

Progress in KHz SLR and Daylight tracking at Changchun Station

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Abstract

This paper introduces that Changchun SLR station upgraded the original system. Using independent research software, Changchun SLR station implemented KHz satellite laser ranging and daylight tracking. It includes kHz laser system, Event Timer, designing Range Gate Generator with event mode and back-scattering avoiding circuit, developing real-time control software and data pre-processing software. The paper presents the progress in KHz SLR at Changchun station, including ranging to the LEO and HEO satellites at night and in daylight tracking. In addition, some new measurement results were also shown in this paper.

Key words: kHz SLR, Daylight tracking

1. Introduction

At present, KHz satellite laser ranging is the new development trend in the international satellite laser ranging. Graz station first realized satellite laser ranging at high repetition rate in the world. Changchun Observatory has made great progress at KHz satellite laser ranging and successfully achieved routine KHz satellite laser ranging and daytime ranging.

2. The kHz SLR system

(1) kHz Laser

The RG30-L-532 series laser of Photonics Industries Company was applied in the ranging system, and the stability of laser improves obviously. The following is the specification of the KHz laser.

The Specifications of KHz Laser

Pulse energy	3mJ @ 532nm/1kHz
Pulse width	10ps FWHM
Repetition rates	500 to 10KHz
Beam quality – TEM00	M2<1.3
Divergention	0. 4 mrad
Pointing stability	<10 urad (typical 5urad)

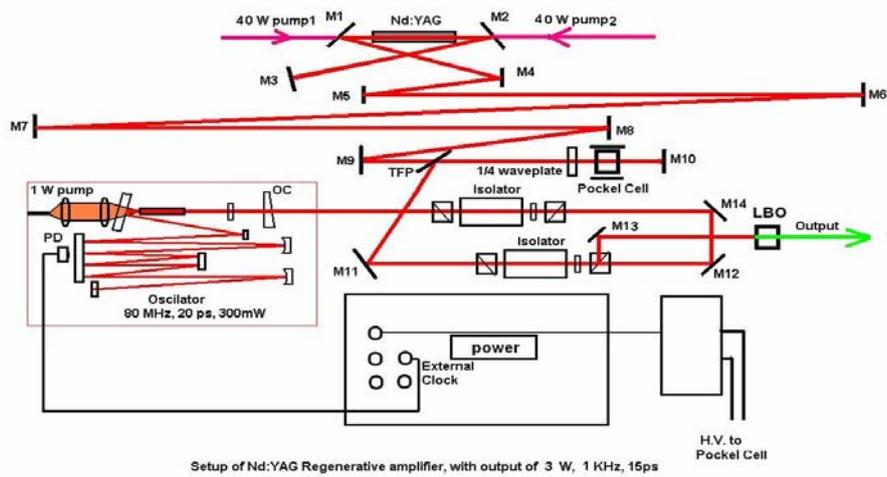


Figure 1. The block diagram of RG30-L-532 laser

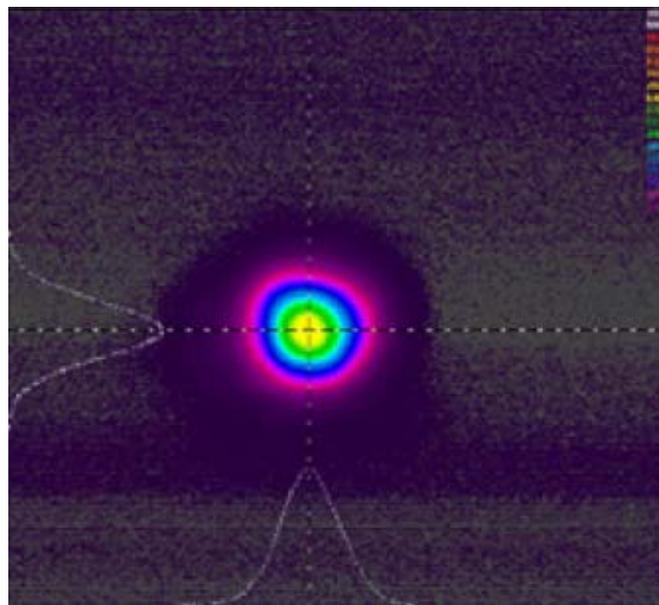


Figure 2. The figure of the RG laser Mode Profile: the laser beam quality M2 factor is 1.11



Figure 3. The photo of RG30-L-532 laser

(2) Event Timer

The application of A032 Event Timer can get epochs of laser firing and the accuracy is to a few picoseconds. It accomplishes the function of KHz recording time.

(3) Ranging control system

Changchun observatory develops the Range Gate Generator, and it generate range gate and laser fire, for avoiding Backscatter. The frequency is from 1 to 3000 Hz and precision is 10 ns. We use one single Windows PC to read ET, drive telescope, control laser, Indication data, display data, archive data in kHz rates. Develop the procedure of precision prediction, mass data processing etc.

3. The main upgrade of Kilo Hertz Daylight Tracking

There are too much background noise in daylight, so it is difficult to acquire the ranging data. In order to reduce the background noise, adjustable iris (0.5mm-7mm) is used in the receiving system. The smaller receiver field of view is $30''$. The Narrow Band spectrum filter is also applied in the receiving system, and the center wavelength is 531.95nm, bandwidth is 0.15nm, transmission>50%, work temperature is 23°C. We developed technology and consisted of real-time data recognition, automatic gate, automatic range-gate and time-bias setting, the method of disposing enormous data.



Figure 4. The first day of Kilo Hertz daylight tracking interface.

4. The result and analysis of observation data

The KHz SLR system has operated in daylight and night routinely since 2009. At night we can get the observation data of all the HEO and LEO satellites, the farthest distance is to GEO. In daylight, we can observe the HEO satellite for glonass, but it can not realize routine observation. The far target calibration precision is about 6.0mm. For the satellite of lageos, the single shot precision is less than 12 mm and the normal point precision is less than 1mm. From the statistics, the daylight data is about 28.1% of the total observation data.

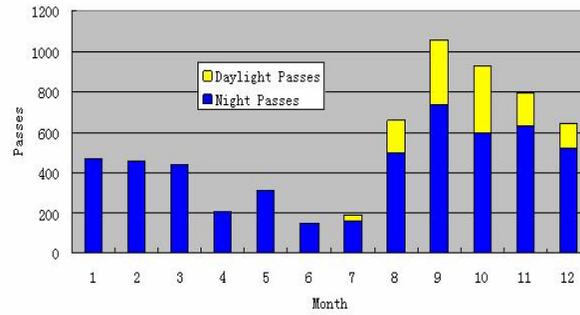


Figure 5. The passes of observation in 2009

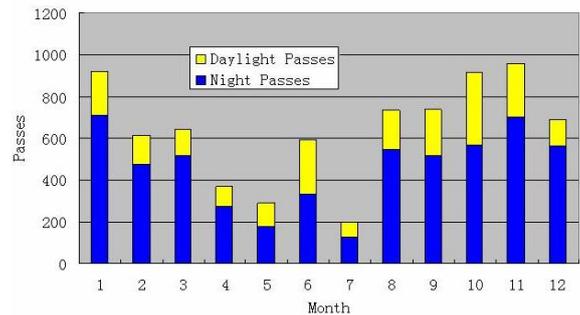


Figure 6. The passes of observation in 2010

Now Changchun Observatory has been Top five in ILRS network.. In China, Changchun Observatory fist succeed to accomplish the experiment of visibility KHz laser beam peak daylight. It uses the technology that integrate backscatter to increase signal / noise ratio, change exposure time, image processing to get clearly and continuous KHz laser beam.

5.conclusion

After the upgrade, the KHz laser ranging system runs in a steady state, and the passes and effective data points of observations improve obviously. The statistics report of international data center shows observation data precision of Changchun observatory has improved significantly.

References

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