

## MINUTES of the RadioAstron Teleconference on June 24, 2008

**N. Kardashev** chaired the teleconference.

The agenda of the teleconference and the list of participants are attached to the Minutes.

The main intent of the teleconference was to review a current status of the **RadioAstron** mission.

**V. Andreyanov** reported the status and progress in technical developments achieved since the last teleconference in March 11, 2008:

1. Mechanical tests of the SRT mass-dimension model have indicated some defects (deformation). Now the construction has been recovered, and corresponding tests will be repeated again.
2. Geometrical tuning of the flight petals has preliminary been done with precision laser measurement system. The full flight antenna reflector will be mounted for the transport vibration tests, and after this it will be inspected also.
3. After the preliminary integration, the flight SRT electronic complex was tested in ASC, and all devices were delivered to the Lavochkin. Now, these on-board devices have been installed on the flight container's frames using the flight cable network.
4. To our regret, the flight model of the radio communication system (VIRK) has not been delivered yet to ASC. Now VIRK (without antenna) is under testing by the factory (ageing tests).
5. The Flight models of the H-masers have been manufactured in the industry. Last month two flight H masers were delivered to ASC, and we are implementing autonomic tests using comparison with ground-based H-frequency standard, and an inter-comparison of the two flight models.
6. Now we are designing a Program "In-Orbit-Checkout" for the SVLBI RadioAstron, and a flight test chronogram (I.e., time sequence). It will be a part of the general flight test Program (including the spacecraft "Navigator").
7. Next steps of the flight SRT preparation will be as follows:
  - an integration test of the electronics in the open containers and VIRK - in the ASC;
  - a test of the closed containers in the Lavochkin and an installation with antenna reflector; a final full SRT test;
  - an integration with spacecraft module "Navigator" and VIRK system,
  - an e-m compatibility test in the unechoic chamber.

**Question:** Will there be any test of the SRT flight model on the real radio source? (D. Jauncey)

**Answer:** No, all tests will be conducted indoors using artificial signals from special generators.

**Question:** It seems that test on the real radio source in the interferometric mode is very essential. (K.Kellermann)

**Answer:** Yes. And such observations were conducted in 2004 on Cyg A during astronomical tests in Pushchino with engineering model of SRT.

Additionally V. Andreyanov reported on the results of measurements of parameters of the improved feed system for SRT. The results are presented in the following table:

Frequency band	327 MHz	1650 MHz	4850 MHz	18-26 GHz
Efficiency	0.8	0.96	0.86	0.85
Losses (dB)	0.97	0.18	0.65	0.70

### **A Tracking Station in Pushchino (reported by A. Smirnov)**

- Last months we continued to test the TS electronic equipment.
- New waveguide filters were designed to improve an attenuation between receiver and transmitter outputs at the uplink and downlink frequencies. The waveguide was manufactured and tested at the laboratory. Next month it will be installed at the 22-m Pushchino antenna.
- Some tests of the 22-m antenna were conducted during last month to measure the efficiency,

system temperature, and beam pattern. The measurements were performed with TS receivers at 8.4 and 15 GHz by boresighting on bright radio sources. Obtained parameters are close to the predicted values

**Question:** D. Jauncey: What SNR do you expect to have at the distance of 300,000 km?

**Answer:** We expect to get a 3-5 dB excess above the given threshold to be able to decode data transmitted by VIRK.

**Question:** What is a status of other tracking stations? (T. Tzioumis)

**Answer:** ASC has presented a request to the RSA for additional funding for the second TS. We hope that our request will be approved. Then, electronic equipment may be installed at another site. Ussuriisk and Green Bank are considered as possible sites for the second TS. (N. Kardashev)

**Question:** Are there any chance to have TS in the Southern hemisphere? (R. Both)

**Answer:** In principle, electronic equipment may be installed in South Africa. (N. Kardashev)

It was a long discussion on the importance and prospects of organizing TS in Southern hemisphere (D. Jauncey, K. Kellermann, R. Booth, Y. Kovalev, N. Kardashev).

**M. Larionov presented plan of pre-launch ground VLBI observations in Russia.** The following radio telescopes may be used to support the RadioAstron mission:

- The Kalyazin 64-m radio telescope equipped with receivers for the 1650 and 4850 frequency bands.
- Three 32-m radio telescopes belonging to the IAA QUASAR geodetic network. They may be used at the 1650, 4850 and 22000 MHz frequency bands.
- The Ussuriisk 70-m Space Communication antenna. This instrument will be equipped with RadioAstron receivers in the first quarter of 2009.
- The Evpatoria 70-m communication antenna is already equipped with receivers for the 327, 1650 and 4850 frequency bands. It also will be equipped with 18-26 GHz receiver operating in MFS mode.
- The Crimea 22-m radio telescope in Semeiz.
- The Pushchino 22-m radio telescope.

There is a preliminary schedule of testing VLBI observations by the ground radio telescopes:

- Kalyazin-Pushchino interferometry at 6 cm in September 2008;
- Pushchino-Zelenchuk (IAA 32-m) interferometry at 6 cm in November 2008;
- Kalyazin-Evpatoria interferometry at 6 cm in December 2008;
- Pushchino-Evpatoria interferometry at 1.35 in February 2009;
- Ussuriisk-Evpatoria interferometry at 6 cm in March 2009;
- Ussuriisk-Evpatoria interferometry at 1.35 in May 2009.

**Compatibility of the recording systems** was discussed, unfortunately in absence of S. Likhachev. It was recommended to use MkV recording system. But, because of funding constraints, it would be possible for ASC to get only a limited number of the MkV terminals, and main recording system will be RDR. ASC will construct a copy machine to convert data from one format to another. Foreign colleagues emphasize on certain inefficiency of using such copy machine in the data correlation (D. Jauncey, K. Kellermann, J. Romney).

Some aspects of getting a software for calculation of the delay model for the spacecraft were also concerned (Y. Kovalev, J. Romney, T. Tzioumis).

**Y.Y. Kovalev** reported that the VLBI observations in the MFS were conducted on March 15, 2008 with two 70-m DSN radio telescopes in Robledo and Goldstone in the range of 18-26 GHz with frequency switching corresponding to the RadioAstron MFS mode. Two radio sources were observed (1803+784 and 3C 345) during 12 hours. Recording was done on the Mk5 disks, and data correlation was started in the Bonn at MPIfR correlator. Unfortunately, at one of the stations the right and left polarization channels were recorded in an opposite sign relative to the configuration at the other station. Therefore, we have only cross-polarisations as a result of correlations. Such situation constrains the efficiency of our test. It is expected that the test will be repeated during this year.

**V.Slysh/M. Popov** described a time-line for the science operations including an In-Orbit-Checkout Program (IOCP) for the RadioAstron mission. The time-line starts with the suggested launch date in April 2009:

- In-Orbit-Checkout(IOC)                                  June-September 2009                                  February 1, 2009
- Key Science Program(KSP)                              October 2009 - January 2010                        June 1, 2009
- General Observing Time (GOT+KSP)                February 2010.    October 1, 2009

In the third column there is the deadline for submitting proposals to the corresponding agencies for the support with ground radio telescopes. An estimate of the necessary observing time for IOC at the foreign big radio telescopes is about 5 x 2 hours by the period of three months. The observing sessions must be separated by the period of about 2 weeks for the data correlation and analysis. The telescopes requested are such as GBT, Effelsberg, DSNs (70m). First of all, for the majority of tests, ASC will use the Russian radio telescopes in Kalyazin (mainly), IAA (QUASAR), and Evpatoria 70-m dish.

**N. Bartel** informed the participants on his understanding of a possibility to measure gravitational redshift by using on-board hydrogen frequency standards. More details will be presented at the October Meeting in Moscow. There was some discussion about technical possibility of such an experiment (V. Andreyanov, N. Kardashev)

**Information from SOC and LOC about October Symposium in Moscow** has been resulted in the decision to prolong the deadline for registration till August 1, 2009.

**Report on the execution of the action items** formulated at the previous teleconference:

M. Popov: To prepare a draft of the IOCP in May 2008 and to distribute it to the members of the IOCWT. The IOCP shall include a rough estimate of the necessary amount of observing time at ground radio telescopes. The estimate is presented in this Minutes.

**New action items:**

- **ASC** to issue a document on the preference for location of the second TS;
- **J. Romney** to provide short recommendations (memo) for implementation at the Russian software correlator.
- **Andreyanov and Kardashev** to provide a description of operation possibilities to conduct gravitational redshift measurements with RadioAstron.

**The next teleconference is planned to be held in September 2008.**

### **Agenda of the RadioAstron teleconference June 24, 2008 (16:00 UT)**

1	Corrections to the Agenda and introductory notes on the status of the RadioAstron mission	N. Kardashev
2	RadioAstron project status and progress	V. Andreyanov
3	Pushchino tracking station (TS)	A. Smirnov
4	Pre-launch ground VLBI observations in Russia	M.G. Larionov
5	Compatibility of recording systems	S.F. Likhchev
6	Results and prospect of the MFS DSN VLBI test	Y.Y. Kovalev
6	RadioAstron observing program	M. Popov
7	Possible gravitational redshift experiment	N. Bartel

8	Information from SOC and LOC about October Symposium	M. Popov
9	Review of the Action Items	M. Popov
13	New Action items	M. Popov
14	Proposed date for the next teleconference (September, 2008)	

**List of participants:**

Andreyanov V.	ASC, Russia
Bartel N.	York University, Canada
Gwinn C.	UCA, USA
Jauncey D.	ATNF, Australia
Kanevsky B.	ASC, Russia
Kardashev N.	ASC, Russia
Kellermann K.	NRAO, USA
Kogan L.	NRAO, USA
Kovalev Y.Y.	MPIfR and ASC
Likhachev S.	ASC, Russia (was not able to attend)
Lobanov A.	MPIfR, Germany
Popov M.	ASC, Russia
Romney J.	NRAO, USA (was not able to connect)
Smirnov A.	ASC, Russia
Tsarevsky G.	ASC, Russia
Tzioumis A.	ATNF, Australia