“Quasar” VLBI network observatories as co-location sites

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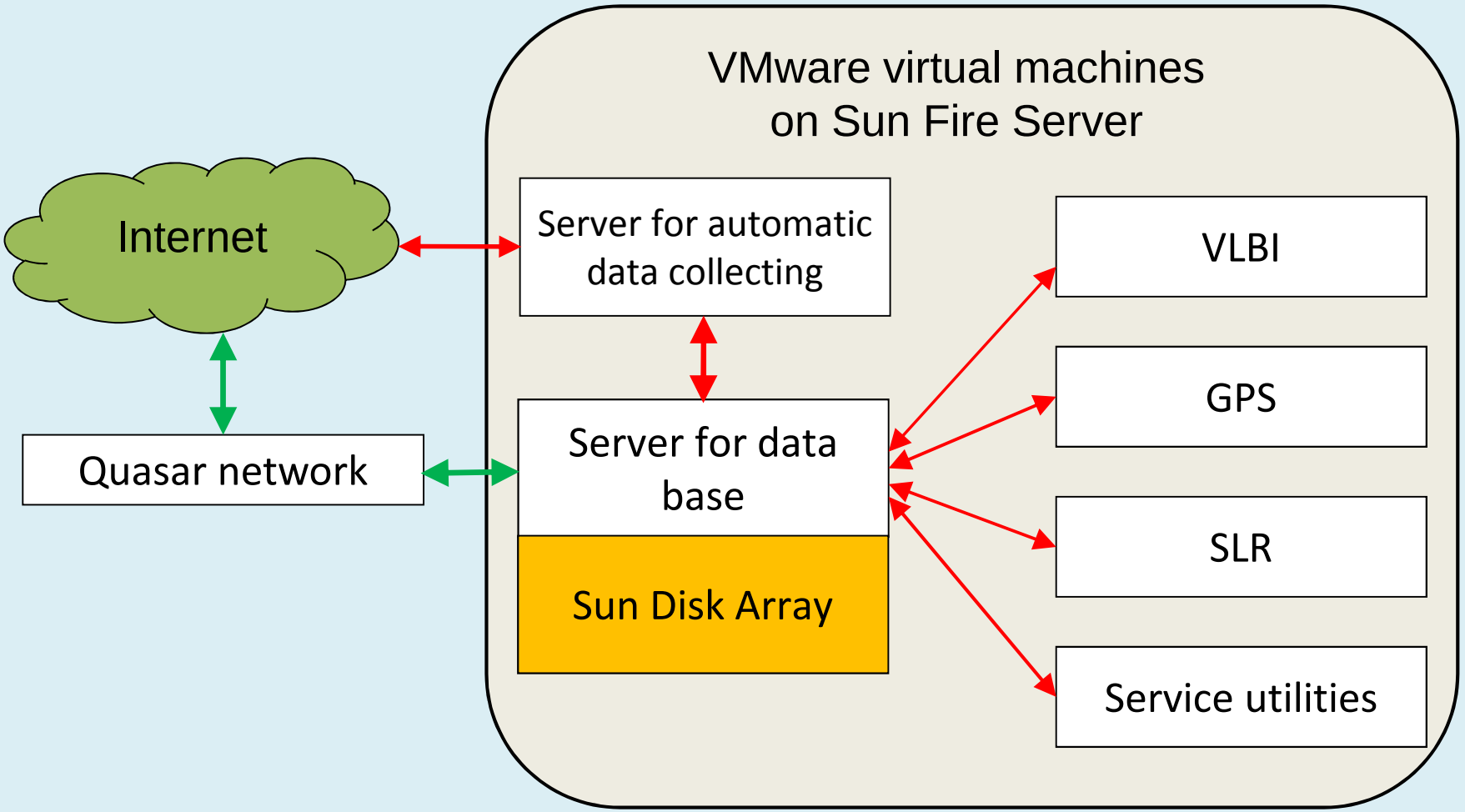
Collocation of Space Geodetic Techniques

- is realized in the framework of IERS
- provides the most reliable results for TRF and EOP
- supposes:
  1. installation of different observational techniques at sites (co-location)
  2. combined processing of different types of observations (collocation)

IAA activity in space geodesy

- **“Quasar” VLBI network:**
  - VLBI observations
  - GPS/GLONASS observations
  - DORIS (Badary)
  - SLR observations
  - Meteo-, WVR-data
  - Local ties monitoring
- **IAA EOP Service:**
  - VLBI (IVS: 24h - weekly, Int - daily)
  - VLBI (Ru: 24h, 1h, weekly)
  - GPS (IGS, 24h, daily)
  - SLR (ILRS, 96h, daily)
  - Combination software development

IAA EOP service structure



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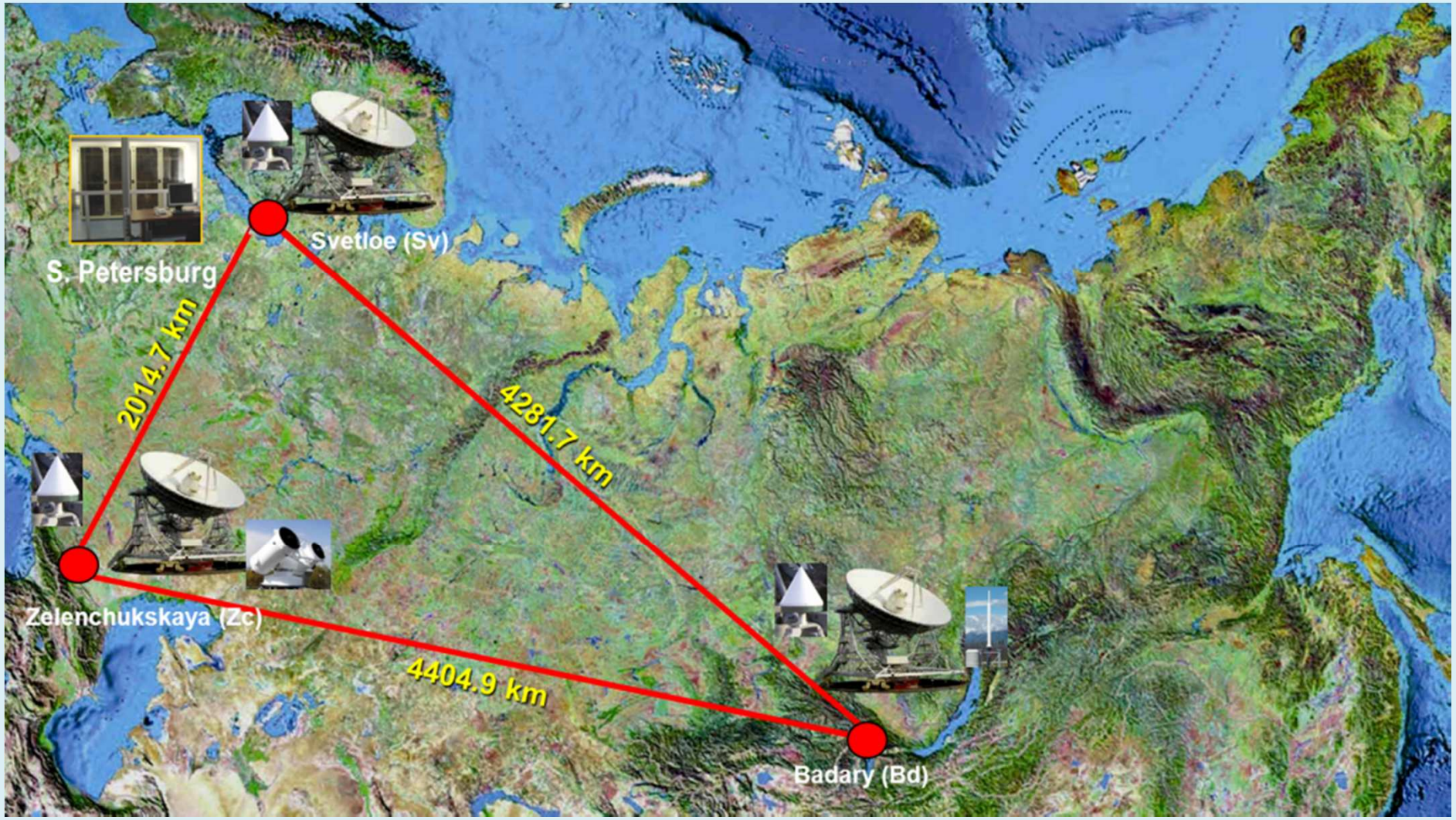
VLBI Network “Quasar”



VLBI systems

Radio telescopes with 32 m antenna

Sv

Zc

Bd

International (IVS, EVN and domestic observation programs

Combined GNSS receivers

SVTL **ZECK** **BADG**







TOPCON NET-G3 **Javad Delta-G3T** **Javad Delta-G3T** **Javad Delta-G3T**

(72 channels) **(216 channels)**

Daily and Hourly submission of observational data

SLR systems “Sazhen-TM”

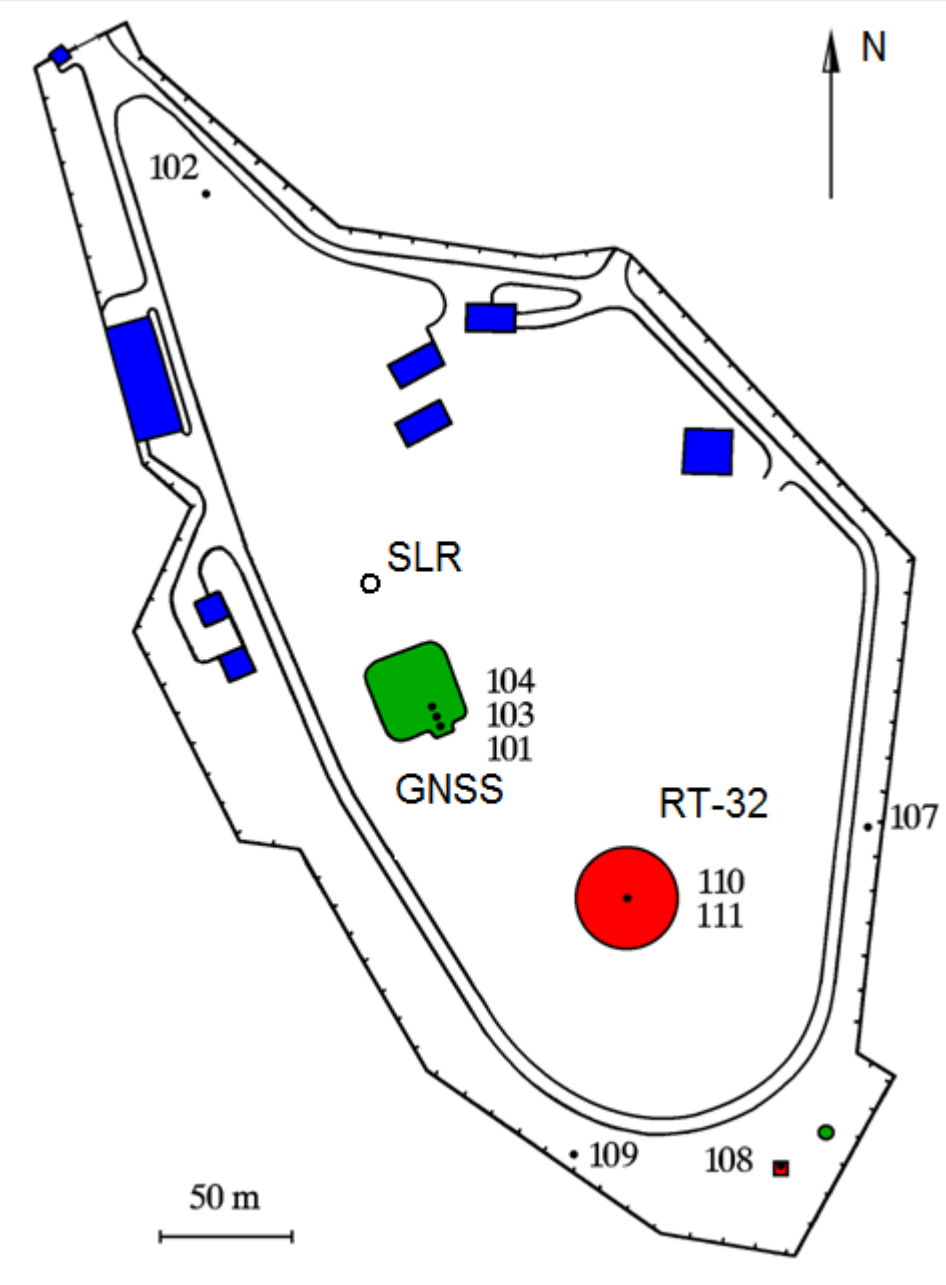
DORIS Antenna
(Badary obs.)

- Common equipment:
  - Time synchronization system with CH1-80 frequency standards
  - Vaisala WXT 510 meteo stations
- Auxiliary equipment:
  - WVR (Svetloe observatory)
  - Equipment for local geodetic survey (GPS receivers Leica SR520, tachymeters, etc.)

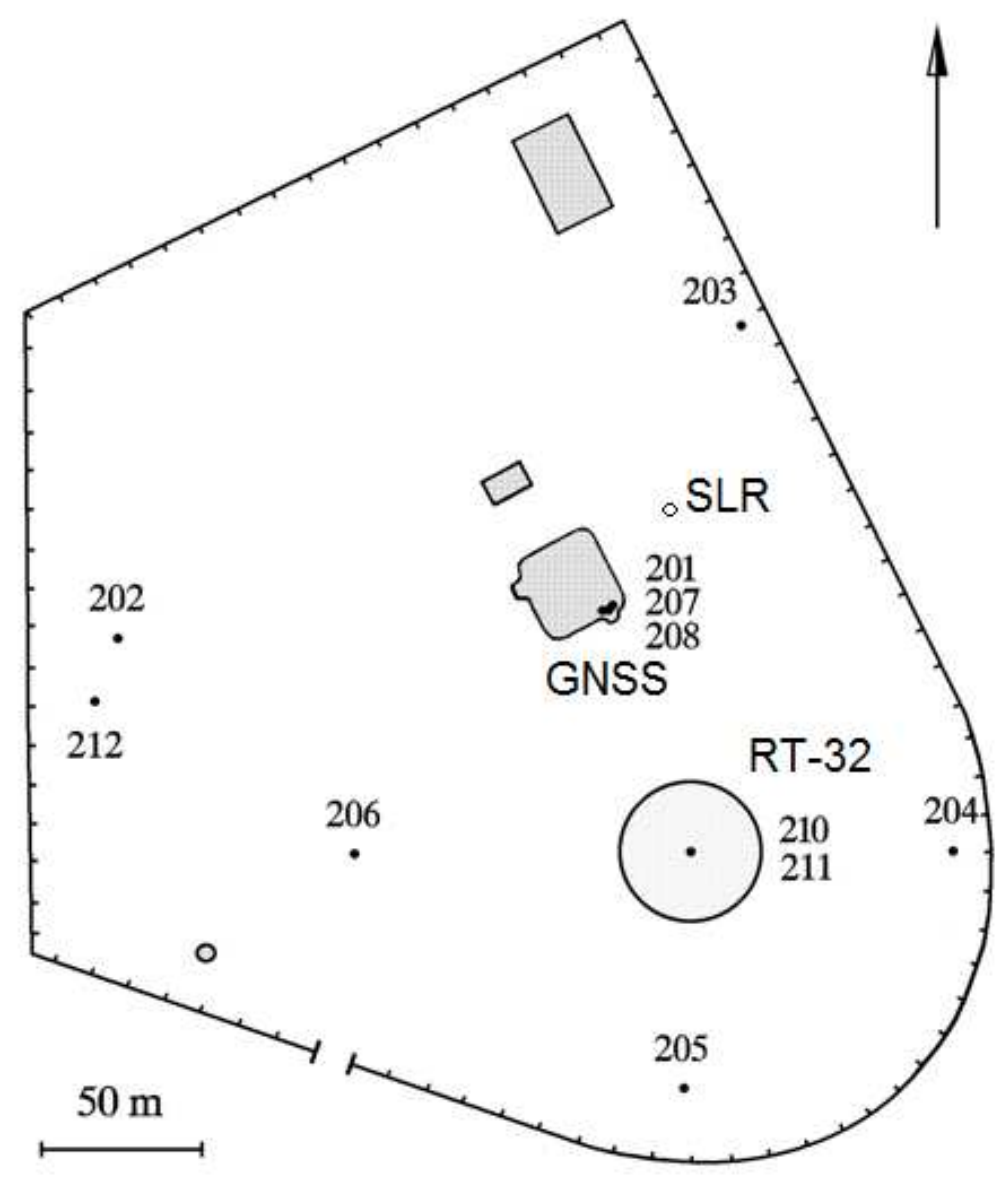
Different global and regional network stations at the “Quasar” observatories

Technique	Network station	“Svetloe”	“Zelenchukskaya”	“Badary”
VLBI	IVS, EVN 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)

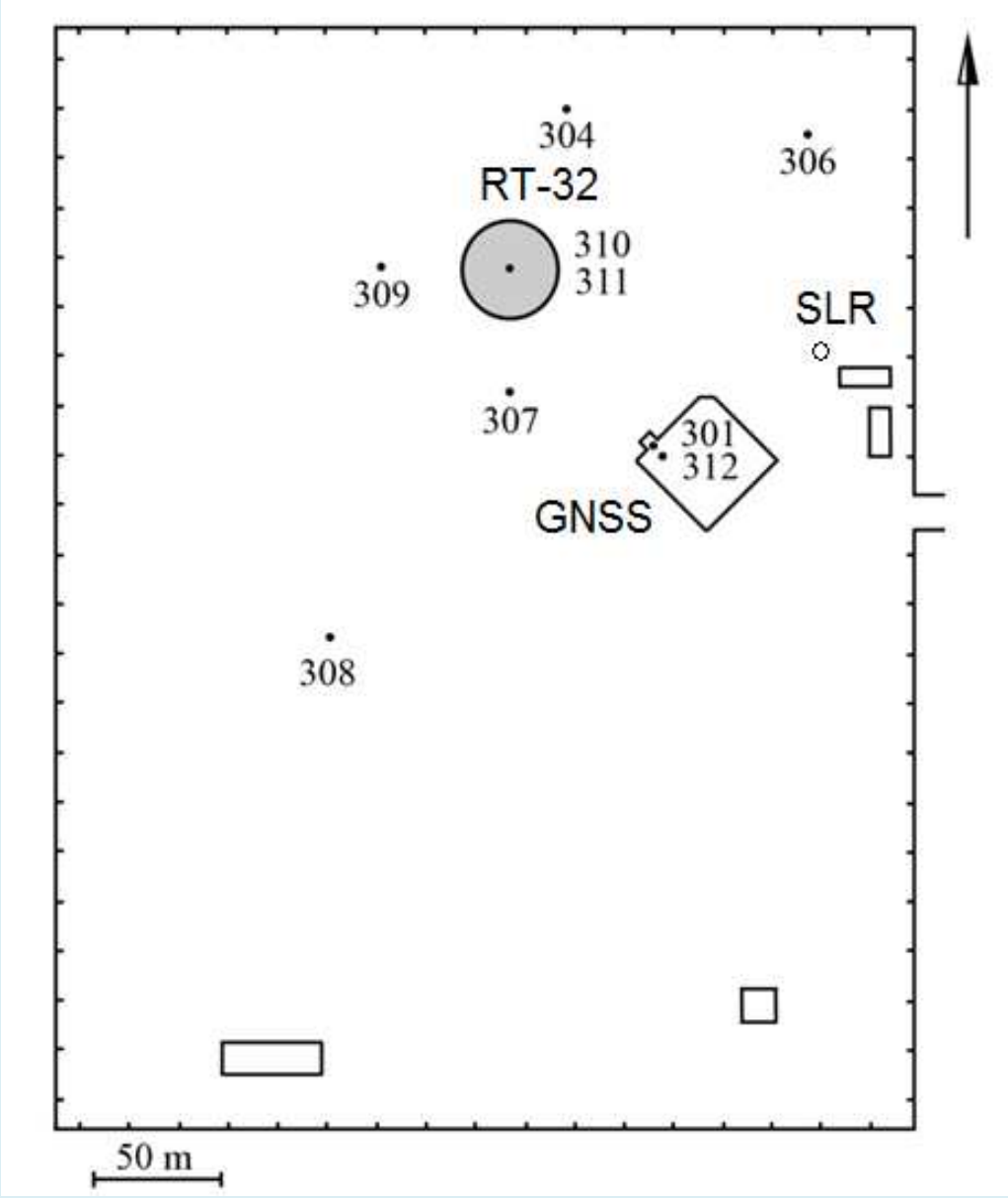
Location of instruments at Svetloe observatory



Location of instruments at Zelenchukskaya observatory

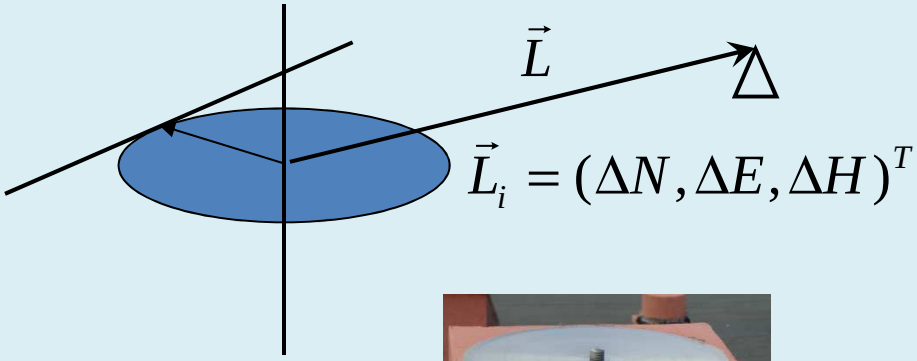


Location of instruments at Badary observatory



Reference points of instruments

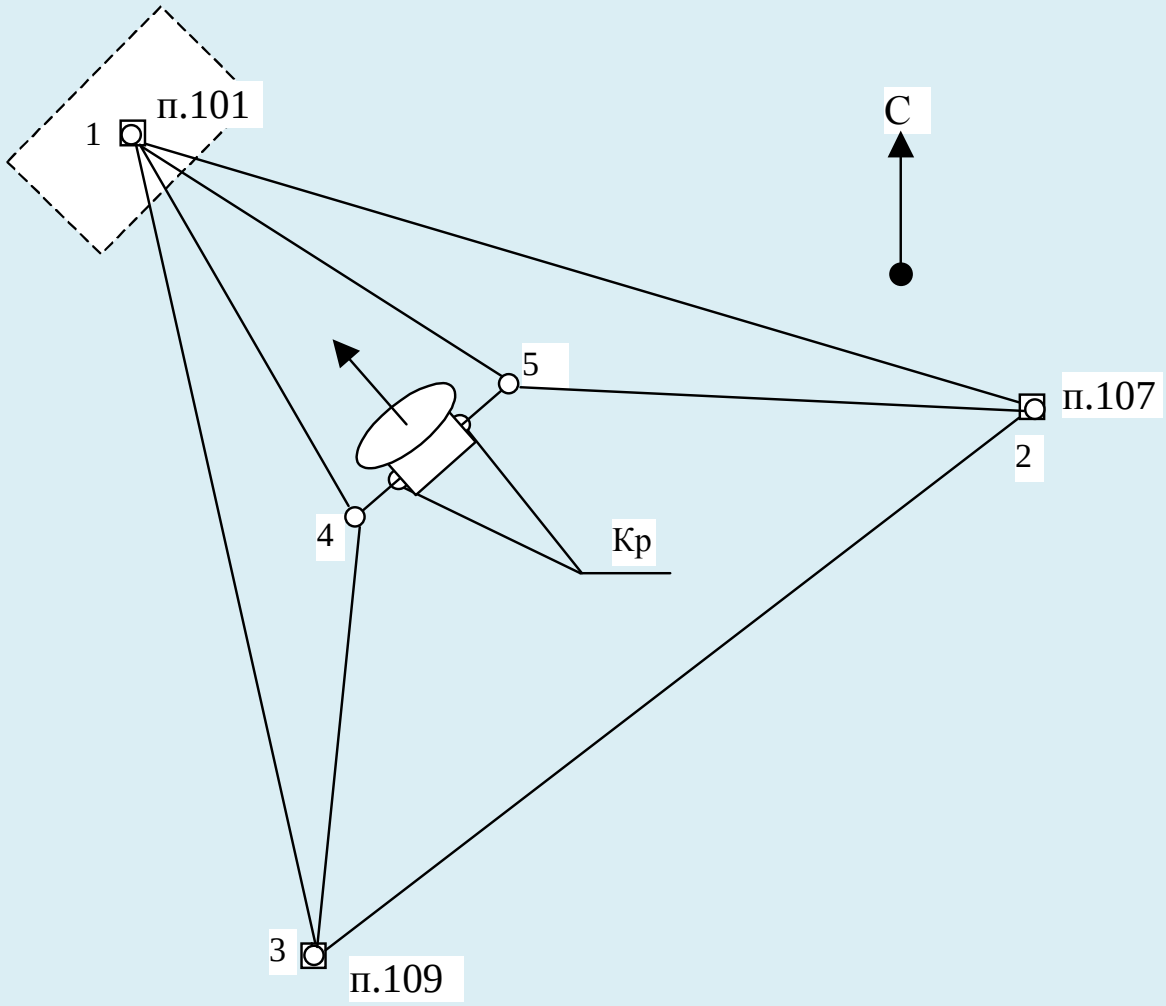
- RT-32 – intersection of axis (accounting antenna offset)



- GNSS receiver – antenna marker

- DORIS – antenna marker
- SLR – intersection of axis

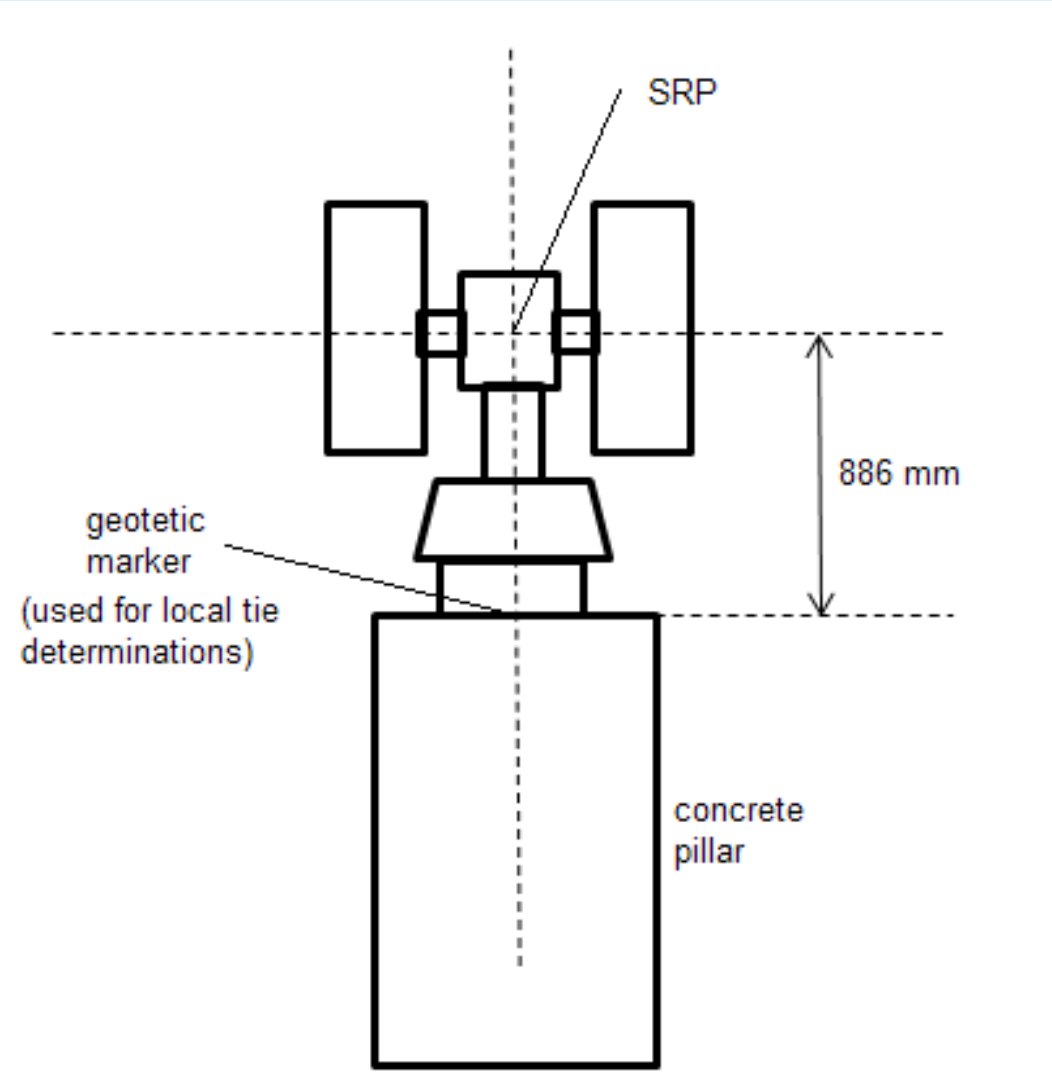
Determination of RT-32 RP



Determination of preliminary coordinates of the SLR system reference points

Data used:

1. Eccentricity vectors from GNSS antenna markers determined from local geodetic surveying
2. Height of the SLR system mount

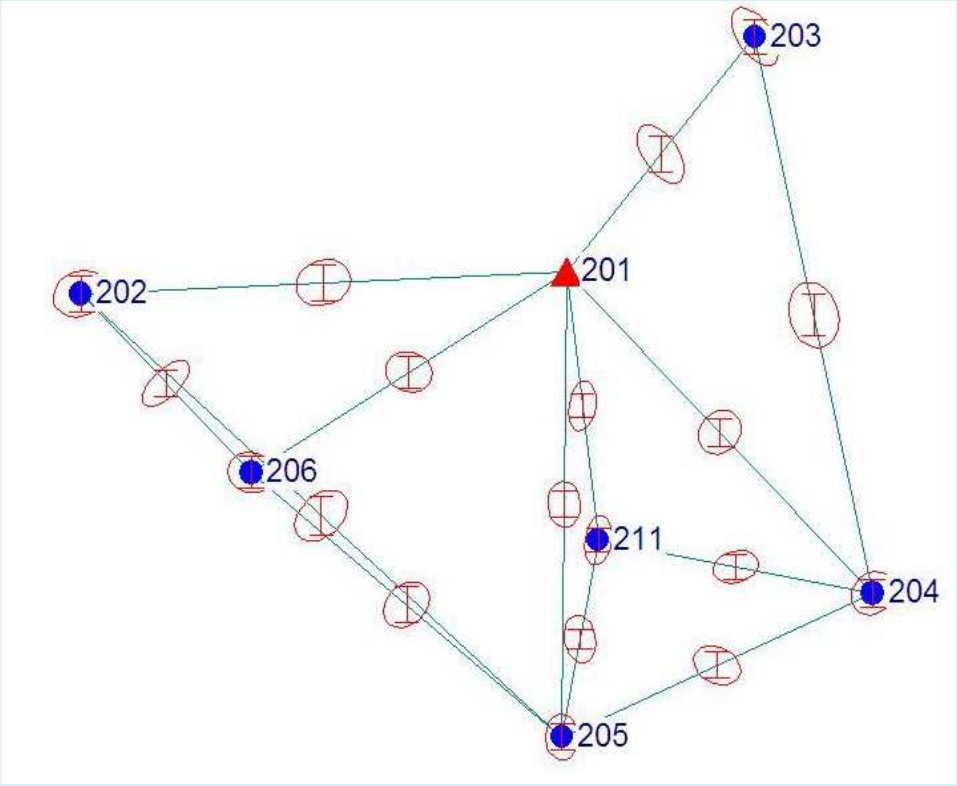


NEU components of eccentricity vectors from markers of GNSS stations

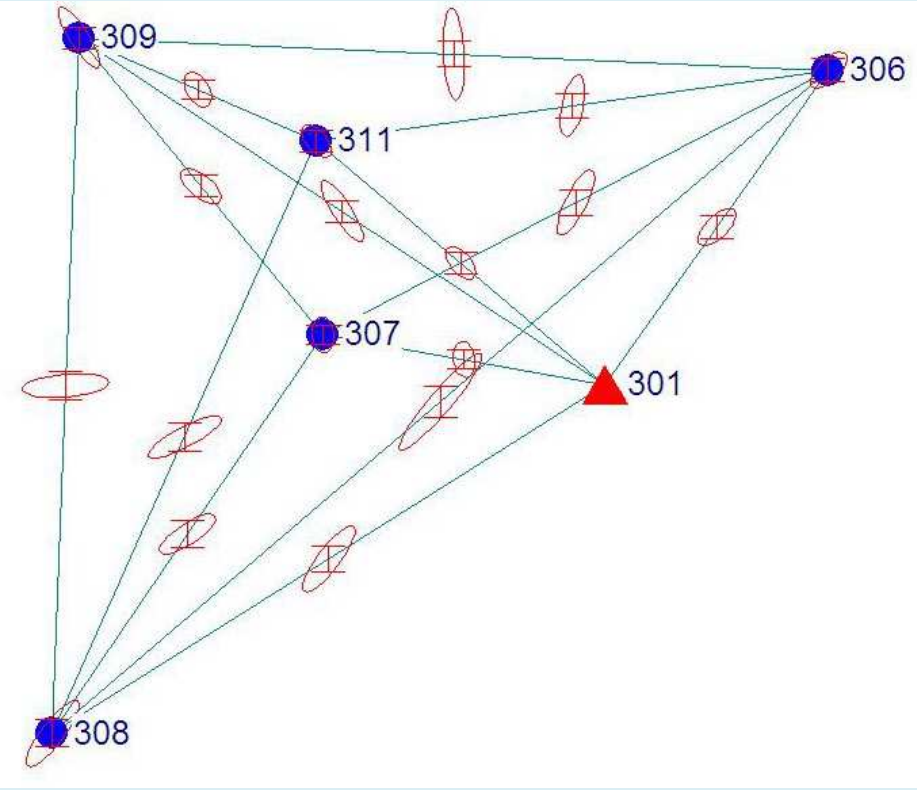
Eccentricity vectors	ΔN, m	ΔE, m	ΔU, m
From SVTL to 1888 RP	32.540 ± 0.003	-23.158 ± 0.003	-7.634 ± 0.001
From ZECK to 1889 RP	30.683 ± 0.002	25.381 ± 0.002	-10.856 ± 0.001
From BADG to 1890 RP	36.585 ± 0.002	25.925 ± 0.002	-8.085 ± 0.001

Local geodetic networks

Zelenchukskaya



Badary



Consistency of VLBI- and GPS-derived coordinates with local geodetic measurements

1) Geocentric coordinates of VLBI antenna reference point
2) Geocentric coordinates of GNSS-antenna marker
3) Eccentricity vectors from local geodetic survey

$$(dN, dE, dH)^T = \vec{L}_{LGS} - \mathbf{T}(\vec{R}_{RT-32} - \vec{R}_{GPS})$$

Differences of coordinates in ITRF2005-system for epoch 2005.0

Observatory	*dN*,mm	*dE*, mm	*dH*, mm
Svetloe	0	5	4
Zelenchukskaya	-2	-12	-4
Badary	2	-15	16

Comparing baselines (VLBI and reduced GPS) Epoch 2005.0

$$\Delta b = \left|(\vec{R}_{V1} - \vec{R}_{V2}\right| - \left|(\vec{R}_{G1} + \mathbf{T}_1\vec{L}_1) - (\vec{R}_{G2} + \mathbf{T}_2\vec{L}_2)\right|$$

$\mathbf{T}_1, \mathbf{T}_2$ - transformation matrixes

$\vec{L}_1, \vec{L}_2$ - eccentricity vectors

Baseline	Δb, mm
Sv-Bd	4.8
Sv-Zc	3.2
Zc-Bd	-9.7


Thank you for your attention!