quasar foresees creation of system remote control and data real-time processing of spectral and VLBI-observations.

To the moment, the hardware and software system has been designed and checked in IAA , which allows to do spectral and correlate processing limited samples of videosignals (at 20 MHz) from VLBI station Svetloe with the special processor TISS1-M (placed in S.Petersburg).

The Automatic meteorological station. The parameters are presented in Table 6.

3. Technical Staff

For all persons the IAA address (Zhdanovskaya st., 8, St. Petersburg, 197110, Institute of Applied Astronomy (IAA) RAS, Russia, Director Andrey Finkelstein, FAX: +7-812-230-74-13) is common.

Table 6. The parameters of the automatic meteorological station.

Measured parameter	Range	Accuracy
Temperature (C)	-50 ÷ +50	0.25
Pressure (mba)	600 ÷ 1090	0.5
Humidity (Mean wind velocity (v) for 10 min (m/s)	1.5 ÷ 40 8 ÷ 55	0.5+0.05v 0.5+0.05v
Max. wind velocity (v) for 10 min (m/s)	0 ÷ 360 Yes/No	10
Wind direction (degree)	0 ÷ 150	0.2+0.05P
Rain	Yes/No	
Sample rate:	1 min (except wind velocity), 10 min, 1 hour.	

Table 7. Technical Staff.

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4. Outlook

At the new IVS year we are planning:

- To include the VLBI site Svetloe into routine CORE-A observations.

- Holography adjustment in Svetloe.
- Receivers and cryogenic equipment installation at new dish in Zelenchuckskay.
- Adjustment of reflector and feed system in new dish, including holography adjustment.
- Parameters measurement at new dish and testing VLBI observations.