

## CURRENT STATUS OF SAN JUAN SLR STATION IN ARGENTINA

T. Wang, F. Qu, Z. Wei, N. Liu, B. Cheng and Q. Xiang(1); Y. Han and W. Liu(2)

(1) Chinese Academy of Surveying and Mapping (CASM)

(2) National Astronomical Observatories, Chinese Academy of Sciences

[wangtq@casm.ac.cn](mailto:wangtq@casm.ac.cn) / Fax: 0086-10-68218654

### Abstract

*A new SLR station will be founded in the near future. The whole SLR systems were already developed completely and checked and accepted by the investor. Some introductions of configurations and characteristics for the systems were in the paper. Also some test results of technique parameters and some achievements of testing observations were introduced. The newest status of station constructions in Argentina and the timetables of the packing and shipment were mentioned as well as in the paper.*

### Introductions

The project of build a new SLR station in San Juan of Argentina is a kind of cooperation between University of San Juan, Argentina and National Astronomical Observatories (NAO), Chinese Academy of Sciences. The investor for the SLR system is Ministry of Science and Technology in China. The whole system was designed and developed by Beijing SLR station, Chinese Academy of Surveying and Mapping (CASM) in the years of 2000 to 2003. The new station building in Astronomical Observatories, University of San Juan, Argentina is nearly ready for installing the SLR systems now including the dome designed and constructed by University of San Juan, Argentina.

The horizontal mount is the most convenient constructions for telescope mounts for tracking satellite especially for low satellite, including their observations in zenith zone. The initial alt-azimuth telescope mount is just same with the one of Beijing SLR station but a lot of changes were made with it by the common work of the people in Shanghai and Beijing station and National Astronomical Observatories (NAO).

The good hardware and software of controlling and servo system were benefit from the people of Wuhan station. The precision was satisfied from the data analysis reports of Delft University.

The whole SLR systems were already developed and tested completely and checked and accepted by the investor, Ministry of Science and Technology in China, in 12<sup>th</sup> of January, 2004.

The South America is a lack of SLR station for many years so the new San Juan station with its good weather conditions will improve the distributing of SLR station in the world. The ILRS needs such a station and the SLR technology needs such a station.

The packaging and shipment will begin before the end of this month and the SLR data of first pass in the new station in Argentina can be ahead of the end of this year if things going well

## THE SYSTEM CONFIGURATIONS

Reflecting telescope: bi-axes; sender and receiver separated.

Control system: only by mouse; tracking, predictions, preprocessing...

Servo system: Bi-close-loop control for velocity and position

Laser system: Nd:YAG passive mod-locked

Receiver: C-SPAD

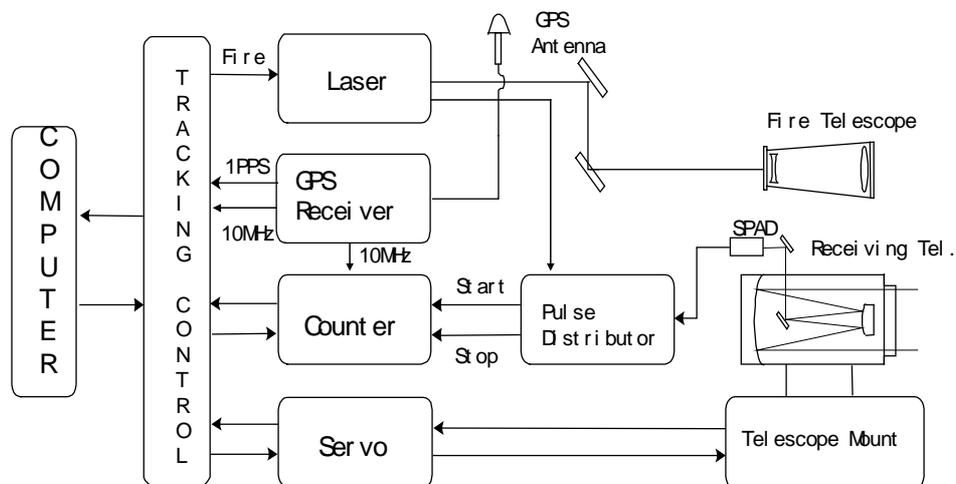
Counter: SR-620

TV system: intensifier + CCD.

Timing and frequency: HP58503A GPS time and frequency receiver.

Calibration: short distance target, out-install, inside the dome.

The frame diagram of configurations for the whole system is shown as figure 1.

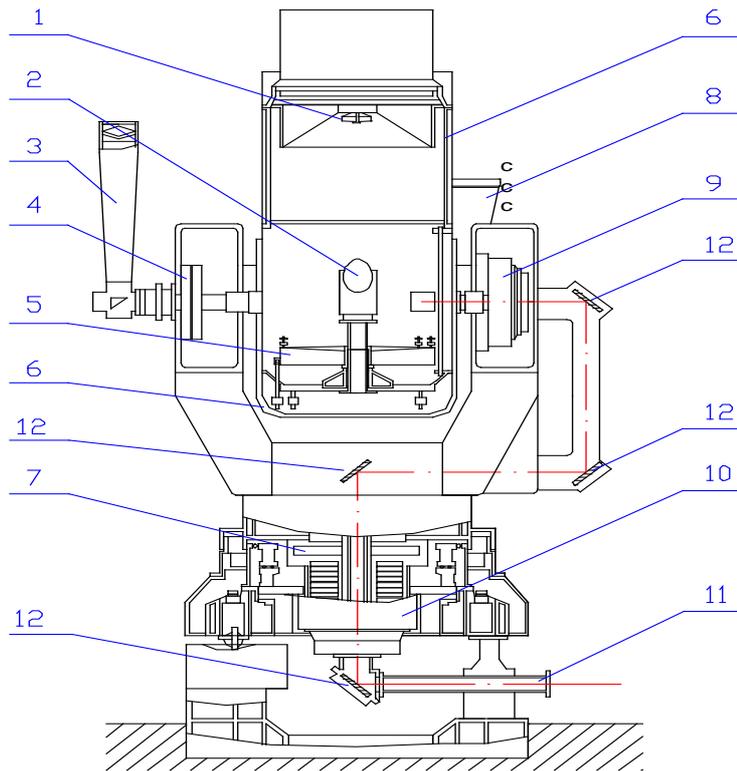


**Figure1.** The frame diagram of configurations for the system

## MECHANICAL CONSTRUCTION

The alt-azimuth telescope mount has flexible mechanical construction with the possibility to dismantle it into separate components to allow packaging in several wood cases for the common container and easily airproof in order to ship the telescope with a long way to South America. It contains a foundation with azimuth plate, an azimuth frame, an elevation frame and a main telescope cylinder with main mirror container and secondary mirror mount.

A general view of the telescope mount is shown in figure 2.



- |                        |                        |                                |
|------------------------|------------------------|--------------------------------|
| 1---Secondary Mirror   | 5---Main Mirror        | 9---Moment Motor for Elevation |
| 2---45degree Mirror    | 6---Main Telescope     | 10---Moment Motor for Azimuth  |
| 3---Telescope for view | 7---Azimuth Encoder    | 11---Coude Path                |
| 4---Elevation Encoder  | 8---Emitting Telescope | 12--- Coude Path Mirror        |

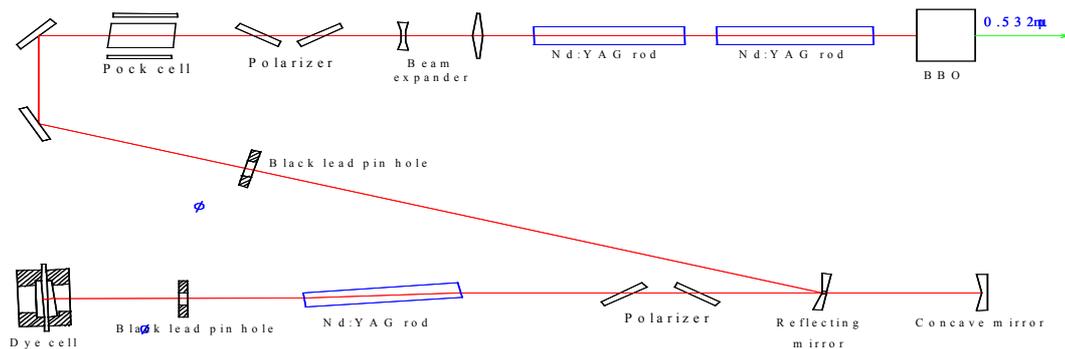
**Figure2.** General view of the telescope mount

## OPTICAL RECEIVING SYSTEM

The optical receiving system has a microcrystalline glass main mirror (weight 80kg) with the diameter of 630mm and a microcrystalline glass secondary mirror with the diameter of 200mm. Also there are a spectroscope, an adjustable set of pinhole, an autocollimator and a broadband filter of 10nm in the optical receiving system. The optical receiving system is able to receive both visible light for ICCD and green laser for ranging detector without any additional adjustment due to the spectroscope.

## LASER SYSTEM

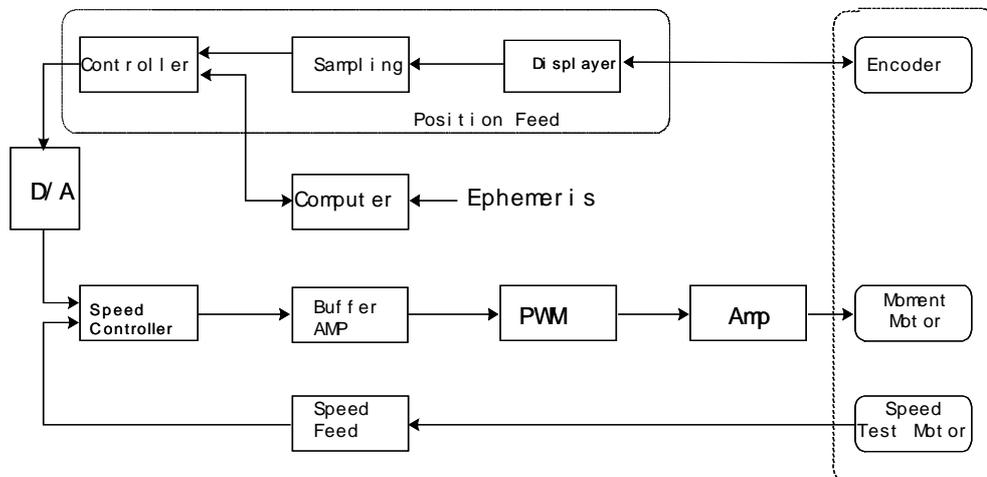
The computer controlled and passive mode-locked laser( Nd: YAG) firing rate up to 20Hz has the pulse width of 30ps and pulse energy of 50mj for wavelength 532nm laser. The principle diagram of the laser is shown as figure 3.



**Figure3.** Principle diagram of Nd:YAG laser

### TRACKING CONTROL AND SERVO SYSTEM

A common PC computer is used for telescope control, range gate setting, laser firing and data acquisition etc. All software including satellite predictions and data pretreatment is running in windows operation system and all things can be done just by the computer mouse. The principal design for tracking control and servo system is given in figure4



**Figure4.** The frame diagram of tracking control and servo system

### TESTS AND TEST OBSERVATIONS

For check and accept of the investors some tests and test observations were achieved since the end of 2002 to 12<sup>th</sup> of January 2004. The results of tests and test observations are show as following:

#### 1) The Velocities and Accelerations of Tracking for the Telescope Mount.

Working velocity:

A. 5degree/s .

E. 1degree/s

Working acceleration:

A. 0.1degree/s/s□ E. 0.1degree/s/s

Min. velocity:

A. 0.004 Arc second/s. E. 0.004 arc second/s

Max. velocity:

A. 24.27 degree/s. E. 12.36 degree/s

Max. acceleration:

A. 14.91degree/s/s. E. 15.64degree/s/s

Tracking Precision(RMS):

A. 4.747 arc second. E. 4.857 arc second

## 2) Laser System

Wave length:0.532 $\mu$ m(Base:1.064 $\mu$ m)

Output energy:51.0mj(1pps). 54.0mj(5pps). 54.0mj(10pps)

Energy unstable: 4%. Continuous running 40 minutes.

Pulse width. 30-50 ps

Repeat of wave form: 83%,1H. 88%, 5Hz.

Beam divergence: 0.41mrad(1Hz);0.30mrad(5Hz)

Output mode: TEM-00

Beam Size of output: 9mm(1Hz);8mm(5Hz)

Repetition: 1 to 10Hz

## 3) Perpendicularity and Pointing Precision for the Telescope Mount

Perpendicularity: -2.75 Arc second

Pointing Precision:

A. 2.19 Arc second E. 2.49 Arc second

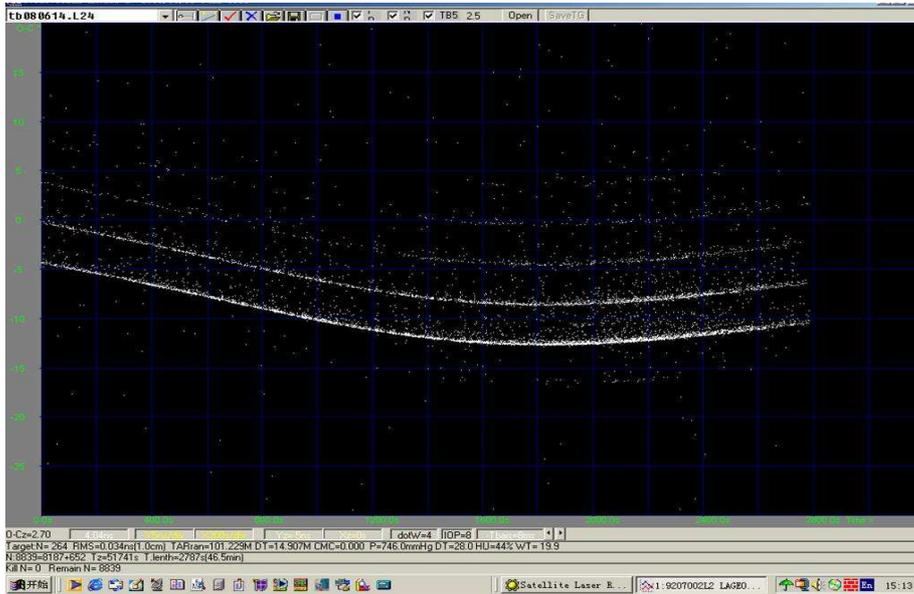
## 4) Ground Target Calibrations

west cal target			short cal target		
	RMS( cm)	DT( m)		RMS( cm)	DT( m)
1	0.8	14.909	1	1.0	14.912
2	0.9	14.909	2	0.8	14.911
3	0.8	14.907	3	0.9	14.911
4	0.8	14.908	4	0.8	14.912
5	0.9	14.908	5	0.9	14.910
6	0.7	14.907	6	1.0	14.911
7	1.0	14.910	7	0.9	14.910
8	0.8	14.907	8	0.8	14.910
Aver age	0.84	14.908	Aver age	0.9	14.911

## 5) Satellite Ranging

60 passes of satellite range data were obtained from the test observation period including all SLR satellite of that time and for Lageos 28 passes. The precision was very good and satisfied from the data analysis reports of Delft University. Hereinafter is a Lageos pass in 14<sup>th</sup> of August 2003. More than 8000 returns were in the pass.

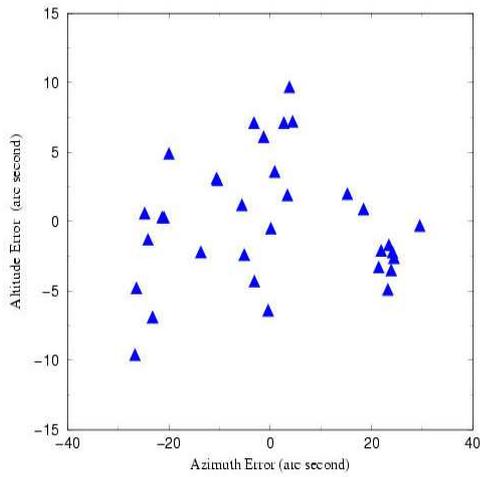
Figure 5 is the tracking screen of the computer and gives a Lageos pass in semi-trains.



**Figure5.** A typical Lageos pass in the tracking screen of the computer

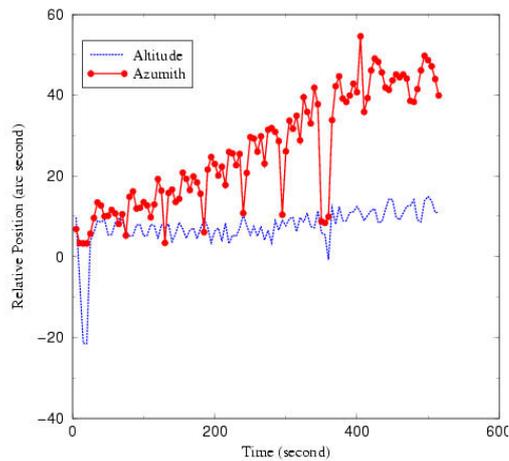
### 6) Star Tracking for the Mount Test

The pointing test



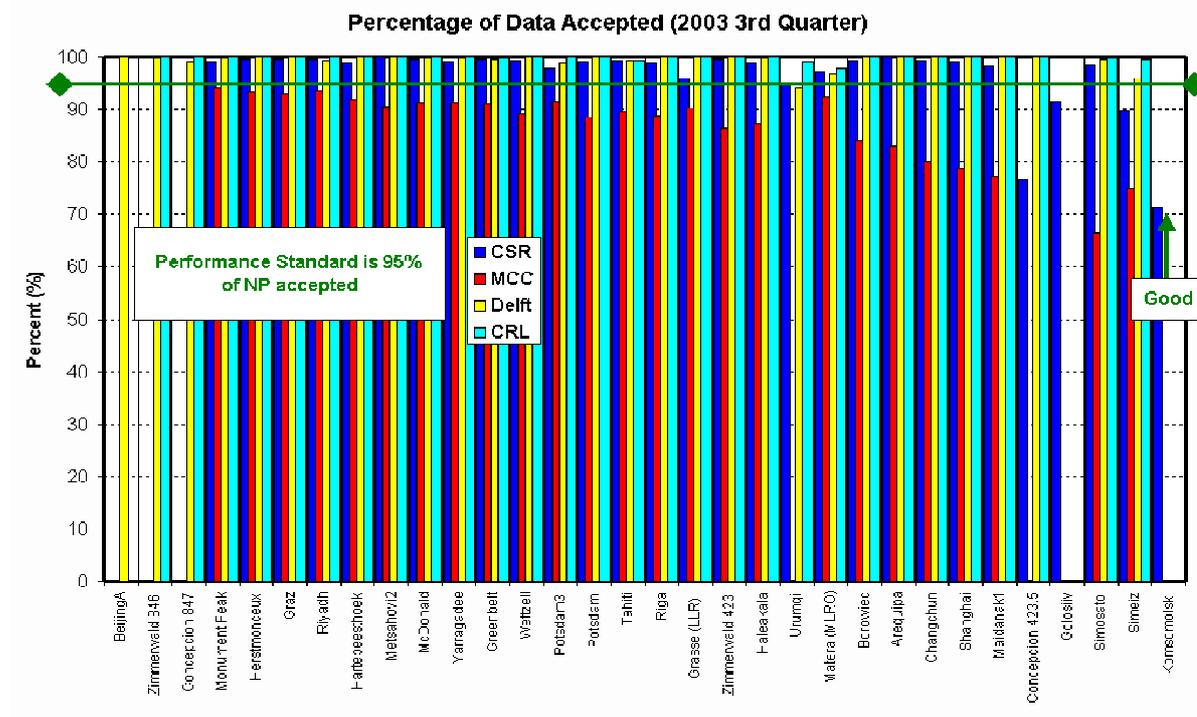
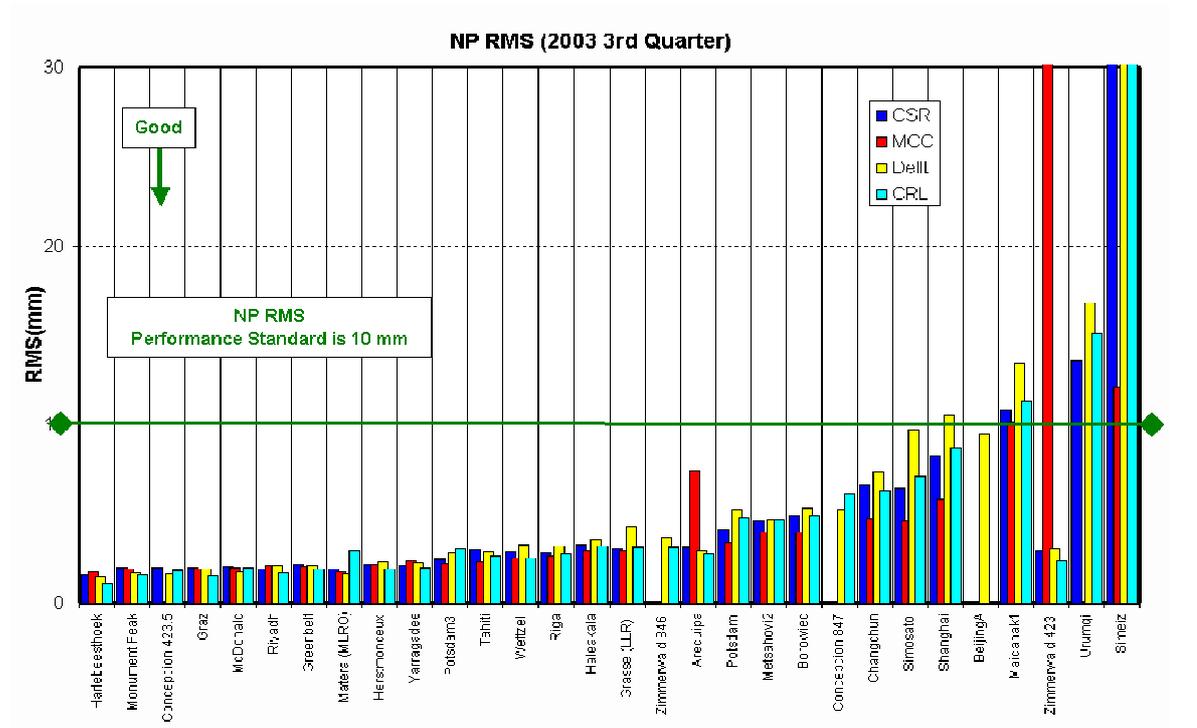
### 7) Satellite Tracking for the Mount Test

The tracking test of satellite Lageos



## 8) The Test Observation Result from ILRS Data Analysis Center.

Station BeijingA is the system for Argentina station.



## **SUMMARY**

The New SLR station in San Juan of Argentina will be running soon. Now the whole system was ready to packing and shipping it to Argentina. The building for SLR purpose in University of San Juan of Argentina was nearly got through maybe in next month. The packaging and shipment will begin before the end of this month when we go back to China after the meeting ended and the SLR data of first pass in the new station in Argentina can be ahead of the end of this year if things going well.

The test observations got 60 passes ranging data for nearly all SLR satellites including GPS 35 and once more than 8000 returns of one pass were obtained for Lageos.