# Estimation of the laser retro-reflector array center location for BEIDOU-3M



**<u>Objective</u>**: to study ways to improve the accuracy of ephemeris support for BEIDOU-3M SC on the basis of joint coordinated use (co-location) of SLR and radio measurements.

### **Publications on the subject from authors:**

1. V. Glotov, M. Zynkovsky, V. Mitrikas, A. Pafnutev (2015): GLONASS SCs laser range measures role in verification of data processing methods. IAC PNT analysis of GLONASS SCs laser ranging by worldwide station net.



#### IAC-COD, IAC-GFZ and IAC-SHA BEIDOU orbit comparison from MGEX web page



2. V. Glotov, V. Mitrikas, A. Pafnutev (2018): Estimation of the laser retroreflector array center location for GLONASS-M

#### **Relevance:**

- 1. ILRS stations have accumulated a large volume of laser measurements for the BEIDOU satellites, since 4 spacecrafts were included in the ILRS priority list.
- There is an improvement in the accuracy of a posteriori ephemeris information for BEIDOU-3M spacecraft and its consistency between various IGS analysis centers.
- 3. Work on co-location of different measurement and observation techniques is highly important in terms of results consistency and verification.

#### Initial data:

- 1. Time period: 01.01.2022 01.08.2024
- 2. Number of SLR stations in research 22
- 3. Stations coordinates taken from ITRF2014 solution
- 4. BEIDOU SC navigational antenna phase center offset from the ANTEX file recommended by the IGS.
- 5. Nominal LRA coordinates available on the ILRS web page
- 6. Number of BEIDOU SC in research: 4 (constantly were in the priority list)
- 7. Number of normal points total 25866
- 8. Number of normal points after filtration 25719

## GNSS data:

To perform integrated research four sets of precise ephemerids obtained a posteriori from the radio measurements in different IGS analysis centers (IAC, CODE, GFZ, SHA) were used as reference ephemeris data for BEIDOU-3M SC.



Residuals with IAC orbits, W ORMS = 30,8 mm

#### Estimated position of CAST SCs LRR



Axis Z, CAST SC

COD

🔴 GFZ

IAC

SHA

- TAB

1,27000

1,26000

1,24000

1,23000

1,22000

1,21000

5 1,20000

1,19000

E 1,25000

#### Axis Y, CAST SC 0,00000 -0,02000 -0,04000 COD 0,06000 🛑 GFZ -0,08000 IAC -0,10000 SHA -0,12000 **—** TAB -0,14000 -0,16000 Number of the spacecraft point in orbit



SC PRN	IAC			COD			GFZ			SHA		
	ΔX, m	ΔY, m	ΔΖ, m	ΔX, m	ΔY, m	ΔΖ, m	ΔX, m	ΔY, m	ΔΖ, m	ΔX, m	ΔY, m	ΔΖ, m
20	0,01387	0,01744	-0,07108	-0,00984	0,01363	-0,05819	-0,00380	0,04228	-0,03318	-0,03420	-0,05115	-0,05272
21	0,00264	0,00945	-0,07105	0,02497	0,01178	-0,05321	0,00739	0,01701	-0,02346	-0,02711	0,02511	-0,05175
29	-0,00283	-0,01550	-0,00009	-0,00344	-0,00845	0,01219	0,03918	-0,01494	0,03310	0,00397	-0,02455	0,06852
30	-0,00479	-0,02090	0,00001	0,00967	-0,02729	0,01602	0,04502	0,00665	0,03770	-0,01051	0,00968	0,06957

#### Estimated position of SECM SCs LRR

Residuals with GFZ orbits, W ORMS = 28,2 mm





Residuals with IAC orbits, W ORMS = 30,1 mm

0,44000

0,43500

0,43000

0,42500

0,42000

0,41500

0,41000

0,40500

0,40000

0,39500

28



COD

Residuals with GFZ orbits, W ORMS = 32,9 mm







