

**Yunnan Astronomical Observatory
Chinese Academy of Sciences
Kunming, China**

Co-optical Path kHz SLR at Kunming Station

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Outline

- **Background Introduction**

- **kHz System**

 - Co-optical Path, Ranging Control

- **Observation Status**

 - Day and Night ranging

- **Key technique**

 - Rotation Shutter

- **Looking into the future**

Background Introduction

Co-optical high repeat frequency SLR technique is very difficult!!!

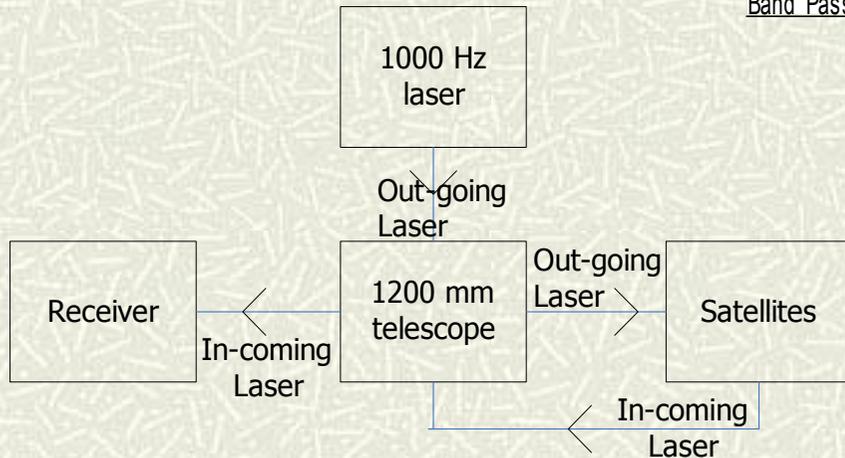
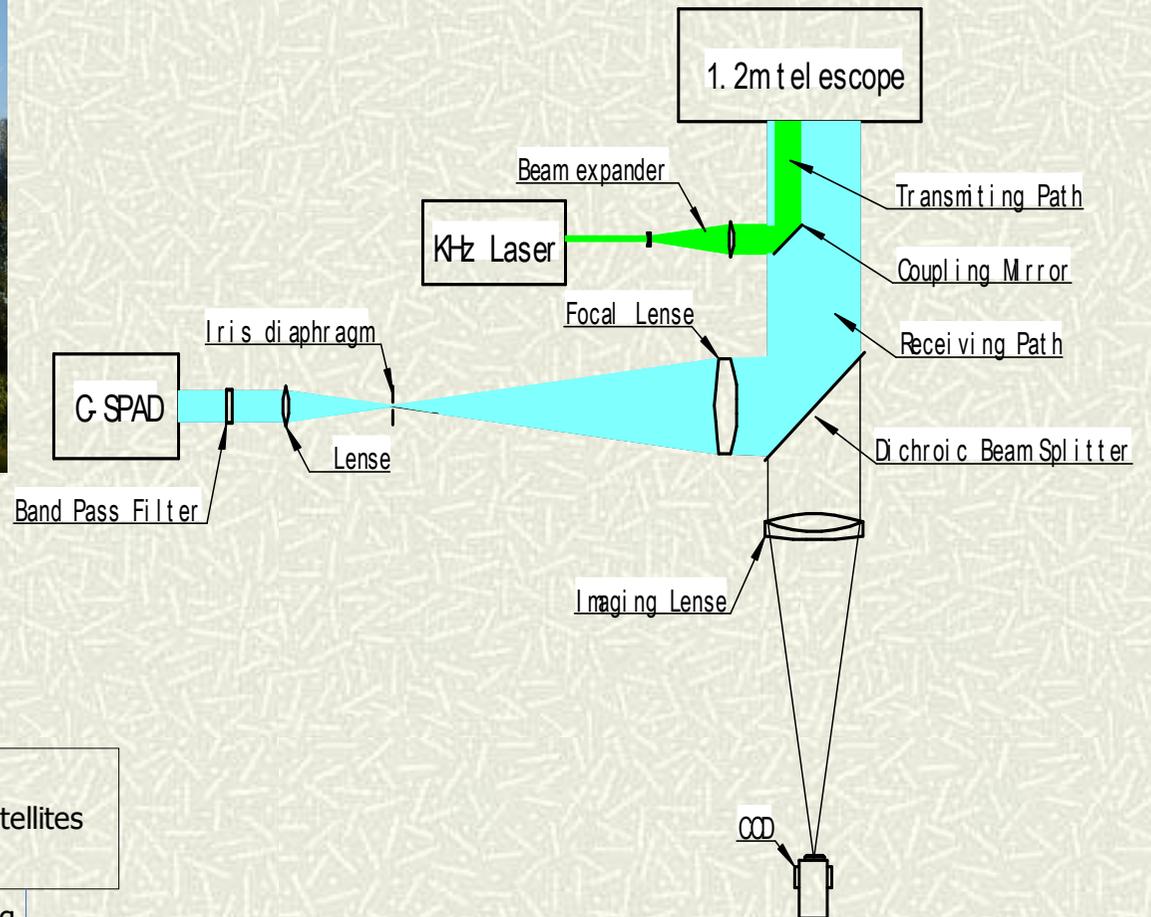
So we planned to do 20Hz SLR before 2009 and ordered the laser from Continus Company, but the order was **denied** by their government.

The Laser part of parameters:

20Hz, 110mJ/pulse, 100ps width

=> Work was delayed several years...

kHz System---Co-optical Path



1.2m telescope is used as both transmit and receive instrument.

kHz System---Ranging Control

云平台1.2望远镜激光测距系统 卫星测距

预报 测距 退出 帮助(H)

云南天文台 预报计算 卫星测距 月球测距 数据处理 退出 关于

数据 displays

方位(度) 高度(度) 距离(ps) 0 0-C(ps)

324.0 47.7

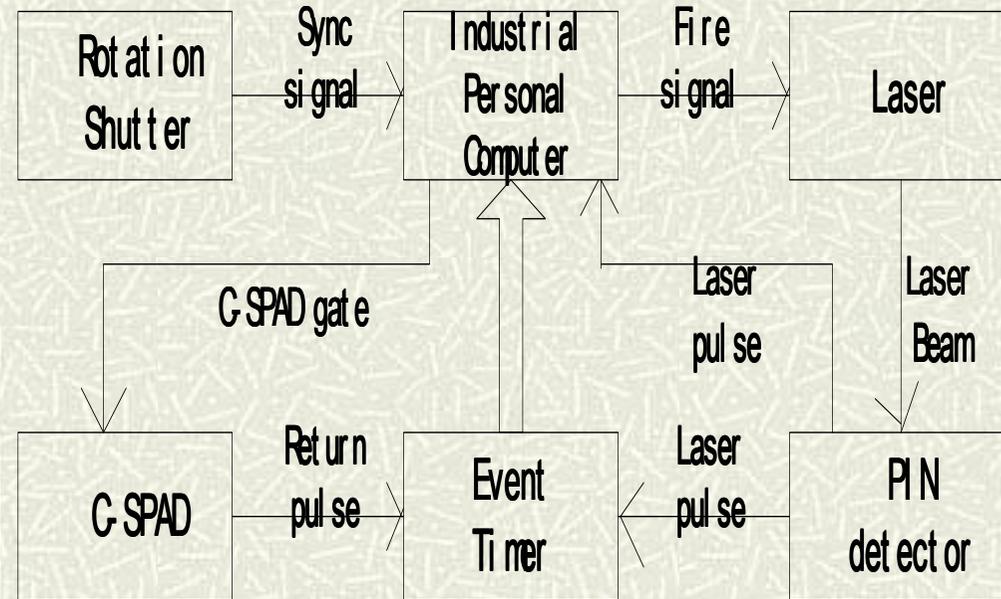
预报(us) 12464.045064 114970.3

DR 600 ns GW 1.20 us save

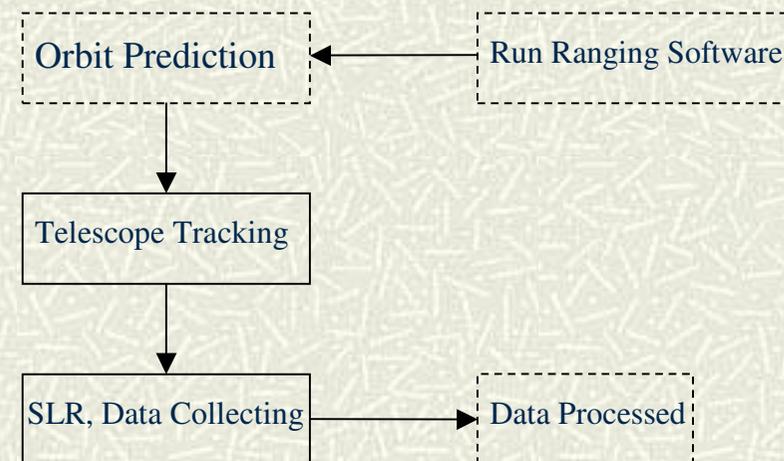
time 15:10:38 同步 设置 NRet: 417 地靶 卫星 气象 801.7mBar +12.7C 62%

A033-ET 频率: 1000 Hz 激光 停止

starID	starName
<input type="checkbox"/>	6503201BE beaconc-5
<input type="checkbox"/>	9502101R2 ers2-1
<input type="checkbox"/>	7501001ST starlette-3
<input type="checkbox"/>	7603901LA lageosl-3
<input checked="" type="checkbox"/>	8606101AJ ajisai-1
<input type="checkbox"/>	0200901EN envisat-2
<input type="checkbox"/>	060620102 glonass102-0
<input type="checkbox"/>	9502101R2 ers2-2
<input type="checkbox"/>	7501001ST starlette-4
<input type="checkbox"/>	090700318 glonass118-1



SDMI:
Single Document Multi Interview



云南天文台 预报计算 卫星测距 月球测距 数据处理 退出 关于

Observation Status

1, Daylight ranging capability (Beaconc)

云台1.2望远镜激光测距系统 卫星测距

预报 测距 退出 帮助(H)

云南天文台 预报计算 卫星测距 月球测距 数据处理 退出 关于

数据显示

方位(度) 高度(度) 距离(us) 12561.590289 O-C(ns)

143.4 35.5 预报(us) 12561.360310 230.0

DR 355 ns GW 0.80 us save 地靶 卫星

time 同步 06:09:30 设置 RG: 5 ns 卫星 气象 797.6mBar +18.2C 39% 地靶 A033-ET 频率: 1000 Hz 激光 停止

starID	starName	starSIC	start	end	elevation	length	visibl
<input type="checkbox"/>	8903903E2	etalon2-0	4146	0515	0630	32	75
<input type="checkbox"/>	0505101IA	giovea-0	7001	0515	0539	18	24
<input type="checkbox"/>	090700318	glonass118-0	9118	0515	0734	74	139
<input type="checkbox"/>	1004501QZ	qzsl-0	1581	0515	1514	56	599
<input type="checkbox"/>	9306102S2	stella-0	0643	0553	0601	39	7
<input checked="" type="checkbox"/>	6503201BE	beaconc-0	0317	0559	0612	72	13
<input type="checkbox"/>	7603901LA	lageosl-0	1155	0634	0656	20	21
<input type="checkbox"/>	7501001ST	starlette-0	1134	0715	0725	62	10
<input type="checkbox"/>	0201202CB	graceb-0	8004	0721	0727	38	5
<input type="checkbox"/>	8606101AJ	ajisai-0	1500	0722	0737	52	15

开始 | A033.1-51 | 20101213 | 我的电脑 | 云台1.2望远镜激光测距系... | 6:09

Observation Status

2, Routinely night ranging (Ajisai)

云台1.2望远镜激光测距系统 卫星测距

预报 测距 退出 帮助(H)

云南天文台 预报计算 卫星测距 月球测距 数据处理 退出 关于

数据显示

方位(度) 高度(度) 距离(ps) 0 O-C(ps)

324.0 47.7

预报(us) 12464.045064 114970.3

DR 600 ns GW 1.20 us save 地靶 卫星

time 同步 15:10:38 设置 NRet: 417 卫星 气象 801.7mBar +12.7C 62% 地靶 A033-ET 频率: 1000 Hz 激光 停止

starID	starName	starSIC	start	end	elevation	length	visib
<input type="checkbox"/> 6503201BE	beaconc-5	0317	1433	1444	35	10	
<input type="checkbox"/> 9502101R2	ers2-1	6178	1443	1451	34	7	
<input type="checkbox"/> 7501001ST	starlette-3	1134	1443	1455	88	12	
<input type="checkbox"/> 7603901LA	lageos1-3	1155	1446	1538	73	52	
<input checked="" type="checkbox"/> 8606101AJ	ajisai-1	1500	1503	1518	47	14	
<input type="checkbox"/> 0200901EN	envisat-2	6179	1503	1511	62	8	
<input type="checkbox"/> 060620102	glonass102-0	9102	1550	2145	54	354	
<input type="checkbox"/> 9502101R2	ers2-2	6178	1624	1628	18	4	
<input type="checkbox"/> 7501001ST	starlette-4	1134	1636	1639	16	2	
<input type="checkbox"/> 090700318	glonass118-1	9118	1704	2115	68	250	

开始 | A033.1-51 | 7820_crd_2010112... | lageos1-0.txt - 记... | 20101121 | aj.bmp - 画图 | gioveb-0.txt - 记事本 | 云台1.2望远镜激光测... | 15:10

Observation Status

2, Routinely night ranging(Lageos)

云台1.2望远镜激光测距系统 卫星测距

预报 测距 退出 帮助(H)

云南天文台 预报计算 卫星测距 月球测距 数据处理 退出 关于

数据显示

方位(度) 0.0 高度(度) 0.0 距离(ps) 0 O-C(ps) 0

预报(us) 40479.886547

DR 1000 ns GW 6.0 us

time 同步 15:32:08 设置 NRet: 96

卫星 气象 799.8mBar +14.1C 43% 地靶 A033-ET 频率: 1 Hz 激光 停止

starID	starName	starSIC	start	end	elevation	length	visib
<input type="checkbox"/> 0200901EN	envisat-0	6179	1351	1354	20	2	
<input type="checkbox"/> 6503201BE	beaonc-2	0317	1357	1407	32	9	
<input type="checkbox"/> 9502101R2	ers2-0	6178	1422	1425	20	2	
<input type="checkbox"/> 9207002L2	lageos2-0	5986	1426	1519	79	53	
<input type="checkbox"/> 0304206AR	larets-0	5557	1429	1436	33	5	
<input type="checkbox"/> 7501001ST	starlette-0	1134	1436	1444	72	8	
<input checked="" type="checkbox"/> 7603901LA	lageos1-0	1155	1510	1557	68	47	
<input type="checkbox"/> 0105501JA	jason1-0	4378	1529	1541	48	12	
<input type="checkbox"/> 0200901EN	envisat-1	6179	1529	1535	32	5	
<input type="checkbox"/> 6503201BE	beaonc-3	0317	1555	1600	21	5	

Observation Status

2, Routinely night ranging(115)

云台1.2望远镜激光测距系统 卫星测距

预报 测距 退出 帮助(H)

云南天文台 预报计算 卫星测距 月球测距 数据处理 退出 关于

数据显

方位(度) 高度(度) 距离(ps) 0 0-C(ps)

13.3 40.1

预报(us) 139746.279862 50907.0

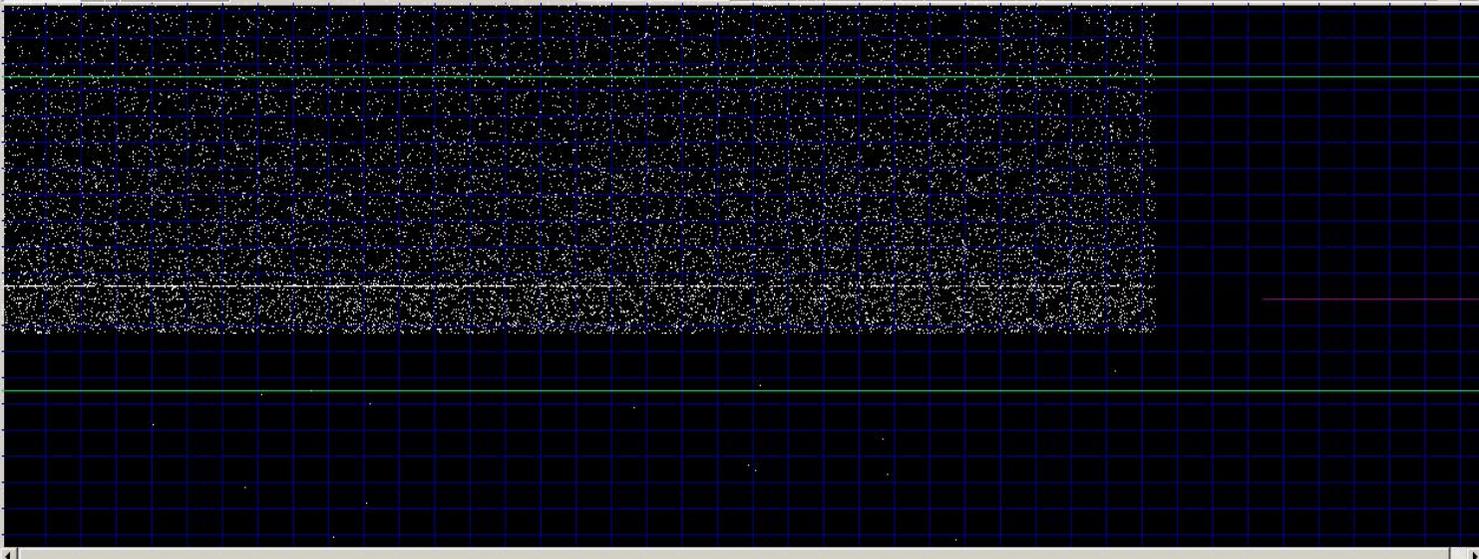
DR 700 ns GW 2.40 us save 地靶 卫星

time 同步 12:59:02 设置 NRet: 2832

卫星 气象 799.9mBar +14.5C 73%

地靶 A033-ET 频率: 1000 Hz 激光 停止

starID	starName	starSIC	start	end	elevation	length	visibl
<input type="checkbox"/> 8606101AJ	ajisai-0	1500	1139	1154	52	14	
<input type="checkbox"/> 6503201BE	beaconc-1	0317	1202	1215	50	13	
<input type="checkbox"/> 070650309	glonass109-0	9109	1219	1630	73	250	
<input type="checkbox"/> 7501001ST	starlette-1	1134	1300	1312	74	11	
<input type="checkbox"/> 0904907BS	blits-0	5558	1321	1329	36	7	
<input type="checkbox"/> 7603901LA	lageos1-1	1155	1337	1429	82	52	
<input type="checkbox"/> 8606101AJ	ajisai-1	1500	1342	1356	41	13	
<input type="checkbox"/> 0304206AR	laret-0	5557	1342	1349	44	6	
<input type="checkbox"/> 0701101M1	compassml-0	2001	1409	2015	87	365	
<input type="checkbox"/> 9207002L2	lageos2-1	5986	1421	1519	60	58	



开始 | ynao_slr | A033.1-51 | 云台1.2望远镜激光测距系... | 12:59

Key Technique



epoch(s)	frequency (Hz)
52167.74765	1003.209371
52167.74865	1003.309512
52167.74964	1001.911749
52167.75064	1002.198528
52167.75164	1003.209664
52167.75264	1003.3217
52167.75363	1001.090285
52167.75463	1003.921925
52167.75563	1003.709411
52167.75663	1001.911844
52167.75762	1003.109543
52167.75862	1004.00971
52167.75962	1002.310725
52167.76061	1002.198425
52167.76161	1002.80987
52167.76261	1003.109543
52167.76361	1003.409387

Rotation Shutter:

- 1, to generate fire signal's synchronization pulse($1002.8 \pm 1.5 \text{Hz}$)
- 2, to reduce backscatter noise of transmit laser to SPAD
- 3, let return photon to receiver,...

Looking into the future

1, to pass the "OC Validated " procedure as soon as possible.

Single CRD format observation data sent by more than 6 months. Both CRD format and NP format have been sent for 1 month, but NP format data hasn't been taken away.

Looking into the future

2, to carry out LLR experiment.

Though LLR is very difficult, we would do a series of experiments for LLR in order to completely utilize our 1.2m telescope advantage.

3, to research the application of SLR data.

Thanks:

CRUSTAL MOVEMENT OBSERVATION NETWORK OF CHINA !

Thanks for your attention!