

Performance of the Kunming SLR Station

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Abstract

The Kunming SLR station began regular operation in December 1998. In this paper we describes the upgrading of this SLR system since the last workshop and the current works in the station.

1. Introduction

In 1996 the Chinese Academy of Sciences offered partial funds, then our group began to set up the Kunming SLR system using Yunnan Observatory 1.2m Alt-Az telescope. We also got some instruments support from NASA through UTA: HP58503A GPS Receiver, SR620 Universal Time Interval Counter, C-SPAD, Oscilloscope, Rm-6600 Universal Radiometer, and made partial instruments by ourselves for the system: transmit/receive optics, software for satellite prediction and data pre-processing, laser ranging controller and computer interface etc. At the end of 1997, the returns from Topex and Ajisa have been obtained using a RCA 8850 PMT as detector.

Since 1998 to now, the system has got the financial support from the Crustal Movement Observation Network of China for upgrading the system. At the end of 1998, the system has put into regular operation with an average annual pass 800 and a RMS of ± 3 cm. The system has showed an advantage for high satellites ranging like GPS 35, 36, which is first got returns from these satellites in Chinese SLR network. During about two year SLR operations, we have solved some technical problems and upgraded the system. Because of a newly system, it is needed to pay a lot of attentions for the stability of the system, especially for the time and ground target calibration. We will discuss the detail of the system upgrading and the system stability in following descriptions.

2. System Upgrading

As mentioned before^{[1][2]}, the Kunming SLR station consists of a 1.2m telescope, a Nd:YAG laser, a transmit/receive optics, an imaging system for pointing calibration, laser echo receivers(a MCP PMT, and a C-SPAD), a time system, interfaces for laser ranging, software packages of satellite prediction and data pre-processing. From 1998 to now we have done following upgrading:

Laser

- (1) A new laser power with more stable and more integrated has replaced the old one. The frequency of the laser emission has up to 8 Hz.
- (2) The 1, 2-dichloroethane, the dye solvent for mode-locking of the Nd:YAG laser, has been purified one class whose purity is from 99.5% to 99.95%. So the laser dye solution, the pentamethylidyne with the 1, 2- dichloroethane, has been obviously lengthened for using. The results is that adding the pentamethylidyne in the dye once

three days is lengthened to once three weeks.

(3) Because the laser beam is transmitted through the 1.2m telescope, it has been partially obstructed by the second mirror of the telescope. As we know, the laser beam has a Gauss distribution, so part of the most powerful laser beam has been lost. We put a prism in the optical path near the laser device to split the beam into two parts so we can reserve the central part of the laser beam and use it more effectively.

Timing Unit

At beginning, we used a rubidium time and frequency standard calibrated by Loran-C receiver belonged to the Yunnan Observatory for the SLR test, and the time system stopped the routine service at the end of 1997. After that, a GPS HP58503A receiver and a H01-150 LPRS(LOCAL Primary Reference Source) were put into use.

Receiver

We used a RCA 8850 PMT as detector for the SLR test in 1997. Because of its low sensibility, our station could not work normally. In the end of 1998, a Hamamatsu R5916U MCP-PMT that we bought was delivered to the station, and soon a C-SPAD that NASA offered to us from Czech Technical University was also arrived to Kunming.

Software

For working normally, we have bought and developed the necessary software packages and interfaces for the SLR.

The ranging software is an old version based on standard PC with a special plug-in circuit board from Prof. Guo Tangyong, Institute of Seismology, Wuhan, China.

We have developed the following software: star prediction, SLR data pre-processing, telescope control and its pointing modal modification, SLR target searching etc.

For the 1.2m telescope, its field of view is small, only about 3'. In order to get the laser returns from the satellite fast and effectively, especially for the LEO satellites, we have developed the target searching software with a visual interface. In practices, the software has showed an advantage to search the targets. Fig.1 is its visual interface.

We have also developed the software for the SLR data pre-processing. Fig.2 is its visual interface.

Satellite Guide System

For the LEO satellite ranging easily, we have built two satellite guide systems with a 30' field of view and a 3° field of view respectively. Both guide systems are equipped with the ICCD, and can detect a 12^m star.

3. Current Works

1. Daytime SLR

In March of this year, a Stigma Optique 1Å passive filter and a 10 Å filter that Dr. J. Luck offered to us was delivered to the station. We began the daytime SLR experiment using the filter in the 1.2m telescope Coudé room where was no special environment, such as high temperature, high moisture, high energy light around it and a dehumidifier working all time. Unfortunately, We soon found that there were a lot of folds on the coat of 1Å passive filter and it could not be used anymore.

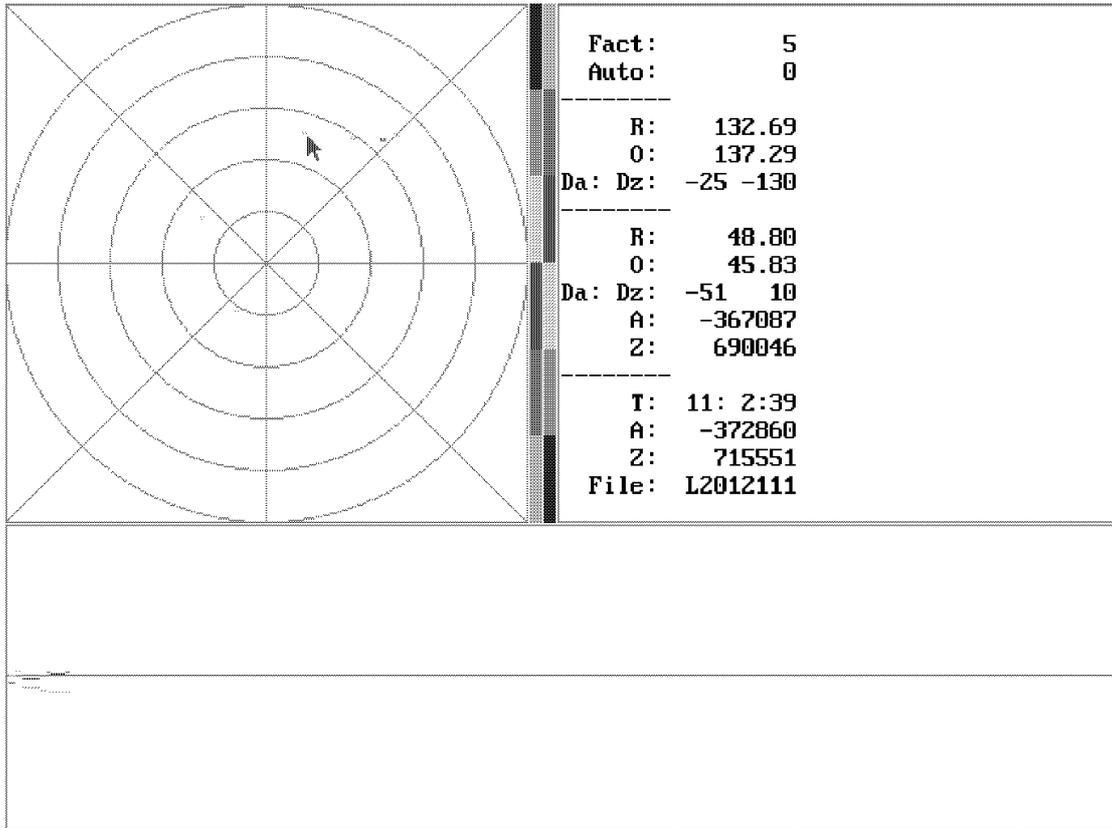


Fig.1 Visual Interface of Target Researching

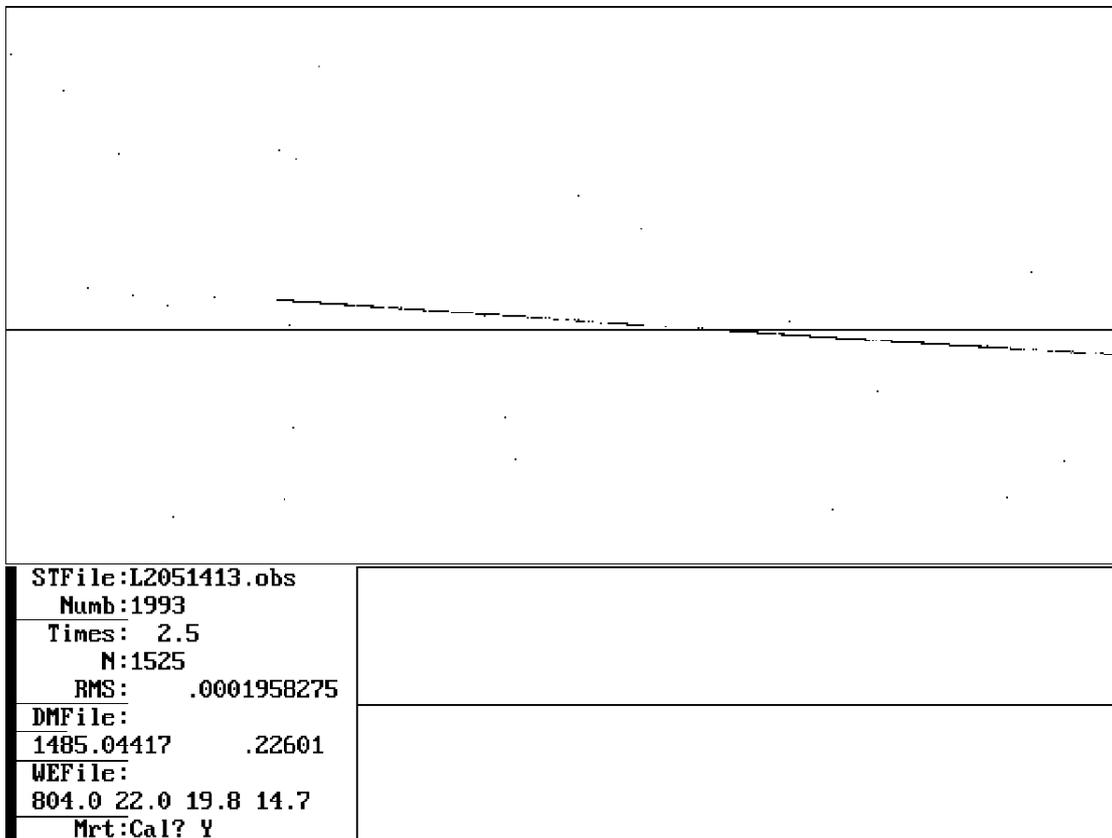


Fig.2 Visual Interface of the SLR data pre-processing

Now we have bought another 1.5Å filter to continue the daytime SLR test.

2. SR620 Oven Oscillator Drift

In this summer, our GPS HP58503A receiver was damaged. The 10MHz int. timebase of the SR620 was used for the working clock of the SLR control system. But it caused a very larger time bias in the SLR data of Kunming station since that time. After a thorough check, we have changed the TI measuring arrangement (see Fig.3), and found two errors in the time interval measurement before. One is that the state of timebase of the SR620 is not correct, the 10MHz int. of the SR620 was used for the time interval measurement, which may causes an error of 10cm because of its aging. The other is that the oven oscillator of the SR620 is not stable and can not be used for the working clock of the SLR control system.

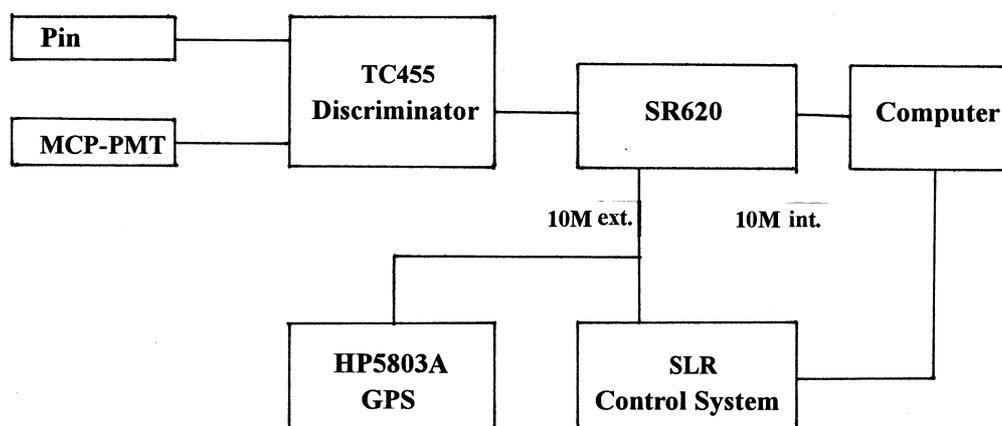


Fig.3 Block Diagram of the Time Interval Measurement

The drifting of the SR620 Oven Oscillator has also affected the ground target calibration, and then affected the ranging bias and the time bias of our SLR data for some time.

Since 23, Oct. 2000, we have used another GPS (H01-150 LPRS) clock for both the SR620 and the working time, so we need to recalculate the station coordinators with the data accumulated for some amounts after that time.

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Reference

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