BLITS: spin parameters and its optical response measured by the Graz 2kHz SLR system

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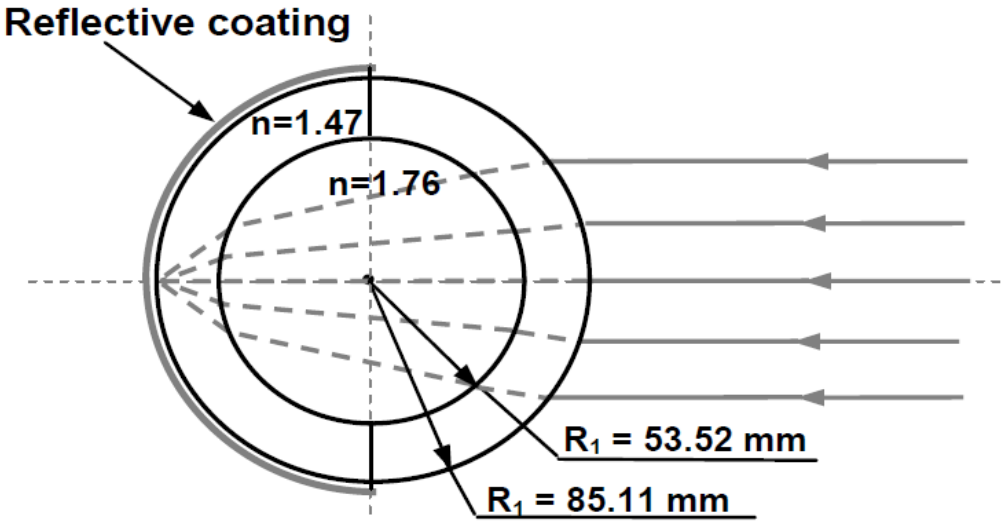
BLITS – spin determination

The BLITS has been designed and manufactured by the FSUE–IPIE (Federal State Unitary Enterprise–Institute for Precision Instrument Engineering, Moscow, Russia).

- experimental verification of the spherical glass retroreflector satellite concept (Luneburg lens)
- obtaining SLR data for the solution of scientific problems in geophysics, geodynamics, and relativity by millimeter and sub-millimeter accuracy range measurements.

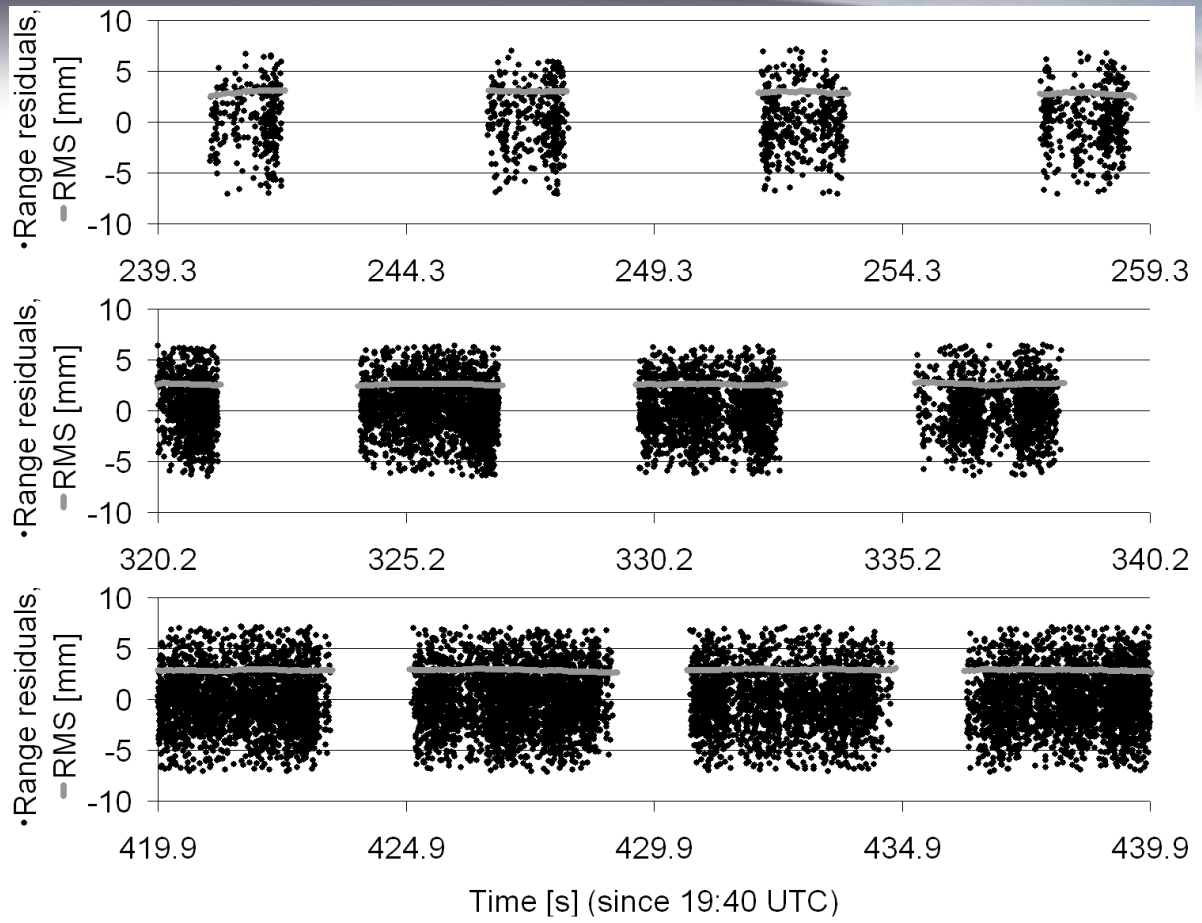
BLITS (courtesy of IPIE), left: inner ball lens in the shell, right: assembled body

Mass 7.53 kg
Circular, sun-synchronous orbit:
Altitude: 832km
Inclination : 98.77°



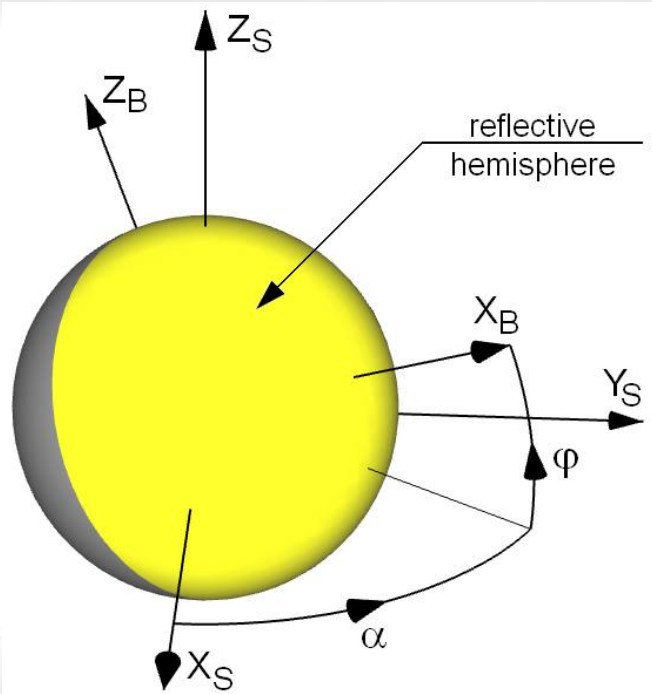
From: Spherical Glass Target Microsatellite. V.D. Shargorodsky, V.P. Vasiliev, M.S. Belov, I.S. Gashkin, N.N. Parkhomenko

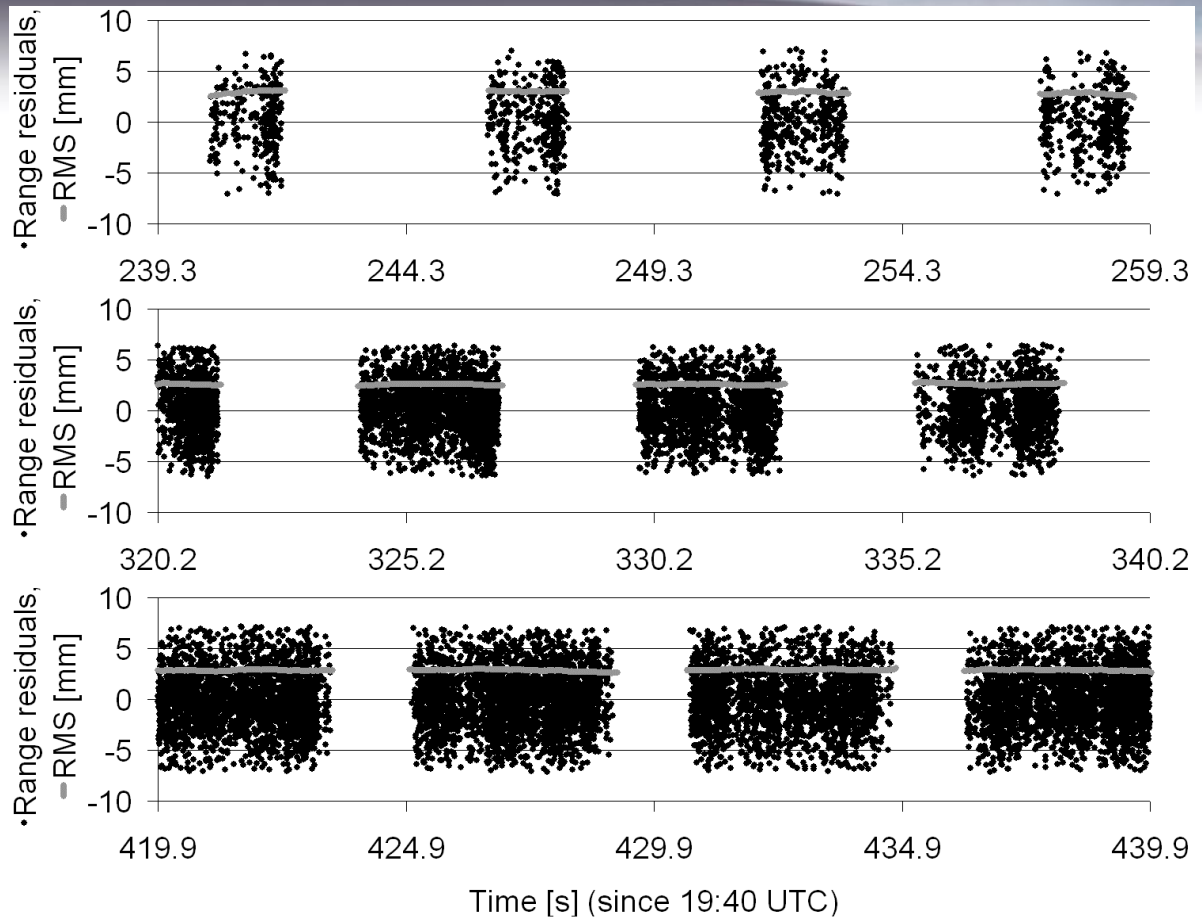
BLITS – spin determination



Range residuals of BLITS; pass from November 14, 2010 (423 days after launch). Three slots (20 seconds) from different parts of the pass show change of intervals duration. The 0 level is the mean value. The average RMS is 2.77 mm.

BLITS – spin determination





Body centered cs:

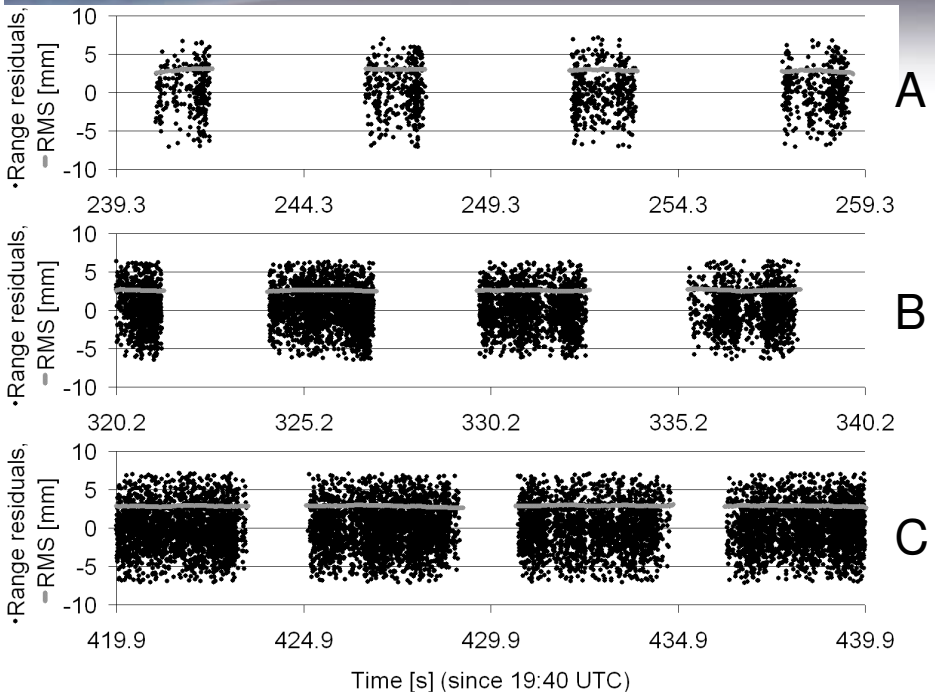
S – spin cs (Z_S – spin axis)

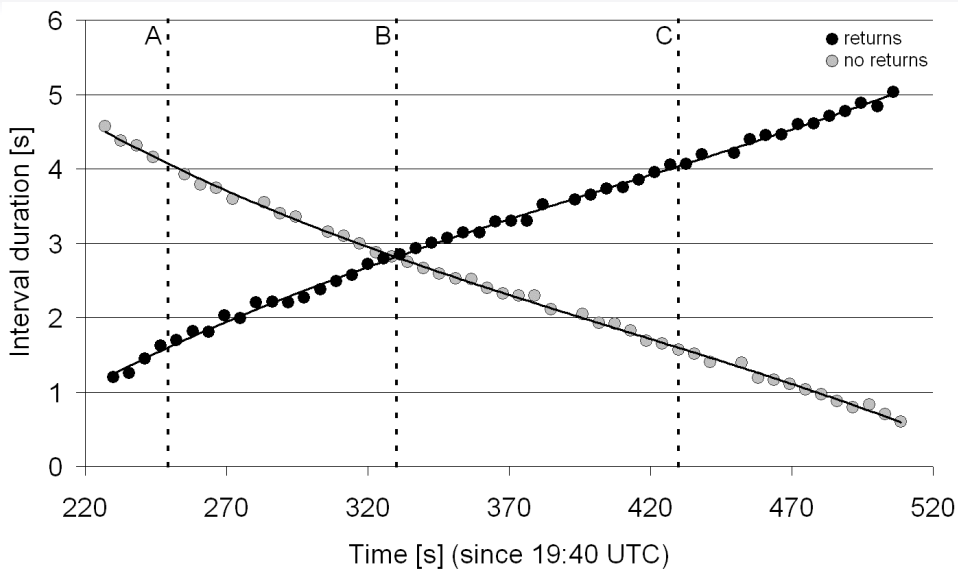
B – body cs (body fixed) (X_B – symmetry axis)

α – phase

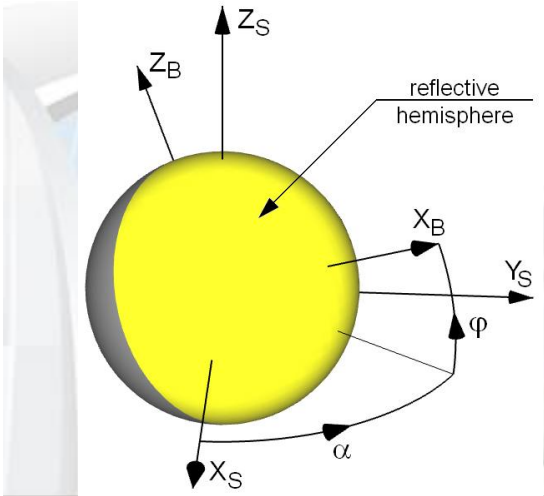
φ – latitude of symmetry axis

BLITS – spin determination



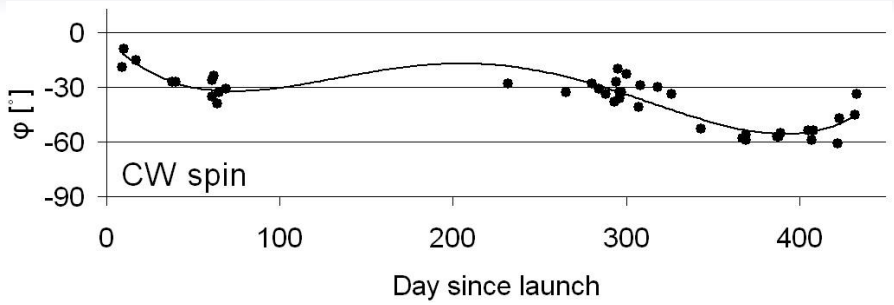


Duration of the intervals during a BLITS pass of November 14, 2010, approximated with poly. functions

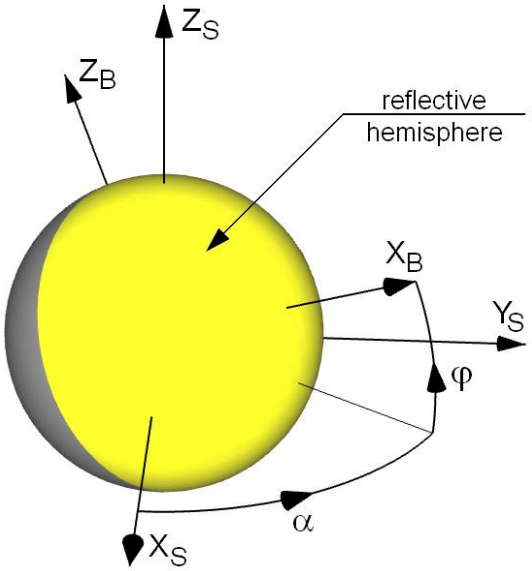


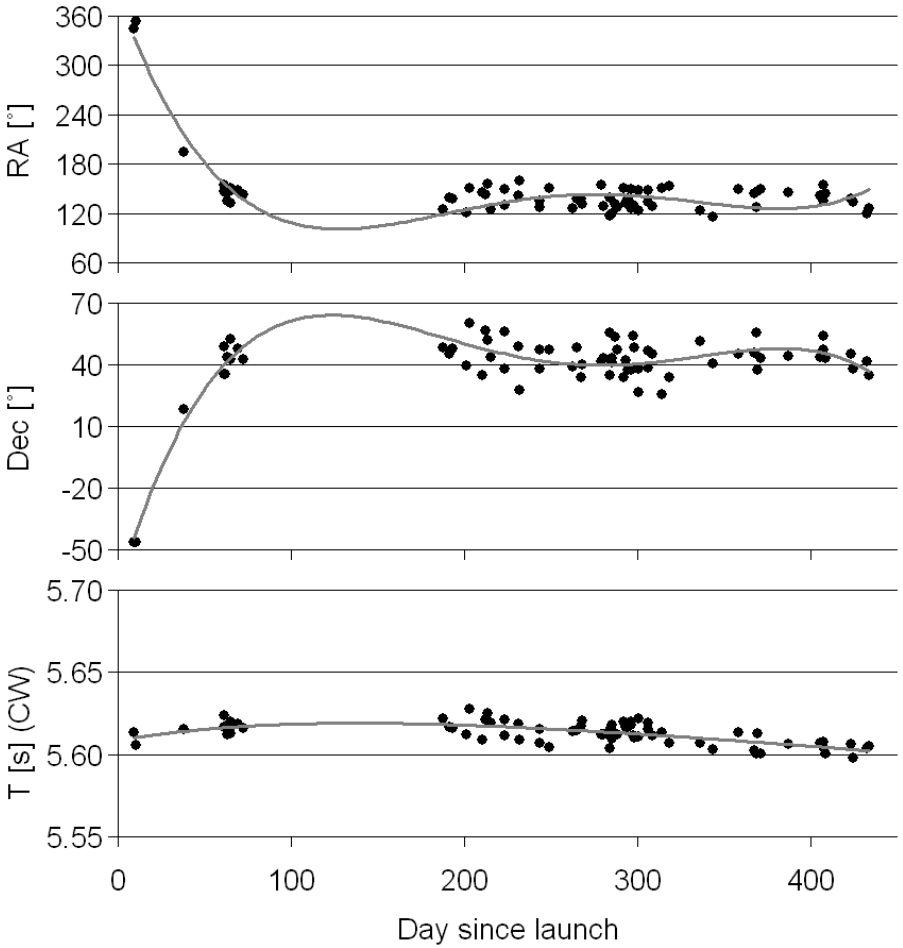
By using simulations we can find spin parameters of the body (spin axis orientation, spin period, φ) for which duration of the simulated intervals coincide the best with the observed values.

BLITS – spin determination

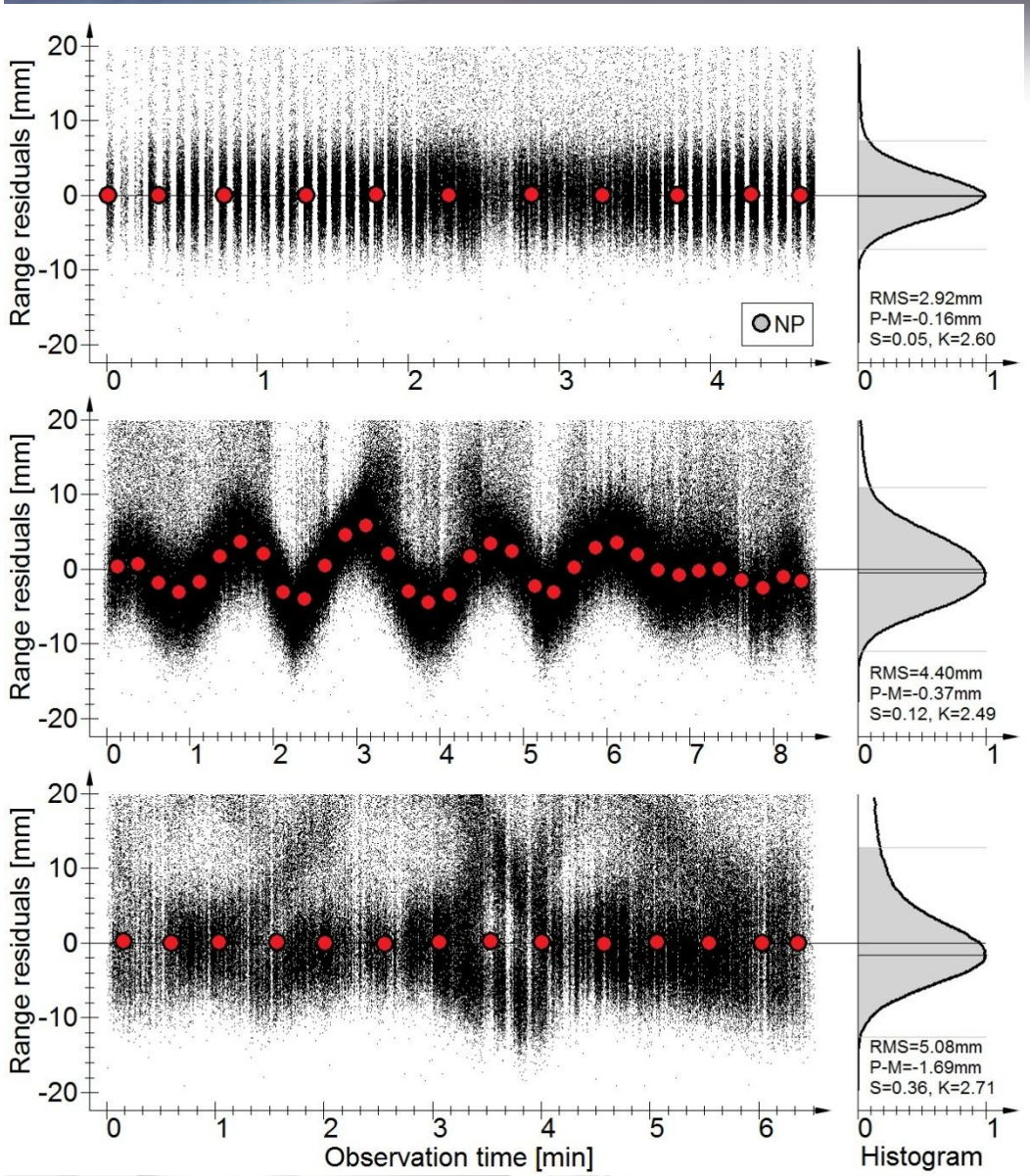


RMSφ=5.85˚
RMS$_{RA}$=14.7˚, RMS$_{Dec}$=7.02˚
T$_{mean}$=5.613s, RMS$_{T}$=4.77ms

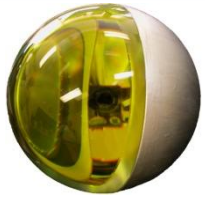




BLITS – optical response

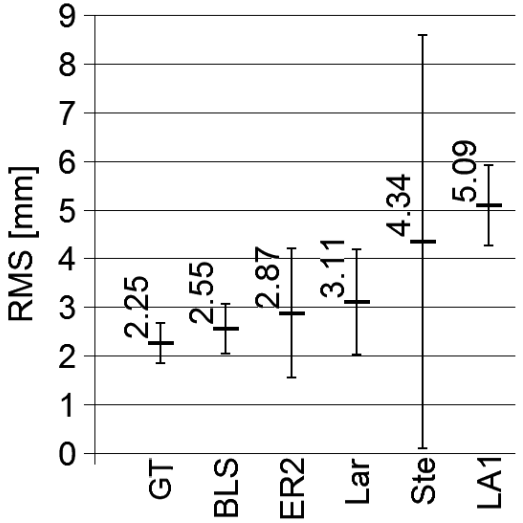


BLITS



ERS-1

Stella

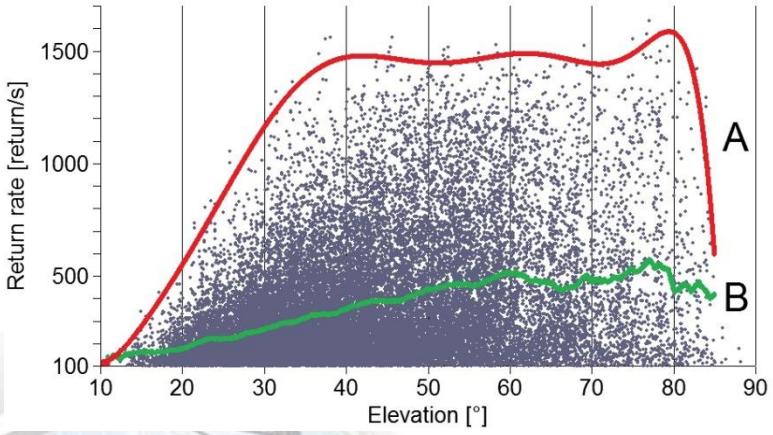


RMS(±3σ) of NPs:

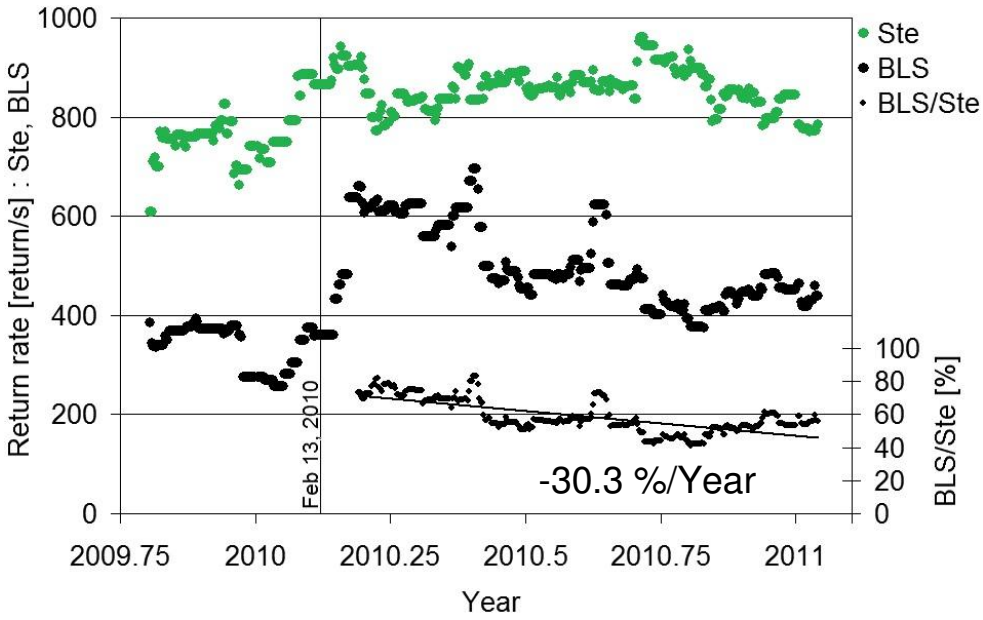
BLS: BLITS
ER2: ERS-2
Lar: Larets
Ste: Stella
LA1: LAGEOS-1
GT: Ground target (calibration)

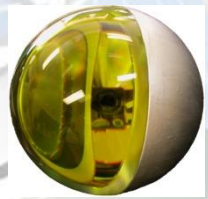
BLITS – optical response

Return rate vs Elevation



Average RR (El 50°-80°) vs time





BLITS
Atlitude: 832 km
Inclination: 98.77°
Cross section: $0.1 \cdot 10^6 m^2$

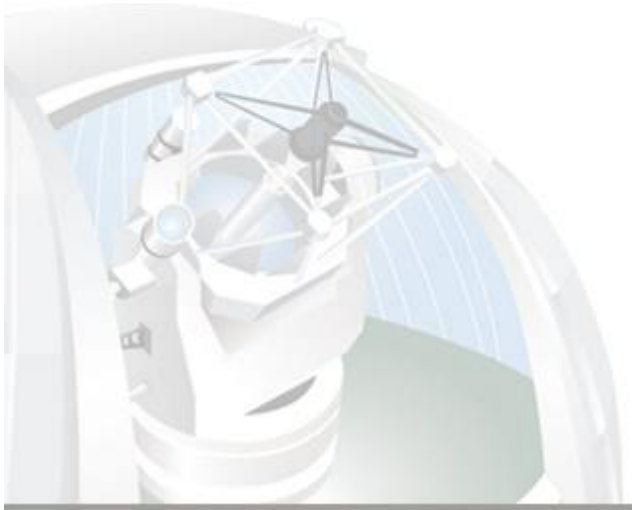
Stella
Atlitude: 800 km
Inclination: 98.6°
Cross section: $1.8 \cdot 10^6 m^2$

BLITS – spin determination and optical response

-Spin parameters of BLITS were not stable after the launch. The initial, very dynamic, change of the spin axis orientation could be caused by a direct action of the deployment mechanism.

-Due to the construction, the optical range correction is constant down to sub-mm level, and is independent on attitude of the satellite. The flat response of BLITS allows for the most accurate range measurements among the SLR satellites, on the accuracy level of the ground target.

-Using this successful design instead of classical RRA panels for active missions (CHAMP, GRACE, GOCE) would provide more accurate and stable COM (down to sub-mm), and a wider incident angle between the laser beam and a nadir direction.



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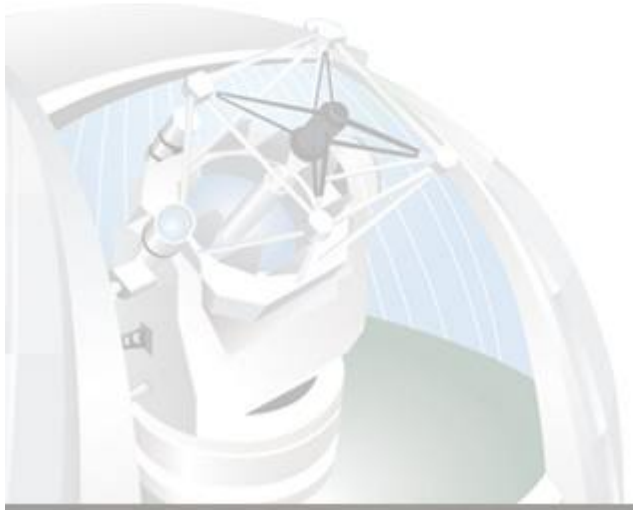

Thank you!