

Orbit determination and SLR evaluation of China's space laboratory



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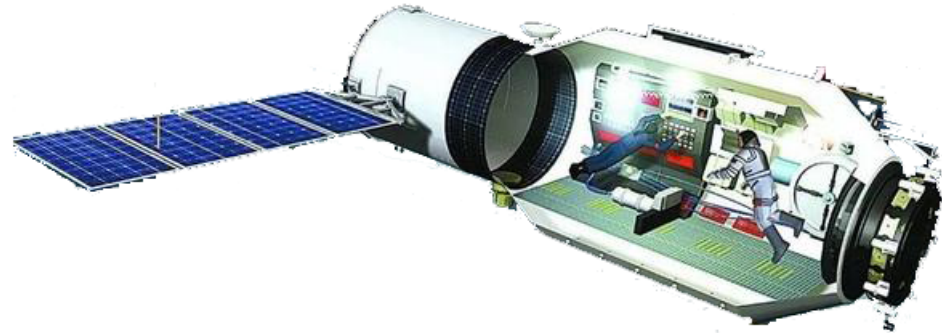
Shanghai Astronomical Observatory, China



Introduction

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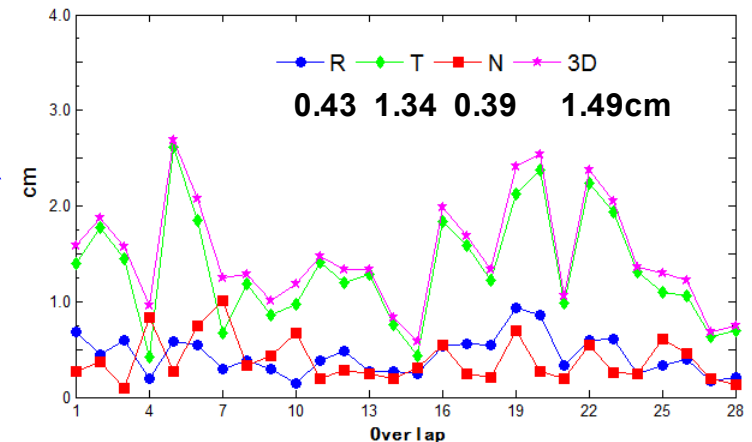
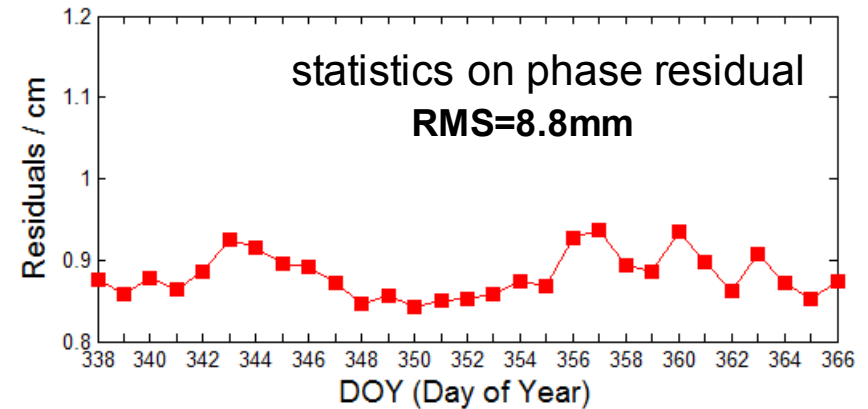
- Tiangong-2, Chinese space laboratory, launched on 15 Sep 2016
- Scientific goal:
 - further verification of space rendezvous and docking technology
 - space to earth observation
 - experiment in space science and technology
 - research in space medicine
- Orbit parameters:
 - circular
 - period : 92.2 minutes
 - inclination : 42.8 deg
 - initial height : 393 km
- Instrument:
 - on-board GPS receiver - tracking and orbit determination
 - SLR retroreflector – orbit accuracy validation
 - cold atomic clocks, spectrometer, microwave altimeter, etc



Orbit determination & evaluation

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- Based on GPS observation
- POD Method :
 - kinematic
 - reduced-dynamic
 - dynamic
- Orbit evaluation :
 - residual fitting
 - overlap comparison

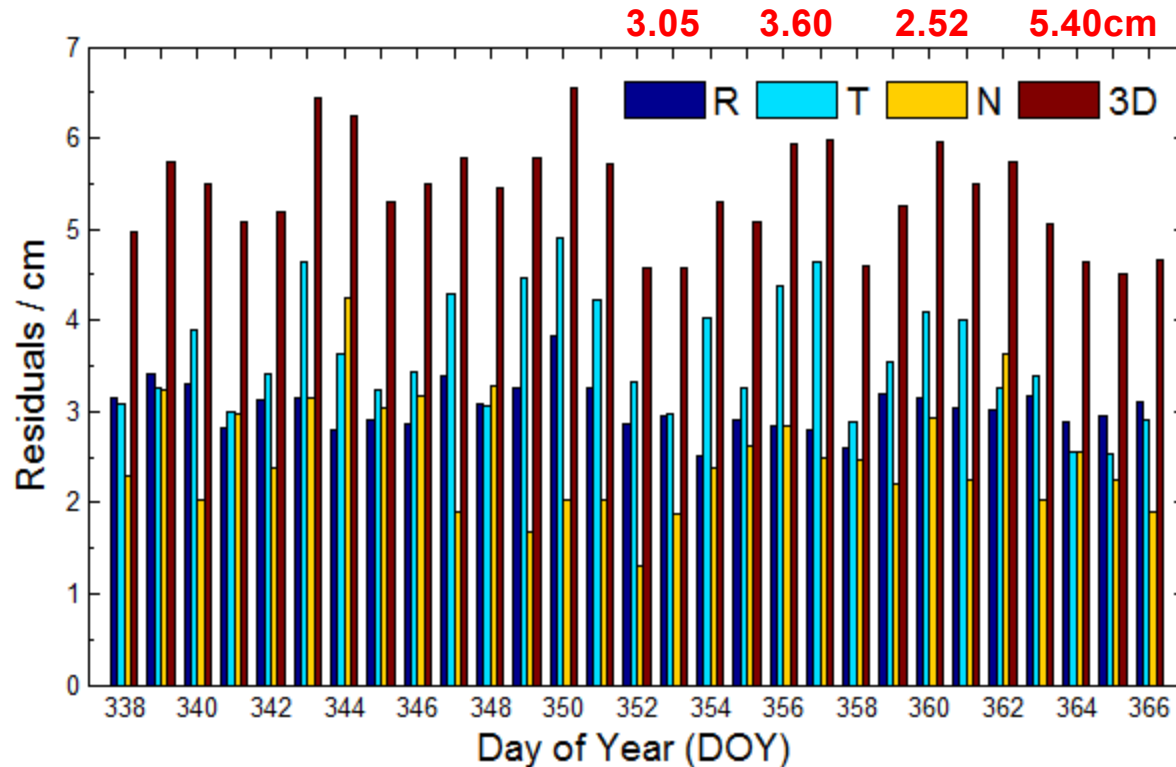




Orbit evaluation

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- Orbit evaluation :
 - independent orbit comparison

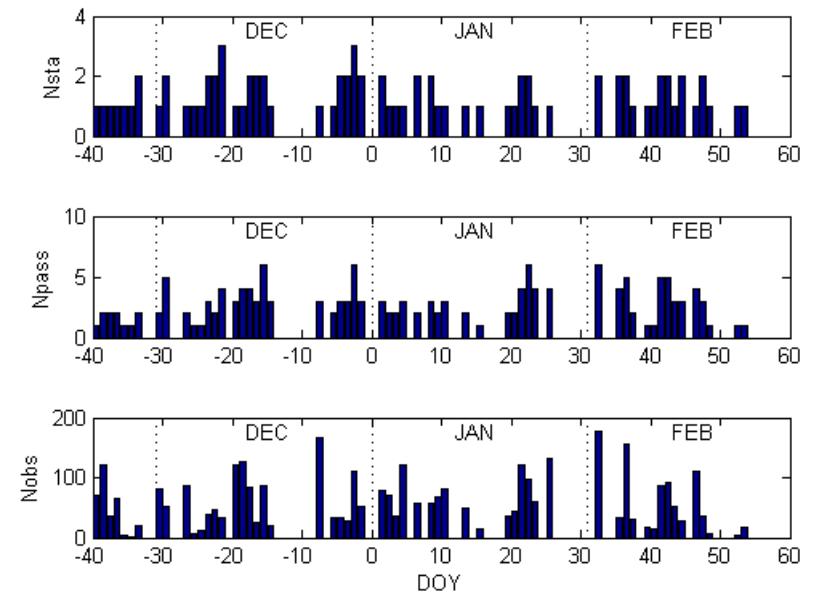
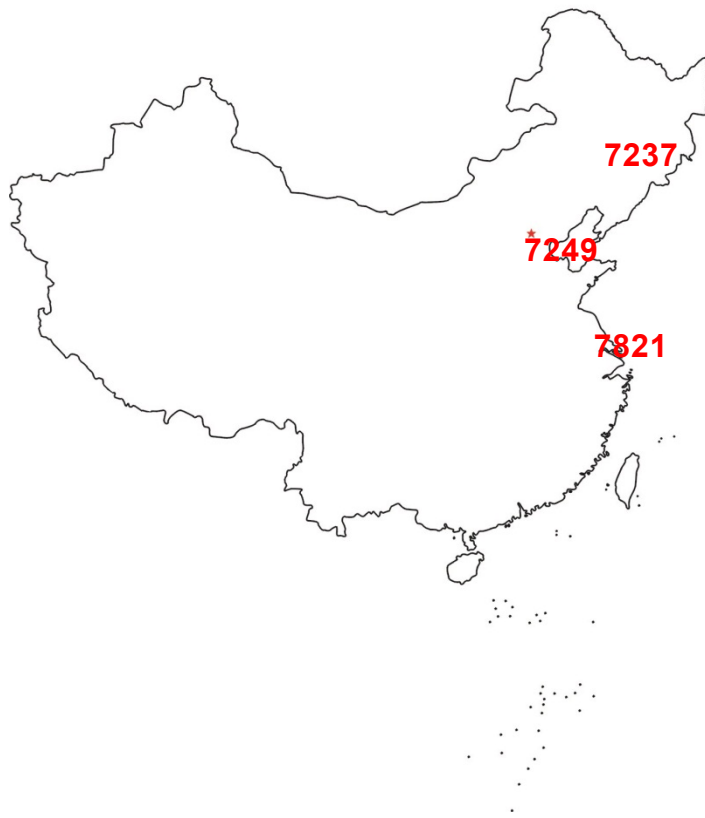




SLR validation

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- Orbit evaluation : SLR validation



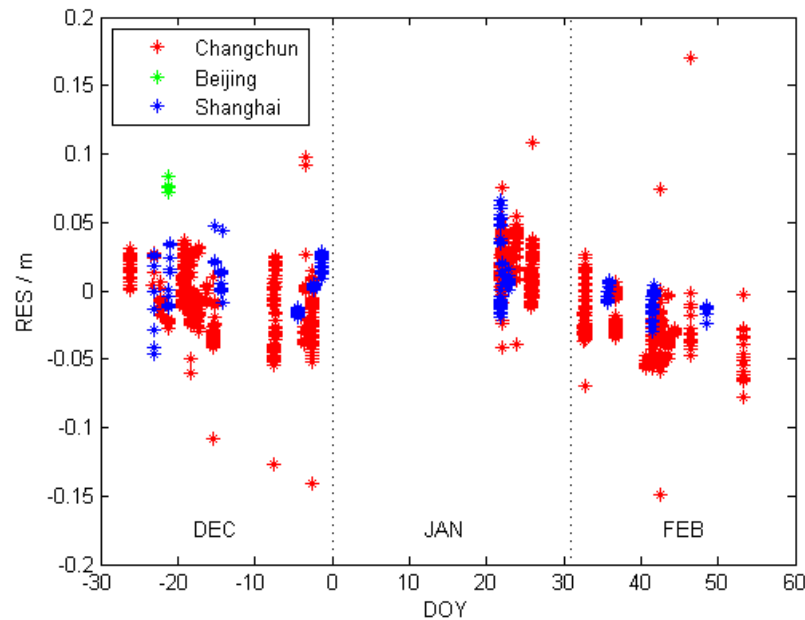
Dec,2016 – Feb, 2017



SLR validation

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- Orbit evaluation : SLR validation



Range residual ~ 2.3cm

Station	Mean / cm	RMS / cm
7249 Beijing	7.68	0.48
7237 Changchun	-0.82	2.86
7821 Shanghai	0.35	2.08



Conclusion

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- Reduced dynamic orbit determination of Tiangong-2 using onboard GPS measurement :
 - Phase residuals
mean 8.8mm, near to noise level of GPS phase measurement
 - Overlap comparison
R / T / N / 3D RMS ~ 0.4 / 1.3 / 0.4 / 1.5 cm
- orbits derived dynamic method and reduced dynamic method
 - quite equivalent
R / T / N / 3D RMS ~ 3.0 / 3.6 / 2.5 / 5.4 cm
- SLR validation
 - an important evaluation method
station-satellite range RMS ~ 2cm