Svetloe Radio Astronomical Observatory

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Abstract

This report provides information about Svetloe network station: general information, facilities, staff, present status and outlook.

1. General Information

Svetloe Radio Astronomical Observatory was founded by Institute of Applied Astronomy (IAA) as first Station of Russian VLBI network QUASAR. Sponsoring organization of this project is Russian Academy of Sciences (RAS). The site for the Observatory was chosen to be Svetloe village located at the Karelian neck nearly 100 km north from St. Petersburg. The basic instruments of the observatory are 32-m radio telescope and technical systems provided realization of VLBI observations.

Svetloe Observatory participated in several regional and global geodetic projects: GIG'91, BSL'93, DOSE'93, DOSE'94, BSL'97, IGEX'98 and is a EUREF permanent station. Its coordinates are defined in ITRF96 and ITRF97 reference frames.

Table 1. Svetloe Observatory location and address.

Longitude	29°47' E
Latitude	60°32' N
Svetloe Observatory Leningrad region, Priozerski district, 188833 Russia	
http://www.ipa.rssi.ru	

2. Technical and Scientific Information

The Svetloe station equipment includes the following main components: 32 m radio telescope, equipped with low noise receivers, frequency and time keeping systems with H-masers, local geodetic network, SLR pad, GPS Trimble 4000 SST receiver and GLONASS A724M receiver, data acquisition system, recording terminal, control computers, local computer network and technical service systems. Local geodetic network is adjusted with accuracy 2–3 mm. Characteristics of the radio telescope and other main components of the station are presented in Tables 2–5.

Frequency and Time Keeping System of Svetloe network station consist of Frequency and Time Standard ensemble, complete set of lock VHF local oscillators and picosecond pulses generators. Frequency and Time Standard ensemble includes four active hydrogen masers CH1-80 developed in Russia. Frequency stability of these masers is presented in Table 6. Frequency and Time calibrations are provided by phase and frequency comparators, passive hydrogen masers CH1-76 used as mobile clock, TV calibration facility, GPS and GLONASS receivers. Local VHF oscillators are locked by reference 5 MHz or 100 MHz signal and provide 10–20 mW power output signals at frequencies 1.26, 2.02, 8.08, 4.5, 22.12 GHz. Picosecond pulse generators utilize the 5 MHz output from frequency standard to produce short duration (about 50 ps) pulses at 1 MHz rate for receivers and down converter phase calibration.

Table 2. Technical parameters of the radio telescope.

Year of construction	1998
Mount	AZEL
Azimuth range	±270 (from south)
Elevation range	from $-5°$ to $90°$
Maximum azimuth - velocity - tracking velocity - acceleration	 $1.5°/s$, $1.5'/s$, $0.2°/s^2$
Maximum elevation - velocity - tracking velocity - acceleration	 $0.8°/s$, $1.0'/s$, $0.2°/s^2$
Pointing accuracy	better than $10''$
Configuration	Cassegrain (with asymmetrical subreflector)
Main reflector diameter	32 m
Subreflector diameter	4 m
Focal length	11.4 m
Main reflector shape	quasi-paraboloid
Subreflector shape	quasi-hyperboloid
Surface tolerance of main reflector	± 0.5 mm
Frequency capability	1.4–22 GHz
Coordinates of axis intersection (ITRF 96)	$60°31'56''.44$ N (Transferred from GPS $29°46'54''.97$ E mark 12350M001) H = 86.6 m

Table 3. Parameters of receivers.

Wave band	Frequency range	Input noise temperature
18–21 cm	1.38–1.72 GHz	22 K
13 cm	2.15–2.5 GHz	18 K
6 cm	4.6–5.1 GHz	10 K
3.5 cm	8.2–8.7 GHz (8.9 GHz under testing)	17 K
1.35 cm	22.2–22.7 GHz	90 K

Table 4. Data acquisition system and recording terminal characteristics.

Frequency band	100–600 MHz
Frequency tuning step	10 KHz
Number of down converters	4
Band pass of channels	0.25, 2, 8, 16 MHz
Using of clipping levels	2, 3 or 4
Recording terminal	S2-RT
Format of output data	S2 or Mark III

Table 5. Control computers.

Telescope control computer	Pentium II 350
Field system computer	Pentium 100
Operation system	Linux
Field system version	9.3.25

Additional information: both passive and active hydrogen masers CH1-76 and CH1-80 have been designed and manufactured by KVARZ Institute of Electronic Measurements, Nizhny Novgorod, Russia.

Table 6. Frequency stability of the CH1-80 H-maser.

Sample time interval	(Allan variance)$^{1/2}$
1 second	$3 \cdot 10^{-13}$
10 seconds	$3 \cdot 10^{-14}$
100 seconds	$1 \cdot 10^{-14}$
1000 seconds	$5 \cdot 10^{-15}$

3. Technical Staff

About 30 persons of IAA are involved in VLBI activity at the Svetloe Observatory. Leading persons are listed in Table 7.

4. Present Status of Svetloe Observatory

The construction of the radio telescope at Svetloe was finished in 1998. The main parameters of the radio telescope on 6 cm band (antenna efficiency SEFD) were measured. The tracking system was adjusted with pointing accuracy less than 10″. First testing spectral observations of OH masers in R and L circular polarization were carried out. Preliminary VLBI observations had been made on the baseline Svetloe – Bear Lakes in December 1998.

Table 7. Leading person of Svetloe Observatory involved in VLBI activity.

Name	Position	Role	Telephone +7-(812)-	E-mail
Prof. Nikolai Koltsov	Chef the Laboratory Signals Conversion and Registration	Data acquisition terminal	235-33-16	nec@ipa.rssi.ru
Dr. Vyacheslav Mardyshkin	Senior Scientific Researcher,	Receivers	230-64-96	vvm@ipa.rssi.ru
Mr. Andrey Michailov	Scientific Researcher	FS software	230-64-96	agm@ipa.rssi.ru
Mr. Alexander Vytnov	Scientific Researcher	Frequency and Time Keeping System	230-74-16	smolen@ipa.rssi.ru
Mr. Eugenie Zhukov	Senior Scientific Researcher	H-masers	230-74-16	smolen@ipa.rssi.ru
Mr. Sergey Syrovoy	Junior Scientific Researcher	Stations software Radio telescope control system	230-64-96	ipatov@ipa.rssi.ru
Vladimir Tarasov	Chief Engineer of the Svetloe Observatory	Technical support	312-36-28	iar@ipa.rssi.ru

5. Outlook

We plan for the near future:

- Final adjustment of all radio telescope systems;
- Measurement of the radio telescope parameters on 13.5/3.5 and 1.35 cm waves;
- Test VLBI observations on 13.5/3.5 cm wave under Field System control;
- Installation of Mark IV data acquisition system in cooperation with NASA;
- Installation of Turbo Rogue GPS receiver in cooperation with OSO.