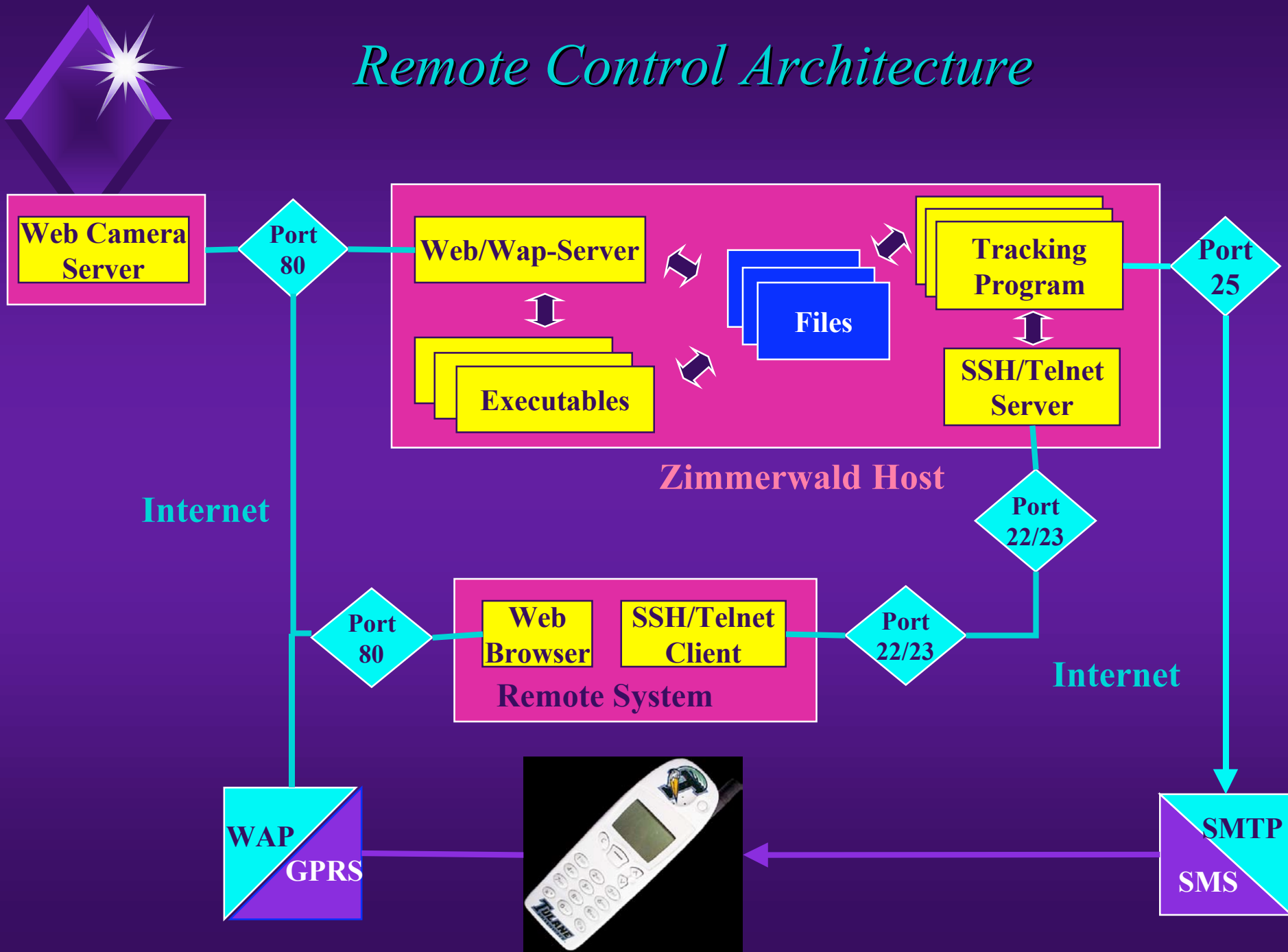


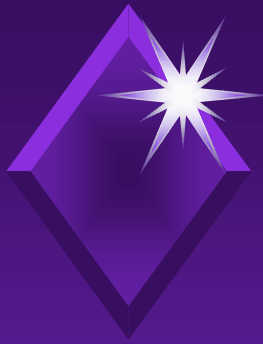
*Zimmerwald Remote Control  
by Internet and Cellular Phone*



Werner Gurtner  
Astronomical Institute  
University of Berne

# Remote Control Architecture





## *Web Access: Zimmerwald Home Page*

- ◆ System Status
- ◆ Station met, web cameras
- ◆ List of possible passes
- ◆ Observers' schedule
- ◆ *During observations:*
  - ◆ Operator screen
  - ◆ Pass scheduler
  - ◆ Sky plot
  - ◆ Telescope cameras
- ◆ Observed passes (lists, graphics)
- ◆ Documents, manuals (password-protected access)



## *System Status*

- ◆ Login message file (messages to operators)
- ◆ Login error message file
- ◆ ILRS Urgent messages
- ◆ Current status of system components
  - ◆ Telescope
  - ◆ Laser
  - ◆ Dome
  - ◆ Tracking program
  - ◆ Cooling system
  - ◆ Station clock
- ◆ Log book



# *Current System Status*

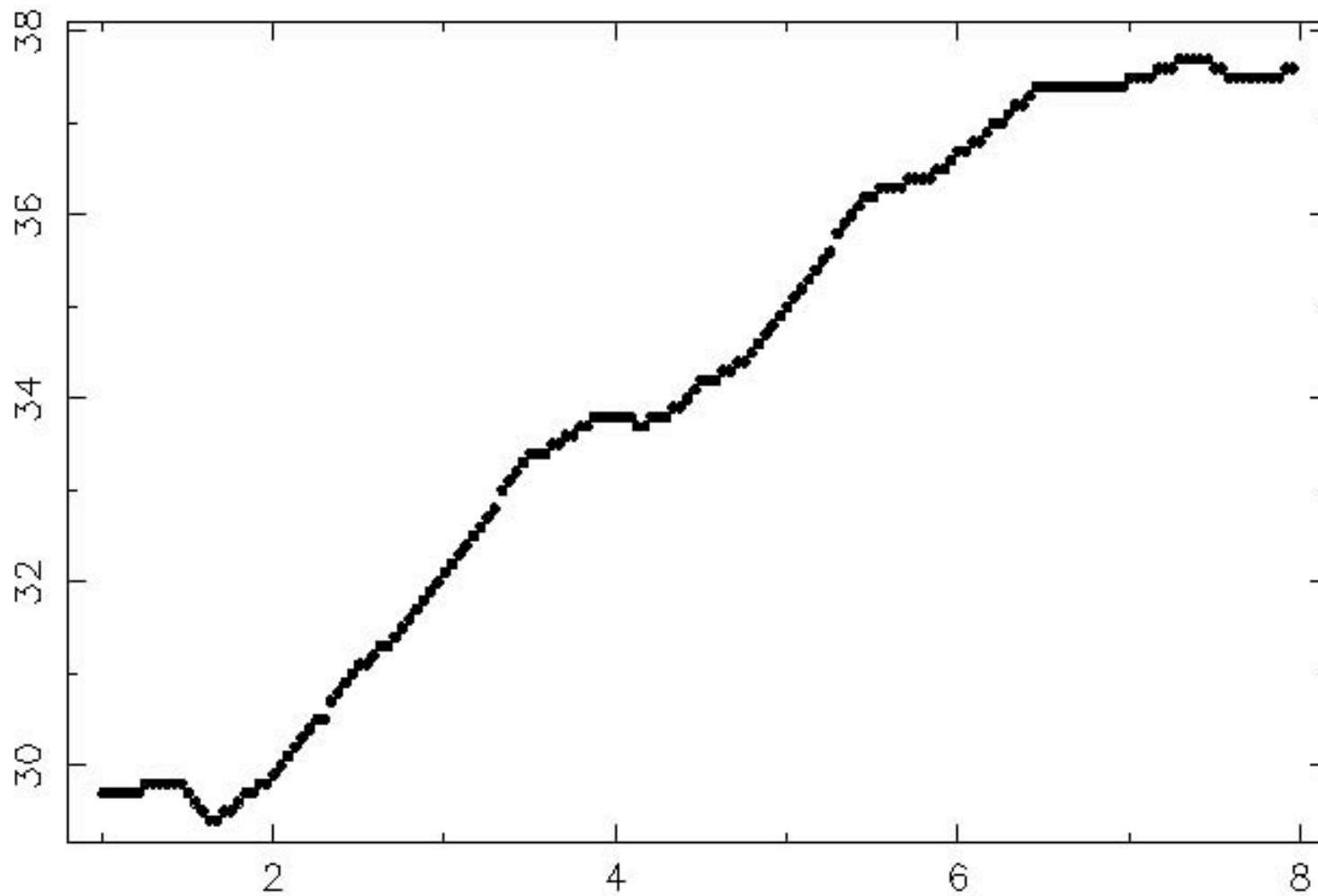
The Telescope / CAMAC are currently used by:

Account : LASER  
Terminal : FTA15  
Remote port:  
Mode : INTERACTIVE  
Program : ZIMLAS  
Observer : EP  
Start time : 07:41 UT  
Stop time : 08:42 UT  
Remote ctrl: No  
Auto mode : No

Laser : ON  
LS air temperature: 19.9  
LS osc.temperature: 21.6  
Dome : Open  
ZIMLAT PC : ON  
CAMAC PC : ON  
CAMAC Crate : ON  
Rain : NO

# Station Clock

GPS minus Station Clock, Week 21/2004 (microsec)



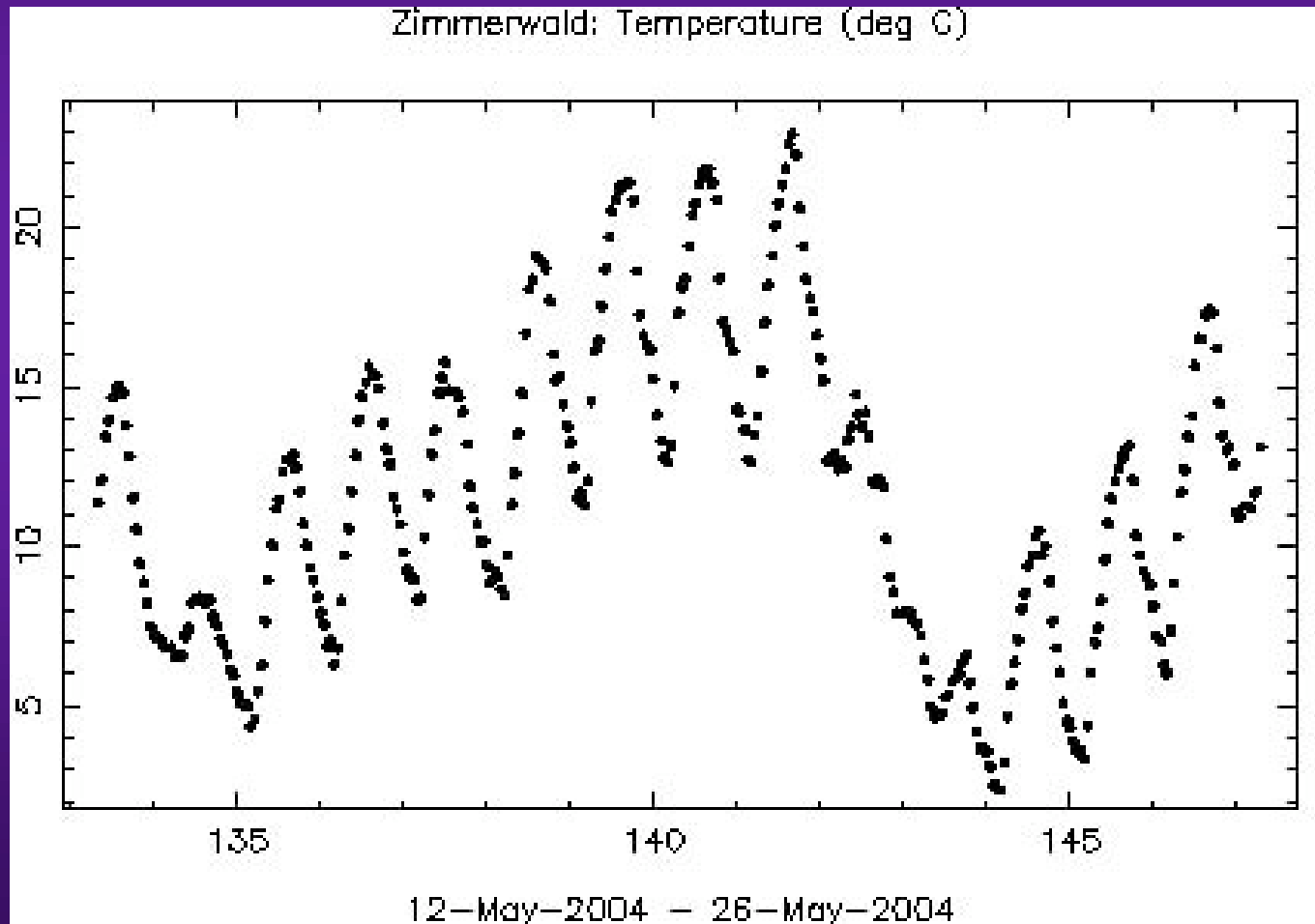


## *Zimmerwald Met Data*

- ◆ Current met sensor readings
- ◆ Graphics of surface met values (p,t,h) for any time interval
- ◆ Weekly RINEX met files



## *Surface Met Values (temperature)*







# RINEX Met File

2										METEOROLOGICAL DATA										RINEX VERSION / TYPE									
MET_STORE					AIUB					17-MAY-04 00:02					PGM / RUN BY / DATE														
ZIMMERWALD																				MARKER NAME									
3			PR		TD			HR							# / TYPES OF OBSERV														
PAROSCIENTIFIC					740-16B					0.2					PR SENSOR MOD/TYPE/ACC														
ROTRONIC PT100					MP409A					0.3					TD SENSOR MOD/TYPE/ACC														
HYGROMER C94					MP409A					2.0					HR SENSOR MOD/TYPE/ACC														
0.0					0.0					0.0					950.0					PR SENSOR POS XYZ/H									
															END OF HEADER														
04	5	17	0	2	3	918.9	9.4	64.0																					
04	5	17	0	25	2	918.8	9.2	65.0																					
04	5	17	0	55	2	918.7	8.9	66.0																					
04	5	17	1	25	2	918.7	8.8	65.0																					
04	5	17	1	55	2	918.6	9.2	63.0																					
04	5	17	2	25	2	918.6	9.3	62.0																					
04	5	17	2	55	2	918.7	9.1	61.0																					
04	5	17	3	25	2	918.7	9.0	62.0																					
04	5	17	3	55	2	918.7	8.8	61.0																					
04	5	17	4	25	2	918.8	8.2	70.0																					
04	5	17	4	55	2	919.0	8.3	65.0																					
04	5	17	5	25	2	919.1	8.9	73.0																					
04	5	17	5	55	2	919.2	9.5	71.0																					



# *Web Cameras*



Roof north



Roof south

Individual frames or continuous (server push)



# *List of possible passes*

Observable Satellite Passes From 09-Jun-04 13:00 To 09-Jun-04 17:00 MESZ

---

No.	Satellite	UTC	MESZ	Filename	Sun	Day	Ele
267	GLONASS-87	11:00 - 13:07	13:00 - 15:07	R709JN04I	Y	Y	67
281	GFO-1	11:00 - 11:05	13:00 - 13:05	GF09JN04K	Y	Y	86
282	AJISAI	11:27 - 11:42	13:27 - 13:42	AJ09JN04L	Y	Y	58
283	GRACE-A	11:28 - 11:31	13:28 - 13:31	GA09JN04L	Y	Y	21
284	GRACE-B	11:29 - 11:31	13:29 - 13:31	GB09JN04L	Y	Y	21
285	JASON	12:09 - 12:21	14:09 - 14:21	JA09JN04M	Y	Y	39
286	TOPEX	12:16 - 12:28	14:16 - 14:28	TP09JN04M	Y	Y	37
	--- Break ---	13:07 - 13:30	15:07 - 15:30	23 min			
287	AJISAI	13:30 - 13:44	15:30 - 15:44	AJ09JN04N	Y	Y	80
	--- Break ---	13:44 - 14:14	15:44 - 16:14	30 min			
288	LAGEOS	14:14 - 15:01	16:14 - 17:01	L109JN04O	Y	Y	62
289	LAGEOS-2	14:20 - 15:05	16:20 - 17:05	L209JN04O	Y	Y	44



# Operator Screen

```
+-----+
| Satellite      : TOPEX                               Vis : SUN      99|
+-----+
| Initialize    : Maximum # of Shots : 40      Actual # of Shots : 7  |
|               : Necessary # of Hits : 6       # of Init Cycles : 2  |
|               :                               |
| Manual Corr. : Step: 4" Up/Dn Lf/Rg: 0/ 0 Total: 1/ 0 E/A: -4/ 0 |
| Search       : Step: 4" Along/cross: 0/ 0 Total: 0/ 0           9 " |
|               :                               |
| Obs.Interval: 0.1 s      ADC 1/2: 308 0 22.4 23.1 Obs: 0 -15 ns |
| Window       : 40 ns     PredErr: 0 ns      Prev: 0 ns |
| Div/Blue/IR  : 600 1850 1750 Late by: -0.002 s |
|               : 2850 2600 |
| Calibration  : Each 70. obs ADC 1/2: 324      3.4 mJ Obs.Value: ns |
|               :                               2.2      55.27 |
| Statistics   : Calibr: 73 16% Bad: 68 0R Ovfl: 757 Hits: 83 23% |
|               : 35 22      46 0      750      150 24 |
| Auto: ON     Mode: F Obs.: ON      ATC: OK      0130000000 |
|               :                               0102100001 |
| A 344.7940 E 17.8127 D 180 TRACKING 26-MAY-04 12:51:21.5 7:11 |
+-----+-----+-----+
| DAY_TV          ON | MOTION_DET      OFF | CM_SHUTTER      OFF |
| ML_DRIVE        5463 OK | NDFILT_BL      0 OK | R_SWITCH_1      1 OK |
+-----+-----+-----+
```



# Pass Scheduler

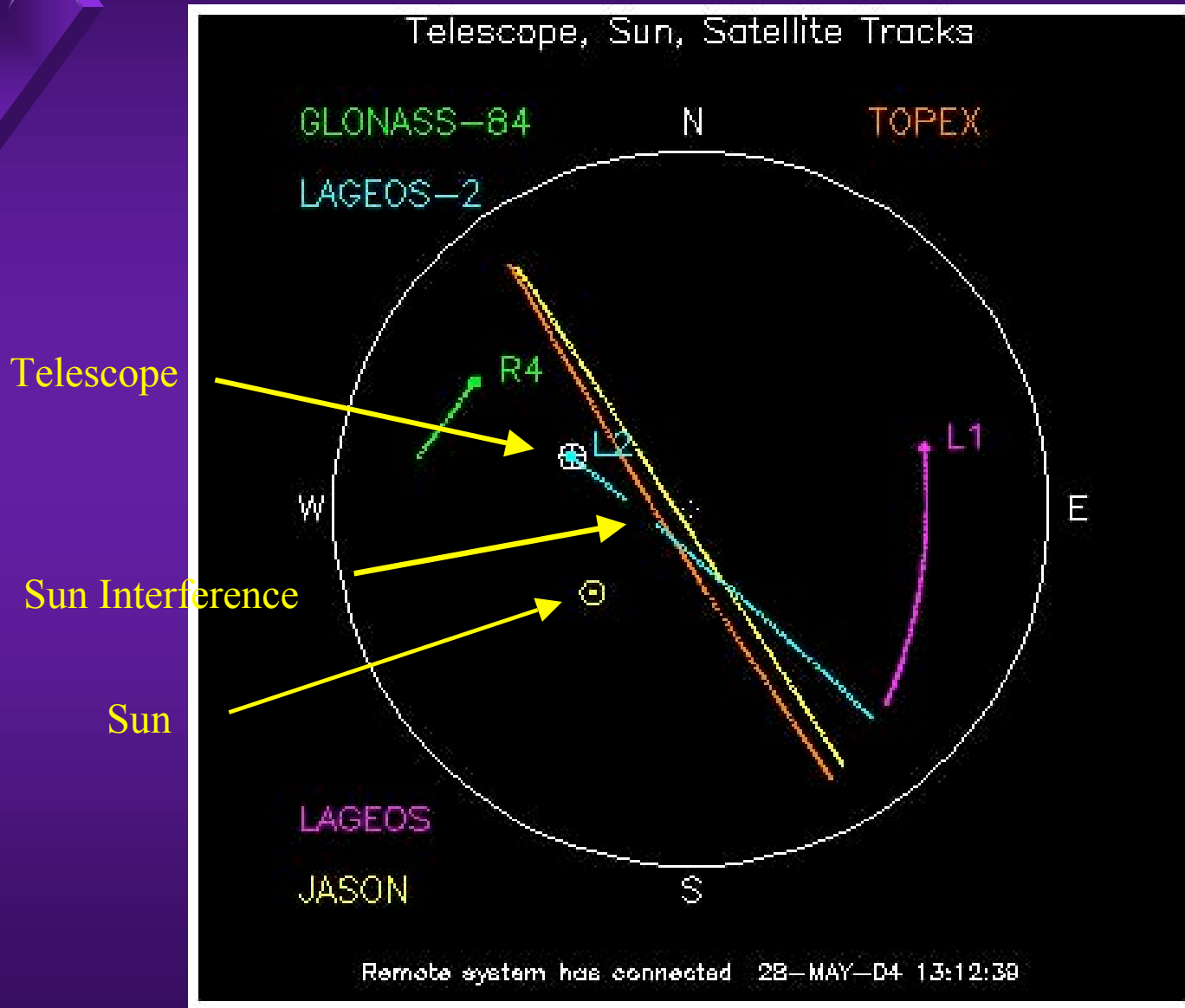
Sun Interference



#	Satellite	12:54:51	13:23:00	13:51:10
01	GLONASS-84	+++++	+++++	+++++
02	LAGEOS-2	#####	#####	#####
03	LAGEOS	-----	-----	-----
04	JASON	-----	-----	-----
05	TOPEX	-----	-----	-----
		1 char = 60 seconds		



# Sky Plot of Passes





# *Telescope Cameras (via Web Camera Server)*



Daylight Camera



Nighttime Tracking Camera  
(field of view 45 arc min)



# List of Observed Passes

CONTENT OF LOG FILE "SATLOG.D30" FOR THE FOLLOWING TIME INTERVAL:

\*\*\*\*\*

FROM: 2004-05-23 12:00

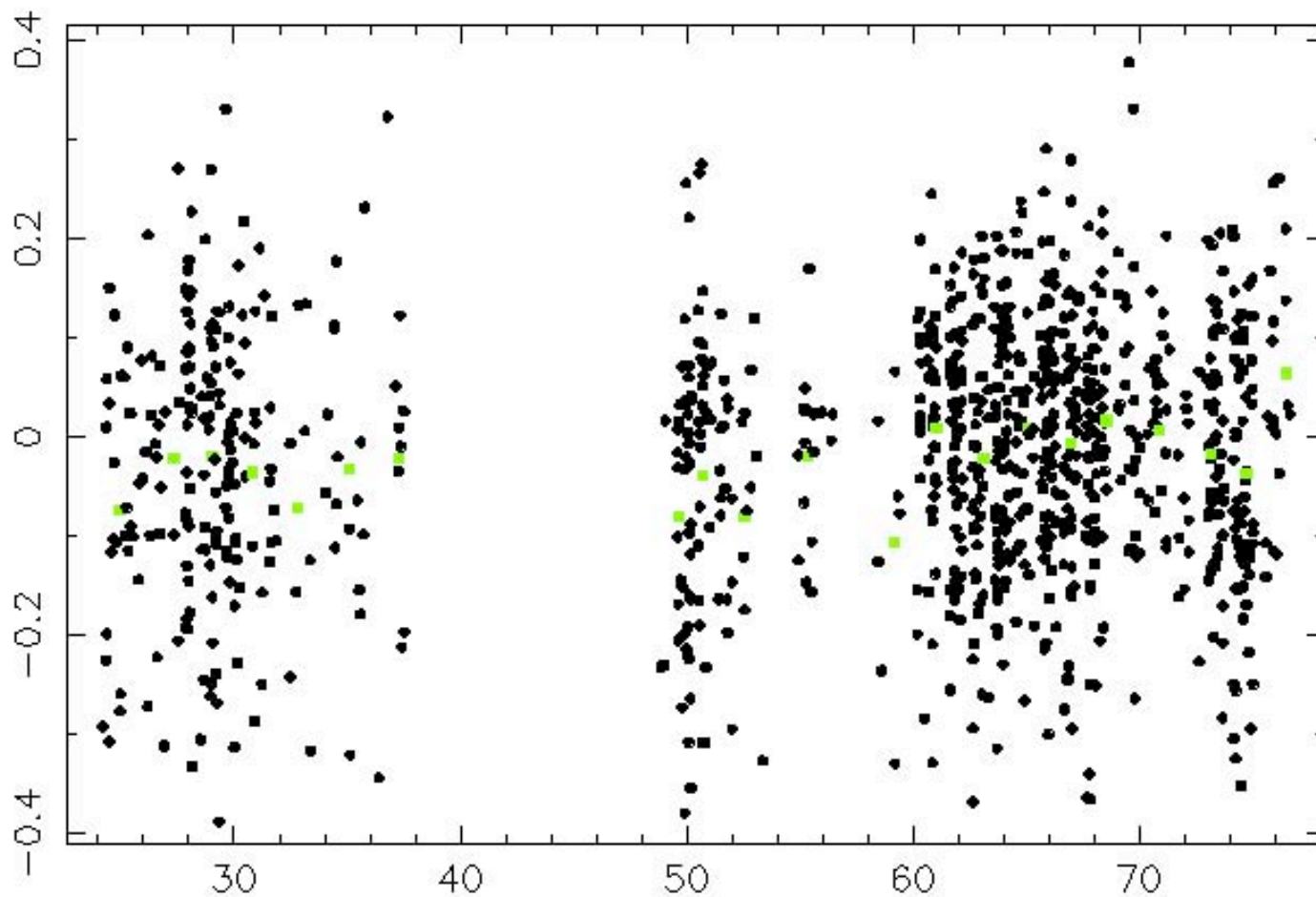
TO: 2004-05-24 12:00

FILE NAME	START	NHIT	DT0	WL	O-SCR	O-RMS	C-SCR	C-RMS	C-CST	O 1-2	Q	DUR
L123MY04M	12:51:36	334	-.001	1	342	.156	217	.111	31.21		Y	20
		899		2	843	.173	224	.172	54.91	0.05	Y	
JA23MY04N	13:27:35	523	0.003	1	517	.094	402	.104	31.21		Y	9
		378		2	315	.145	359	.176	54.91	-0.02	Y	
TP23MY04N	13:34:36	691	0.001	1	594	.204	615	.102	31.21		Y	12
		690		2	511	.236	567	.177	54.91	-0.06	Y	
L223MY04O	14:23:13	993	-.001	1	966	.131	851	.097	31.22		Y	53
		2147		2	2004	.167	858	.196	54.90	0.03	Y	
AJ23MY04O	14:39:24	301	-.002	1	286	.259	432	.096	31.22		Y	8
		326		2	292	.271	422	.194	54.91	-0.04	Y	
JA23MY04P	15:24:30	125	0.003	1	111	.120	583	.107	31.21		Y	11
		299		2	232	.155	604	.192	54.88	-0.03	Y	
TP23MY04P	15:32:13	276	0.002	1	240	.190	564	.107	31.21		Y	9
		310		2	222	.224	585	.190	54.88	-0.07	Y	



# Graphics of Pass Values

L223MY040 RESIDUALS [NS] (COUNTER 1)





# *WAP Access by Mobile Phones*





# WAP Access (2)

(using web-based WAP Emulator)

TT Emulator -Netscape

TagTag.COM®

-- Result --

Laser : ON  
Dome : Open  
The Telescope / CAMAC are currently used by:  
Account : LASER  
Terminal : FTA20  
Remote port:  
Mode : INTERACTIVE  
Program : ZIMLAS  
Observer : EP  
Start time : 12:37 UT Stop  
time : 13:38 UT  
Remote ctrl: No

HOME    ▲  
         ▼    BACK

Station Status

TT Emulator -Netscape

TagTag.COM®

-- Result --

Graz OUT  
Zimmerwald Lageos2 CUR  
917  
Wetzell Lageos2 CUR 0  
Herstmonceux Lageos2 CUR  
177  
Yarragadee Starlette CUR  
1650

---

[WAP device](#)

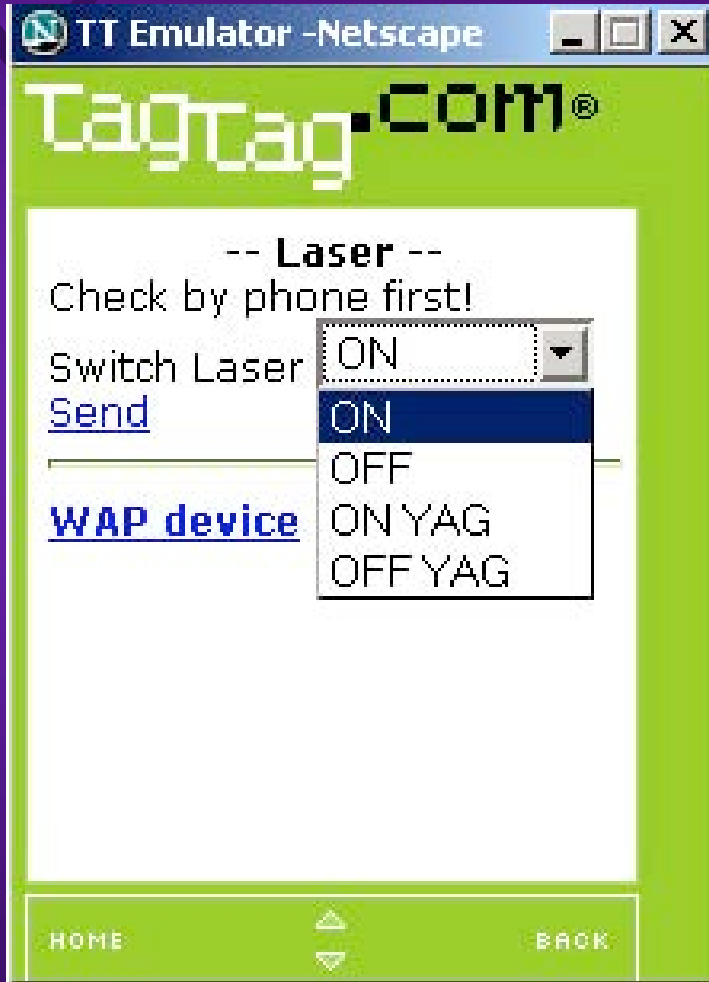
HOME    ▲  
         ▼    BACK

EUROLAS Status



# WAP Access (3)

(using web-based WAP Emulator)



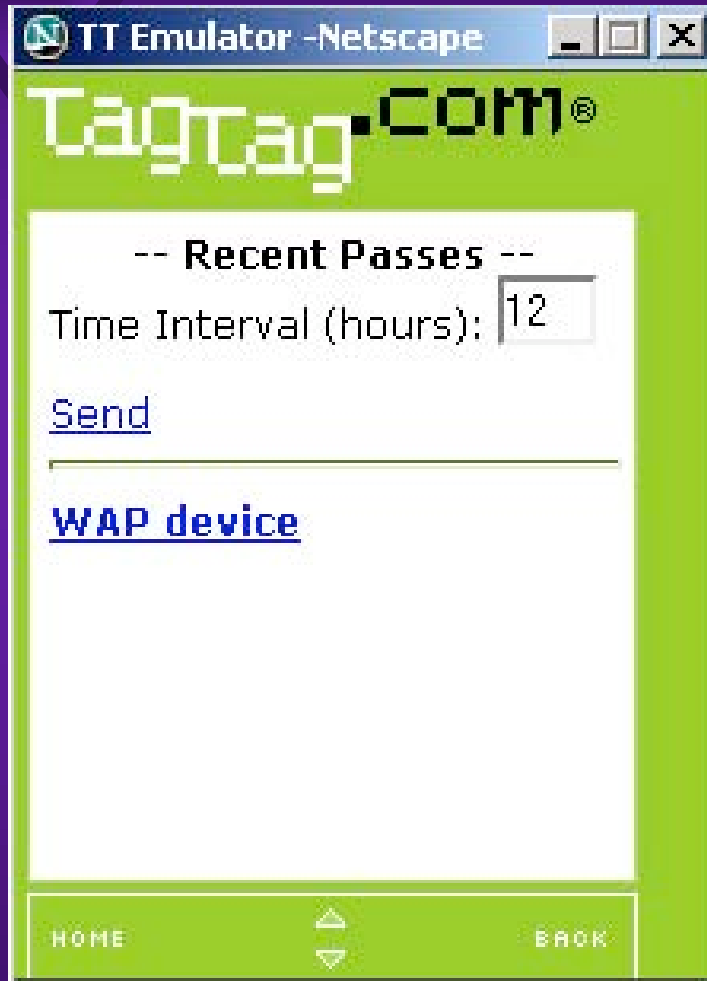
Switch Laser ON/OFF



Initialize Telescope

# WAP Access (4)

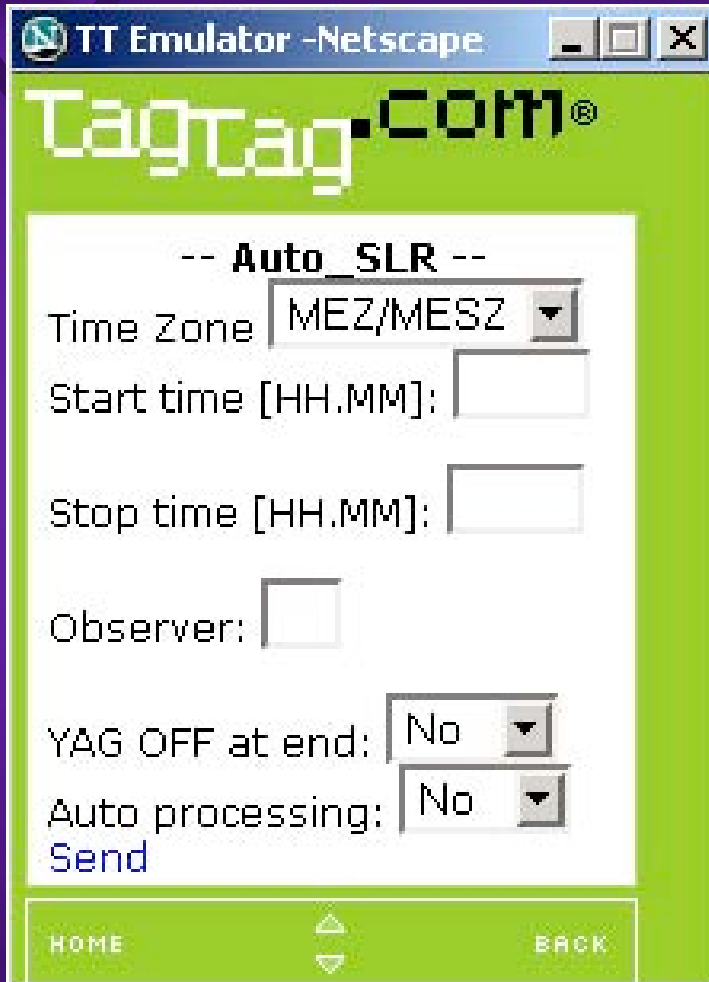
(using web-based WAP Emulator)



Recently observed passes

# WAP Access (5)

(using web-based WAP Emulator)



TT Emulator -Netscape

Tagtag.COM®

-- Auto\_SLR --

Time Zone: MEZ/MESZ

Start time [HH.MM]:

Stop time [HH.MM]:

Observer:

YAG OFF at end: No

Auto processing: No

Send

HOME    BACK

Start fully automated session

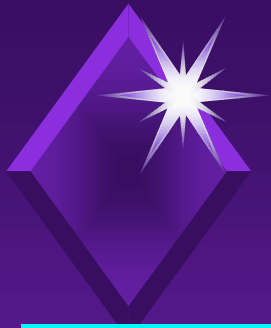


Daylight camera



## *Remote Control*

- ◆ **Telnet/ssh** connection into the station computer
- ◆ Full system control over all necessary components via remote keyboard
- ◆ System output in telnet window
- ◆ Realtime operator screen in separate telnet window
- ◆ Graphics (returns/noise) and sky plot, if local **x-window server** is available
- ◆ Camera images (and sky plot) on **web browser**
- ◆ Remote control also simultaneous with onsite operation (tutoring, trouble shooting)



# Station Control: SLR Menu

```
+-----+
| 1 | Laser-Programme |
+-----+
| | *** Teleskop/CAMAC in Betrieb! *** |
+-----+
| | |
| 1 .. | LASPRED : Manuelles Berechnen von Prognosen |
| 2 .. | LASINIT : Hochfahren des Lasers, Teleskop-Initialisierung |
| 3 .. | LASOBS : Beobachten und Bearbeiten von Laser Messungen |
| 4 .. | LASEXIT : Abschlussarbeiten |
| 5 .. | LASDISP : Display von Datenfiles |
| 6 .. | LASDB : Programme rund um die Datenbank |
| 7 .. | LASSAVE : Datenarchivierung |
| 8 .. | LASUTIL : Verschiedene Hilfs-Programme |
| 9 .. | LASTEST : Test Programme |
| | |
| =H | Help |
| =X | Exit |
| | |
+-----+
Enter Selection :
```





# Station Control: SLR Operation

1.3		Laser: Durchgaenge beobachten und verarbeiten	
1	ZIMLAS	:	Beobachten von Laser-Satelliten
2	POST_PROC	:	Postprocessing (CALIBR+SCREEN+NORMPT+QUICK)
3	CALIBR	:	Datenscreening von Calibriermessungen
4	SCREEN	:	Datenscreening von Laserbeobachtungen
5	NORMPT	:	Erzeugen von Normal Points
6	QUICK	:	Quick-Look Daten erzeugen
7	OBSMRK	:	Manuelles Markieren von Beobachtungen
8	TPOSIT	:	Positionierung des Teleskopes
9	AUTO_SLR	:	Station im Automatik-Modus betreiben (Background)
0	ZIM_REMOTE	:	Remote Control of ZIMLAS Program

Enter Selection :

# Automated Data Screening

## Off-line Data Screening

-----

Filename [BC28MY04G] : L125MY04R

There are data of two counters in the file.

Which ones do you want to process: 1, 2 or both=3 [3] ?

### Realtime Filter Information

Number of good returns : 5125  
Number of bad returns : 1530  
Delta T0 (along track error): 0.001 sec  
  
RMS from experience : 0.10 ns

Iteration	Good Obs	Bad Obs	RMS (ns)	RMS (cm)
1	5126	1535	0.18	2.6
2	4997	1664	0.15	2.2
3	4918	1743	0.14	2.1
4	4855	1806	0.14	2.0

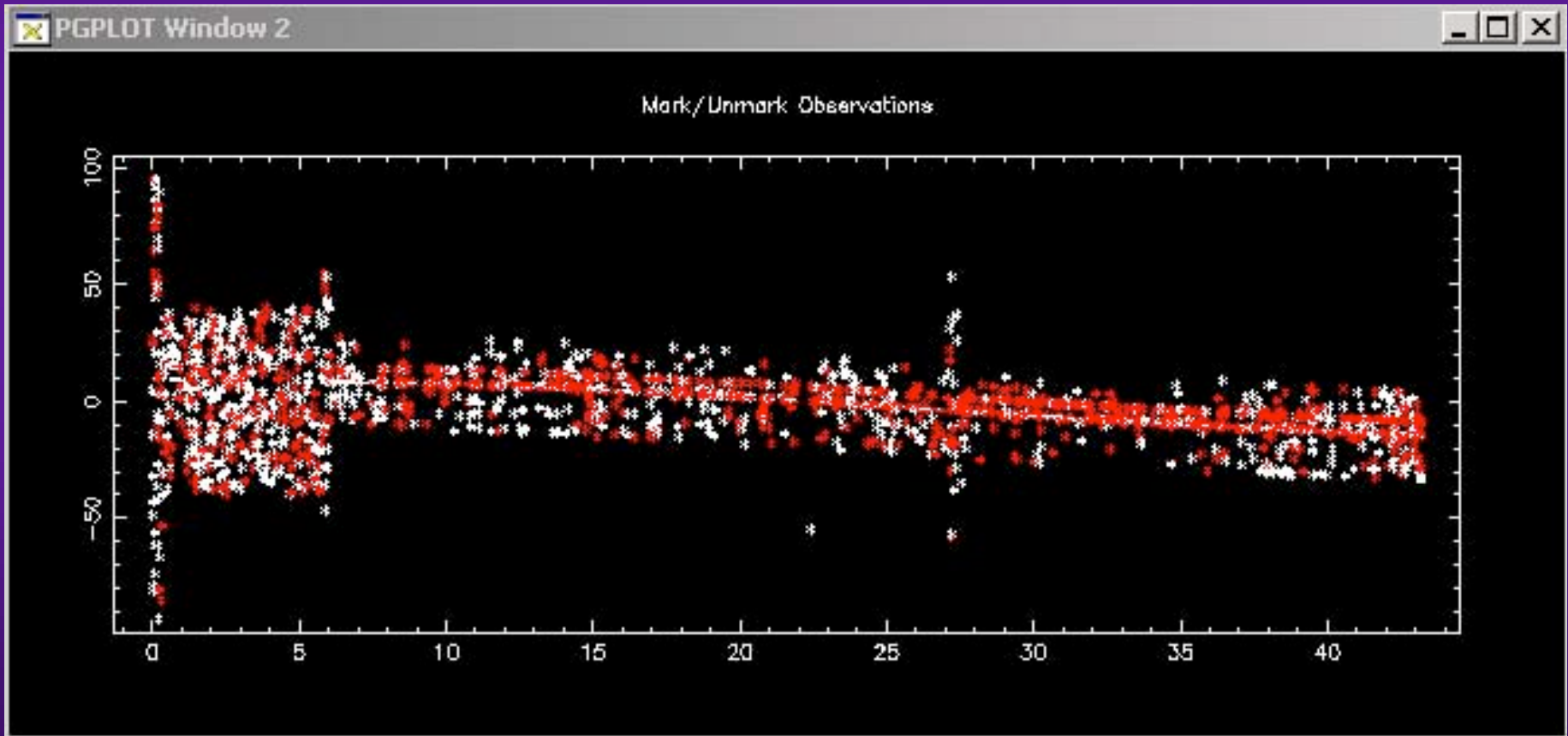
Average resid.difference between counters (2-1): 0.01 ns

Counter 1: Accepted 2456 RMS 0.11 ns = 1.7 cm

Counter 2: Accepted 2399 RMS 0.15 ns = 2.3 cm

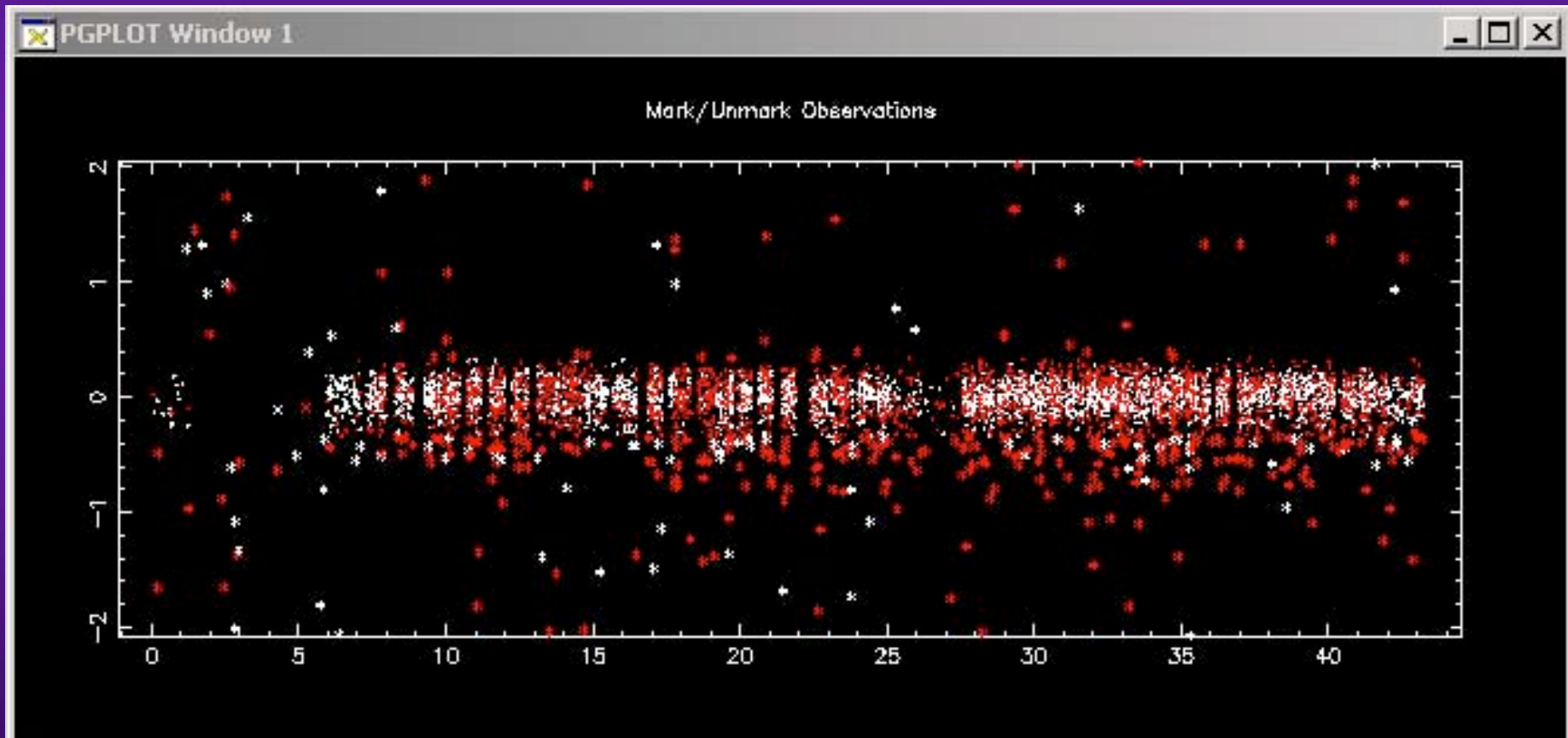


# *Interactive Data Screening: Observed-Predicted*





# *Interactive Data Screening: Residuals*





## *Limitations*

- ◆ Evaluation of actual weather conditions  
→ Optimization of pass segment selection
- ◆ System crashes (e.g. telescope stopped by hardware limit switches)
- ◆ Power failures
- ◆ Communication problems (interrupts)
- ◆ Communication limitations (bandwidth)
- ◆ Unauthorized access
  - ◆ Warning signs
  - ◆ Motion detector in dome (→interrupts Laser)



## *Conclusions*

- ◆ Remote Control very useful for
  - ◆ Tutoring, trouble shooting
  - ◆ Remote tests
  - ◆ Occasional checks during fully automated operation
  - ◆ System start-up, start automated session, shut-down
  - ◆ Handle unexpected shift problems
  - ◆ Holiday shifts
- ◆ Cellular phone access
  - ◆ Occasional checks during fully automated operation
  - ◆ System start-up, start fully automated operation