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Co-location of Space Geodetic Instruments at the "Quasar" VLBI Network Observatories

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Abstract

This paper discusses the current status of creating the co-location stations at the observatories of the Russian VLBI network "Quasar". Satellite Laser Ranging systems "Sazhen-TM" manufactured by Research-and-Production Corporation "Precision Systems and Instruments" were installed at all observatories of the network in 2011. The main technical characteristics of the SLR system and the co-location of high-precision observational instruments at the observatories are presented in this paper.

1. Introduction

Observatories of the Russian VLBI Network "Quasar" have actively participated in both international and national programs of VLBI observations since 2006. During 2008–2011 essential upgrades to and development of the "Quasar" Network were performed [1]. All observatories have been linked by optical fiber lines, providing operational determinations of Universal time from 1-hour sessions in e-VLBI mode. Combined GPS/GLONASS/Galileo receivers perform continuous observations in the framework of IGS global and European permanent networks, sending the observational data hourly. New satellite laser ranging systems were installed at all observatories of the "Quasar" Network in 2011.

2. SLR System "Sazhen-TM"

Compact satellite laser ranging system "Sazhen-TM" (Figure 1) has been manufactured by Open Joint-stock Company "Research-and-Production Corporation "Precision Systems and Instruments". The main technical characteristics of the "Sazhen-TM" system are given in Table 1.

3. Current Status of Co-location Stations

At present the observatories "Svetloe" and "Zelenchukskaya" are the co-location stations with three types of high precision space geodetic instruments and the "Badary" observatory is one of those few stations with four types of instruments. The status of the observatories as stations of different global and continental space geodetic networks is presented in Table 2.

SLR system mount.

Laboratory equipment.

Figure 1. "Sazhen-TM" SLR system.

Table 1. Main technical characteristics of "Sazhen-TM" system.

Characteristics	**Values**
Ranging distance	day 400-6000 km night 400-23000 km
Aperture	25 cm
Wavelength	532 nm
Beam divergence	12"
Laser pulse frequency	300 Hz
Laser pulse width	300 ps
Pulse energy	2.5 mJ
Mass	170 kg
Normal points precision	1 cm
Angular precision	1-2"

Table 2. Different network stations at the "Quasar" observatories.

Technique	Network station	"Svetloe"	"Zelenchukskaya"	"Badary"
VLBI	IVS station (year)	Sv, 7380 (2003)	Zc, 7381 (2005)	Bd, 7382 (2006)
GNSS	IGS, EPN station (year)	SVTL (2004)	ZECK (1997)	BADG (2011)
SLR	ILRS station (year)	1888 (2012)	1889 (2012)	1890 (2012)
DORIS	IDS station (year)			BADB (1992)

4. Location of Instruments at the Observatories

The optical mounts of the SLR systems were installed on concrete pillars inside specially built mini-towers covered with dome "Astro Haven" (Astro Haven Enterprises Inc, USA). The mini-towers are 2 – 4 m in height and are located at distances of 20 – 35 m from the laboratory buildings of the observatories (Figures 2, 3, and 4). These locations provide full views in all azimuths at elevations greater than 20°. Electronic blocks of the SLR systems, including the equipment for laser pumping, control, and management, are installed in the laboratory buildings of the observatories.

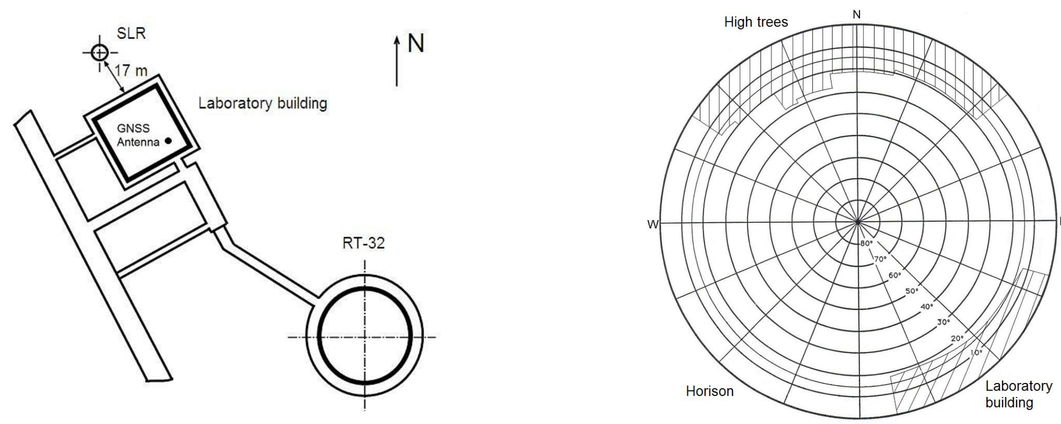

Figure 2. Location of observational instruments (left) and cut-off angles for the SLR system (right) at "Svetloe" observatory.

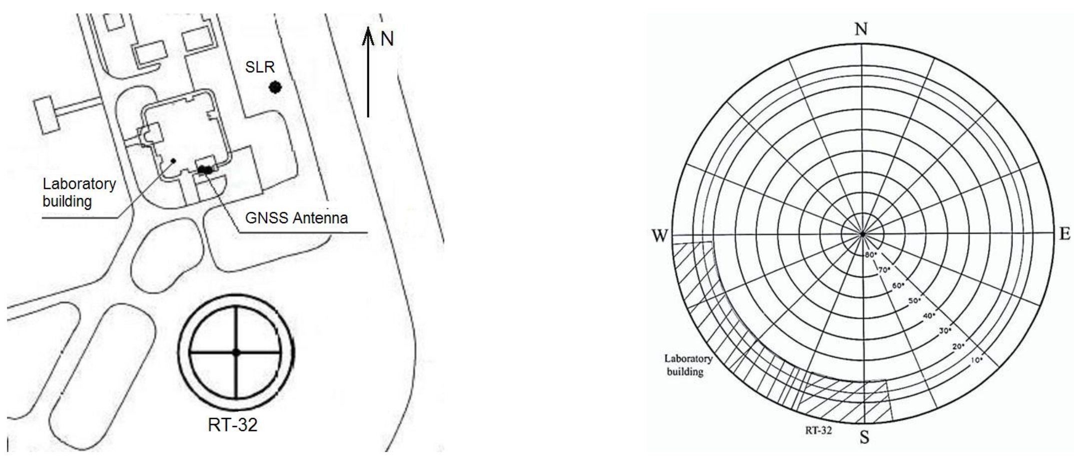

Figure 3. Location of observational instruments (left) and cut-off angles for the SLR system (right) at "Zelenchukskaya" observatory.

Eccentricity vectors from the GNSS antenna markers to the reference points of the SLR systems (intersection of axis) were determined by means of local geodetic surveying, taking into account the height of the system mount according to its passport data. Results are given in Table 3.

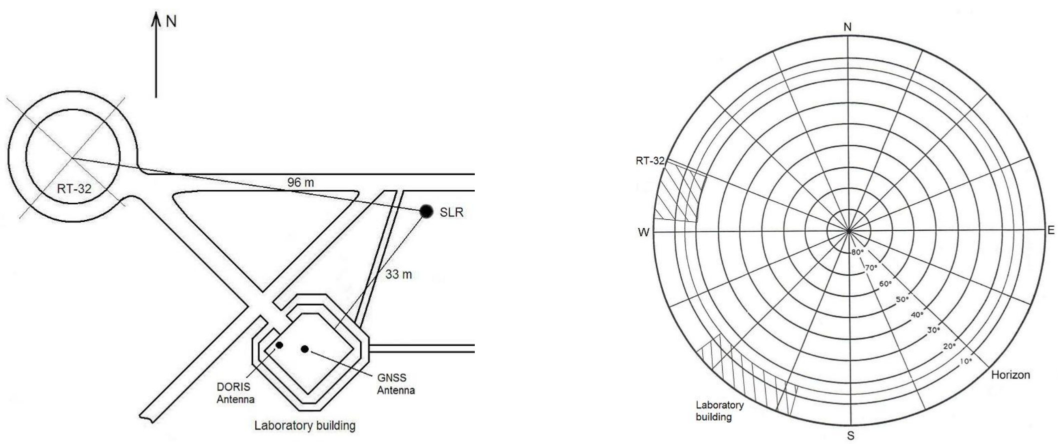

Figure 4. Location of observational instruments (left) and cut-off angles for the SLR system (right) at "Badary" observatory.

Table 3. NEU components of eccentricity vectors.

Eccentricity vectors	ΔN, m	ΔE, m	ΔU, m
From SVTL to 1880 RP	32.540 ± 0.003	-23.158 ± 0.003	-7.634 ± 0.001
From ZECK to 1889 RP	30.683 ± 0.002	25.381 ± 0.002	-10.856 ± 0.001
From BADG to 1890 RP	36.585 ± 0.002	25.925 ± 0.002	-8.085 ± 0.001

Figure 5. View of "Svetloe" observatory (left) and the SLR system (foreground) and the VLBI antenna (background) at "Badary" observatory (right).

References

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