SLR Return Analysis for SOHLA-1

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Overview of SOHLA-1 (1/2)

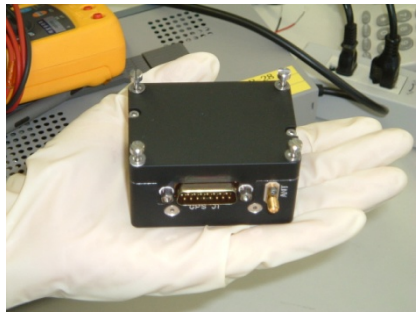
Features of SOHLA-1

1. Technical demonstration satellite developed by local SMEs (small and medium-sized enterprises) with technical support of JAXA.
2. Low-cost, simple tech-demo platform with 50kg-class spin satellite.

Necessity of SLR

One of the missions of SOHLA-1 is the tech-demo of the low-cost, micro-GPS receiver developed by JAXA based on COTS automobile technology.

SLR is needed for the calibration of GPS based satellite positioning.



Micro-GPS receiver

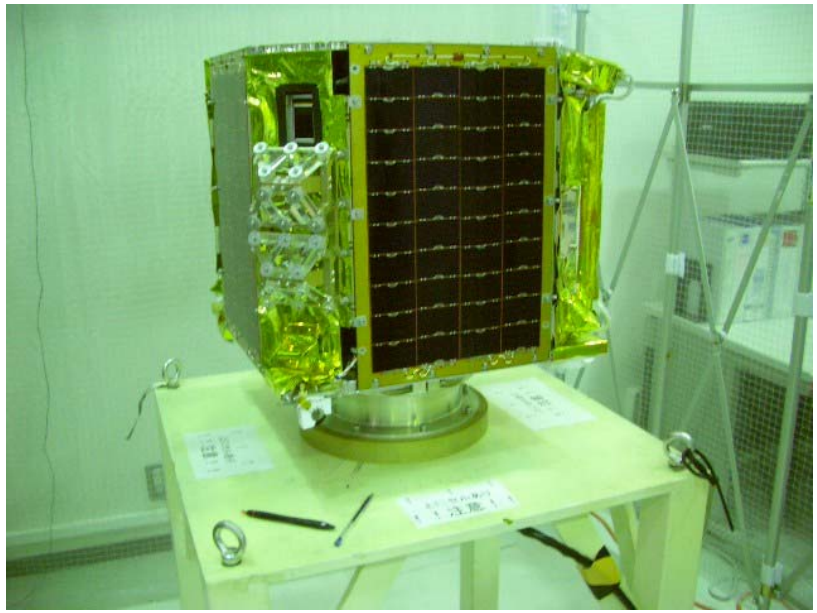
GPS Antenna

Overview of SOHLA-1 (2/2)

Characteristics of SOHLA-1

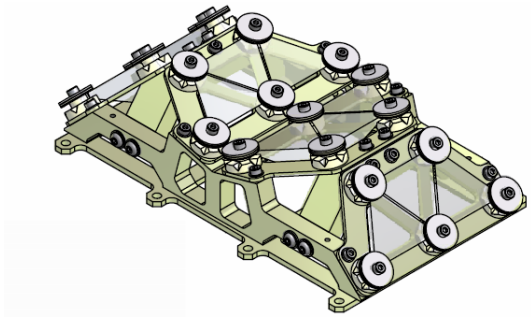
- Launch Rocket: HII-A
- Orbit : Sun-synchronous
- Attitude : Spin stabilized

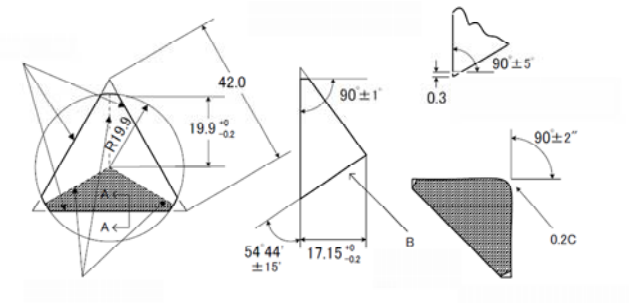
Mass	Approx. 50kg
Dimension	Approx. 50cm x 50cm x 50cm
Orbit Altitude	666km (SSO)
Orbit Inclination	98.06 deg
Period	About 1.6hours
Launch	2009 Winter(Jan)



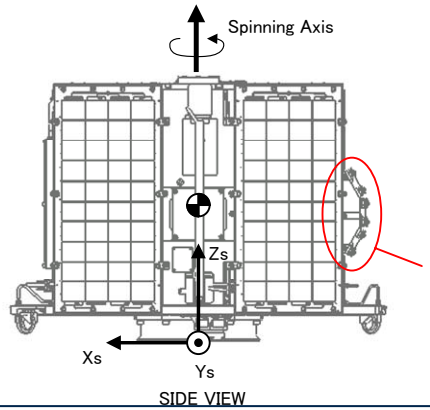
SOHLA-1

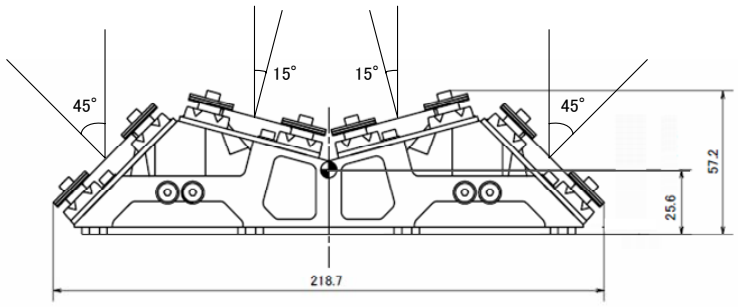
LRA for SOHLA-1





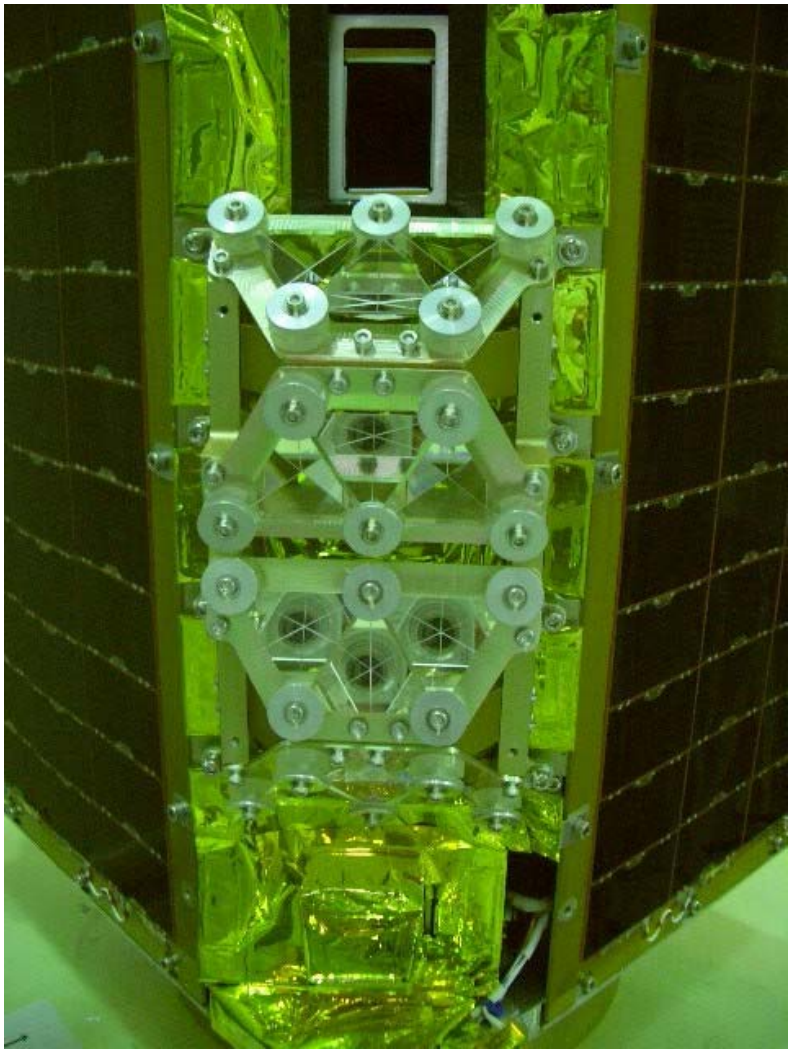
Shape of prisms are same as Ajisai (42 mm diameter) and material is BK7.
Laser reflector consists of 12 prisms. Coverage angle is about 60 deg.

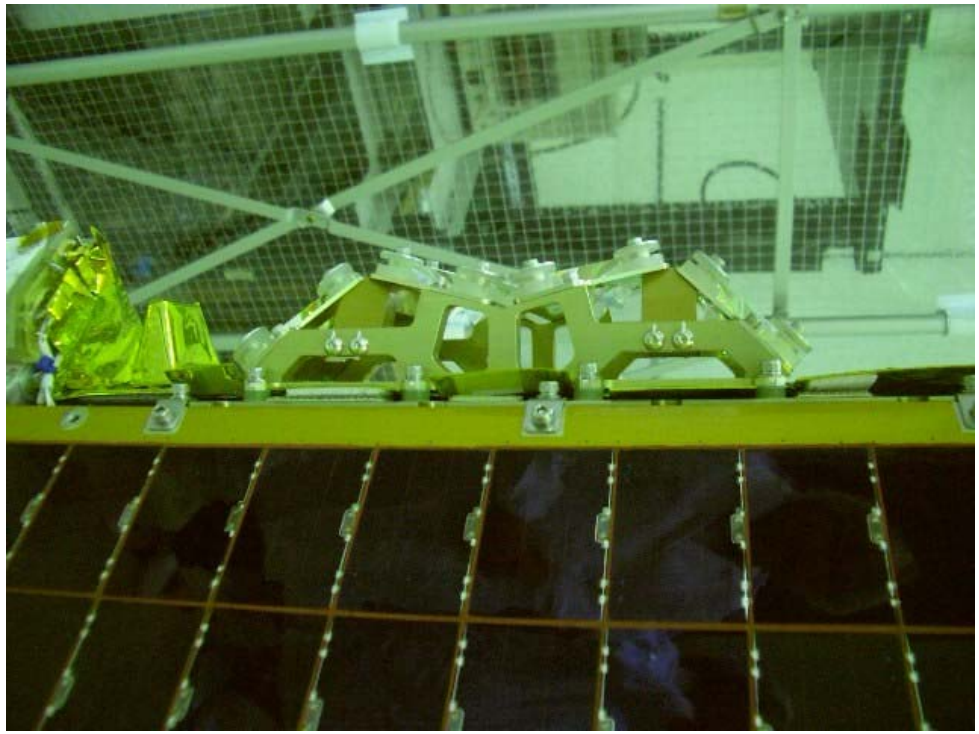




A LRA has been mounted at one side of spinning satellite.
Spin rate is 3 +/- 1 rpm, and it's controllable in this range.

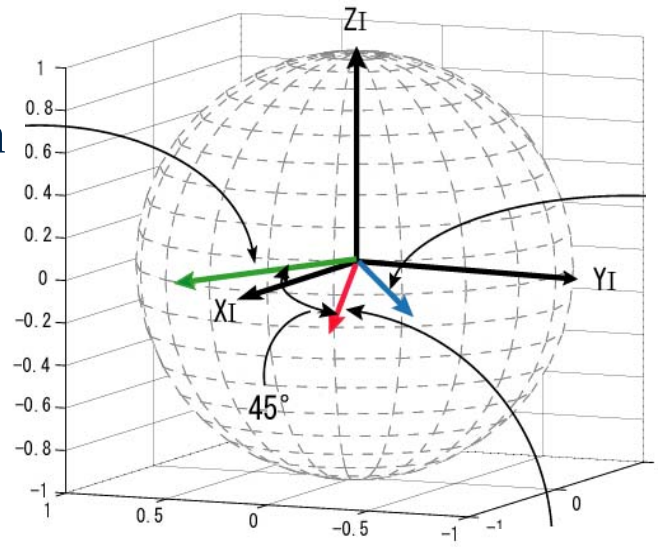
LRA for SOHLA-1 (photo)





Direction of Spin Axis

Solar direction



Normal to the Orbital plane

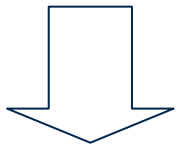
Spin axis

- The spin axis lies in the plane containing the solar direction and the normal to the orbital plane.
- The angle of spin axis and the solar direction is 45 degrees.

Return Availability

SOHLA-1 ~spin stabilized satellite~

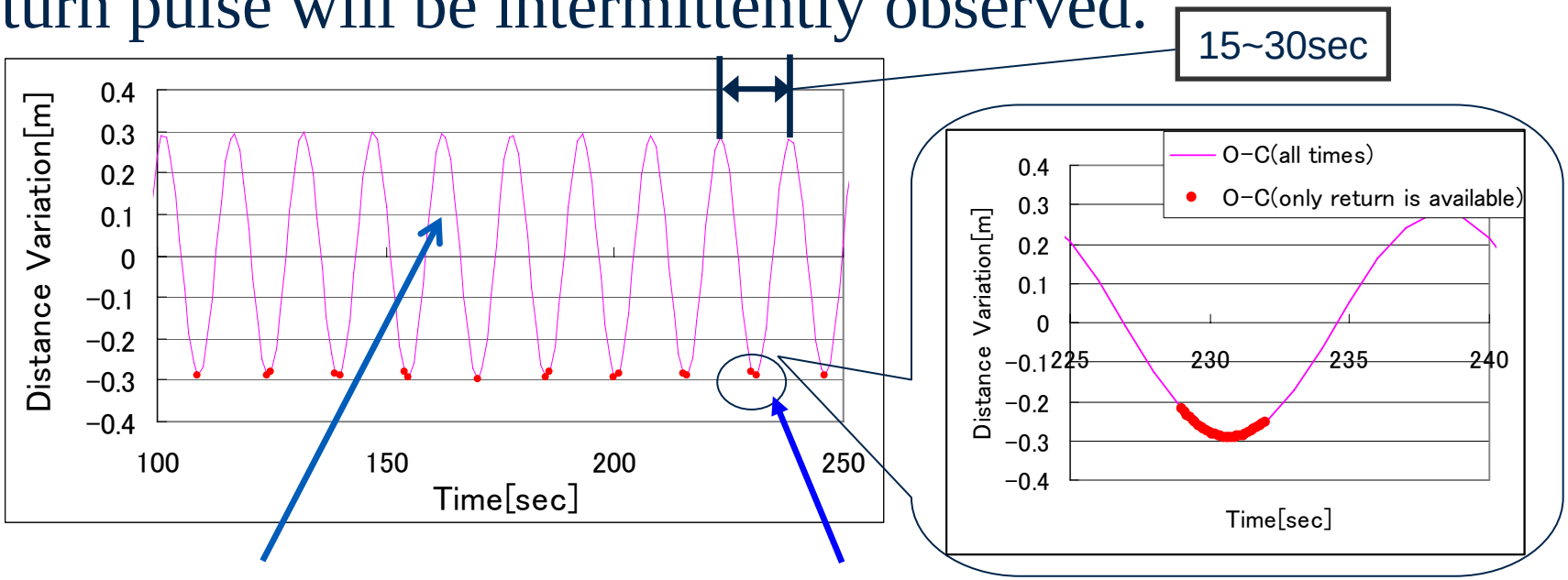
- LRA spins along with satellite.
- Spin axis changes slowly (one year cycle).
- Spin rate can control within a range of +/- 1rpm. (nominal: 3rpm)



- Return pulse will be intermittently observed.
- Whether return is available or not depends on...
  - ✓ Spin axis direction
  - ✓ Relative position between SLR stations and SOHLA-1
  - ✓ Spin rate

Simulation of return intermittency

Return pulse will be intermittently observed.



LRA position and pointing direction is varied because of satellite spin.

We can get the return laser pulse only while appropriate incident angle. It's period is ~3,4 sec.

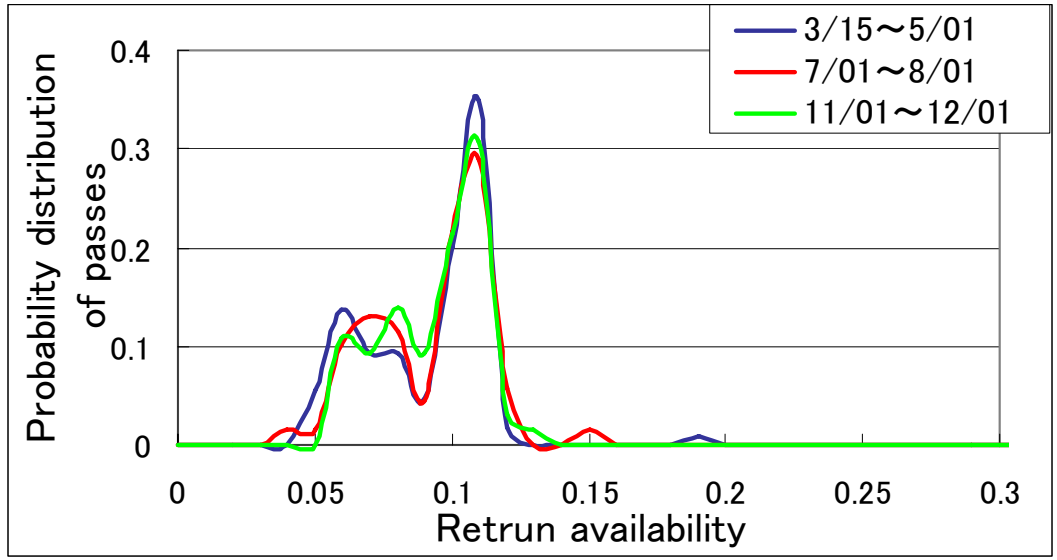
QLNP with 5sec bin size is preferable

Simulation of return availability (1/3)

Dependency on spin axis direction

Period of time	Number of passes	Remarks
2009/03/15~2009/05/01	~100	Include the duration of campaign
2009/07/01~2009/08/01	60~70	During summer
2009/11/01~2009/12/01	60~70	During winter

Spin rate : 3rpm
Station : Tanegashima (GMSL)

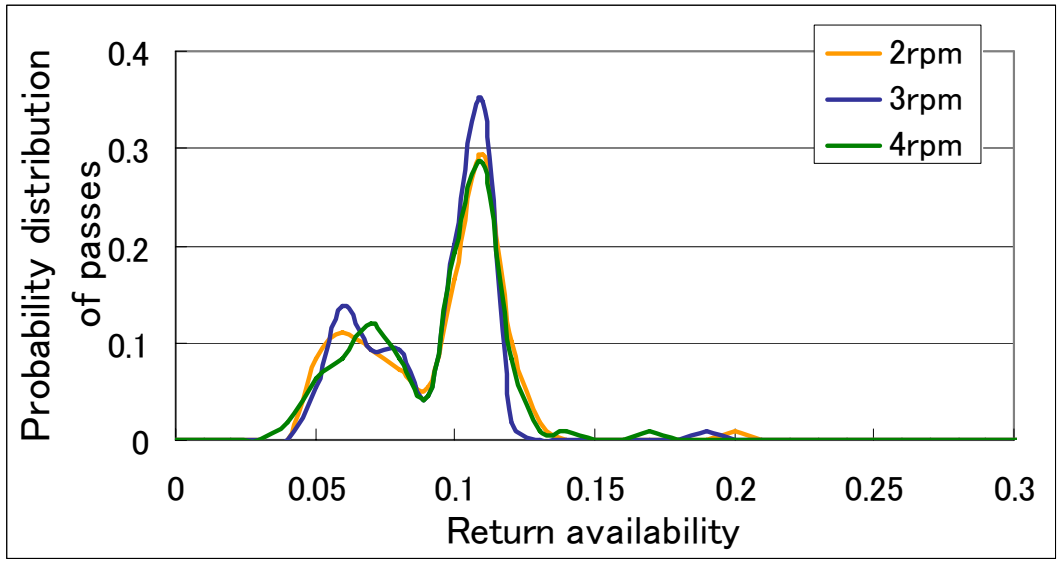


Simulation of return availability (2/3)

Dependency on Spin Rate

Spin rate
2rpm
3rpm
4rpm

Period of time : 03/15~2009/05/01
Station : Tanegashima
Number of passes : ~100

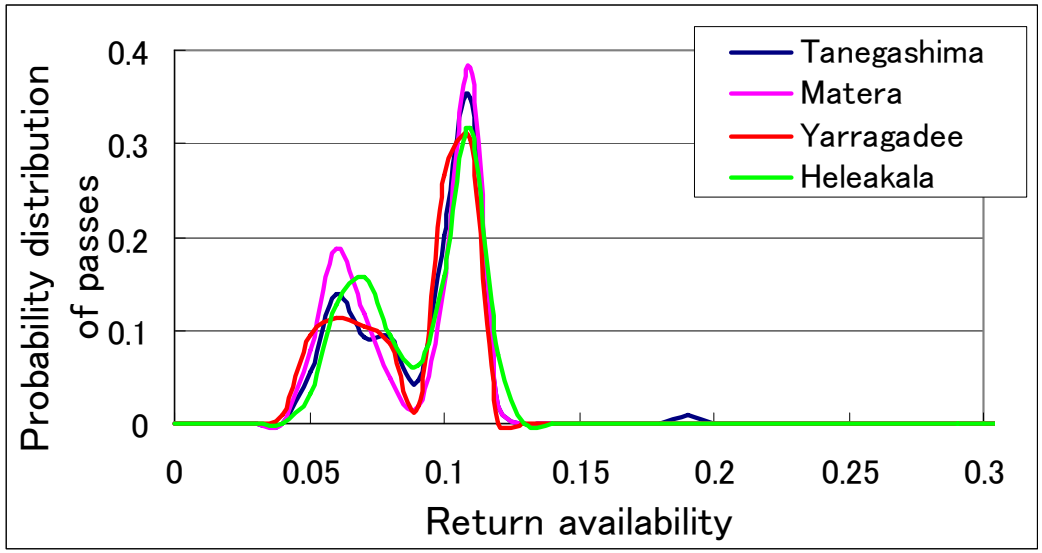


Simulation of return availability (3/3)

Dependency on relative position.

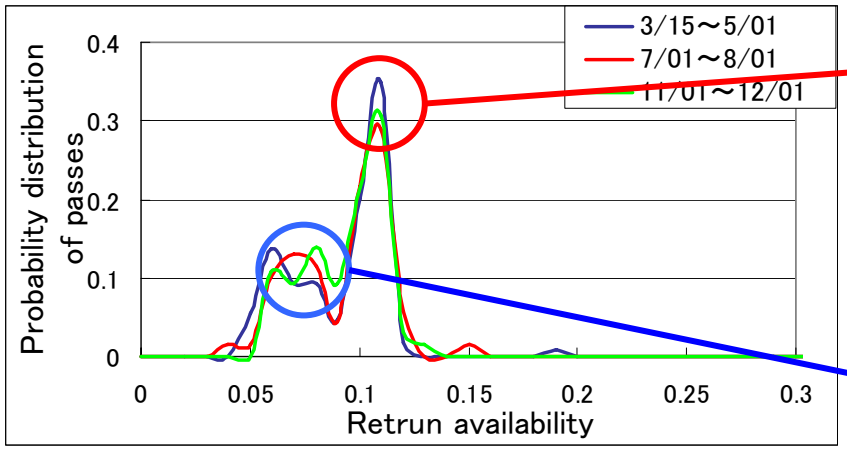
Station	Latitude	Longitude
Matera	40.6486 N	16.7046 E
Tanegashima	30.556513 N	131.015412E
Heleakala	20.7072 N	203.7441 E
Yarragadee	29.0464 S	115.3467 E

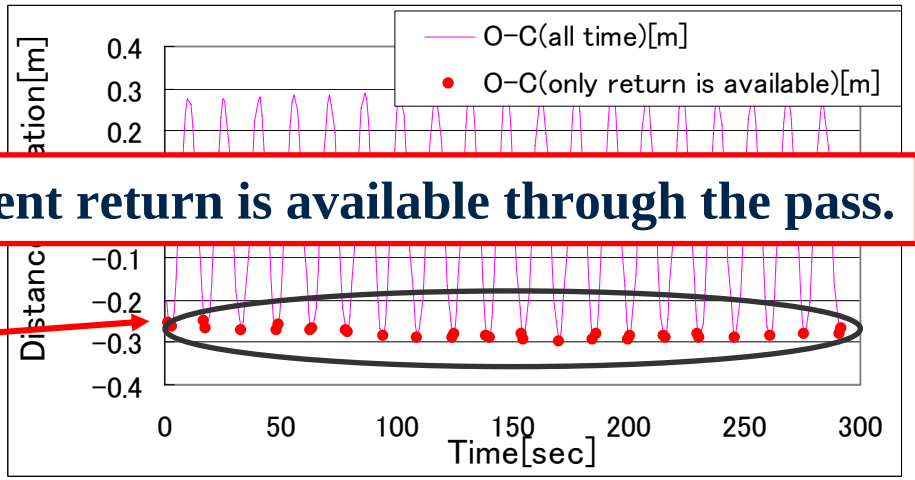
Period of time : 03/15~2009/05/01
Spin rate : 3rpm
Number of passes : ~100



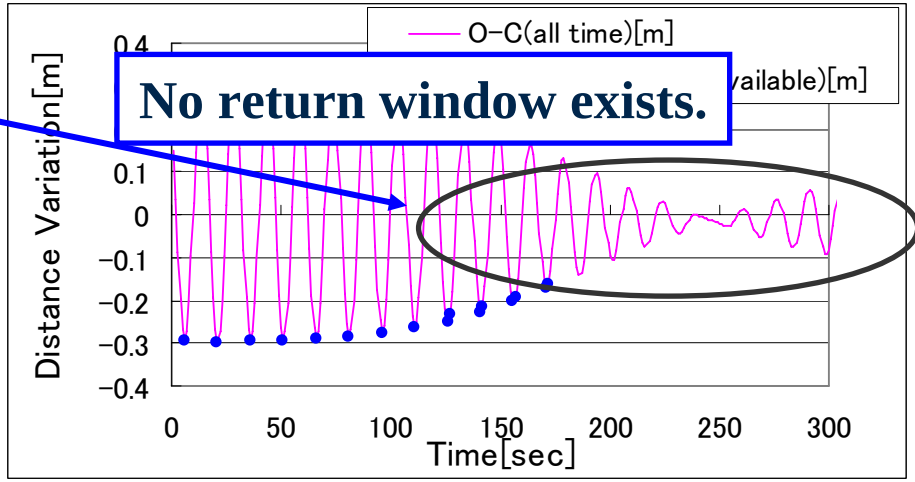
Characteristics of Return

O:the length of station to CoM of satellite.
C:the length of station to phase center of LRRA.





Intermittent return is available through the pass.



No return window exists.

Summary

- SLR for SOHLA-1, the return is intermittently-observed, and its nominal cycle is 20sec.
- In a 20sec cycle, the duration of continuous return is less than 5sec.

  (➡QLNP with 5sec bin size is desirable.)

- The laser pulse return is not available in case of inappropriate incident angle, but this case is uncommon.
- We can get enough return at all the passes.