

The Yebes RAEGE telescope

Telescope control, commissioning tests & results



P. de Vicente on behalf of the Yebes Team
Observatorio de Yebes - CDT (IGN)



MINISTERIO
DE FOMENTO

DIRECCIÓN GENERAL
DEL INSTITUTO
GEOGRÁFICO
NACIONAL

OBSERVATORIO
ASTRONÓMICO
NACIONAL

Outline

- Remote telescope control
- Basic commissioning tests
- Local connection and data transport
- RFI at S band
- Gain, efficiency and SEFD
- VLBI observations & results

ICD: Interface Control Document

Interface between the remote control and the ACU

2 Category of commands:

Mode commands

Positioning

Pointing corr.

Time source

Master setting

Trajectory & special commands

Az/El Ra/Dec tracking tables

Az/El Offset tracking tables

M2 Offset tracking tables

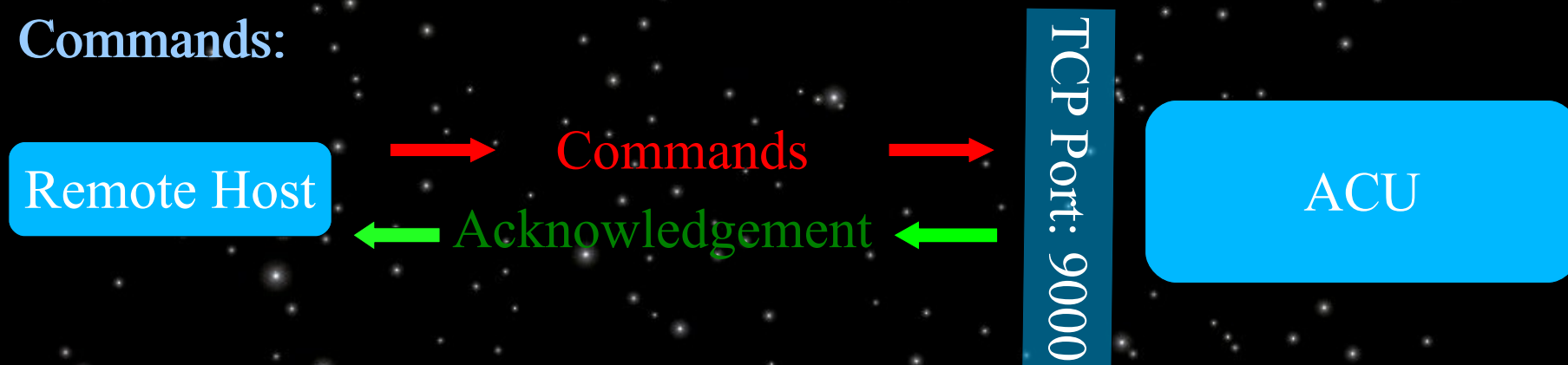
M2 Offset elevation dependency

Description of command parameters

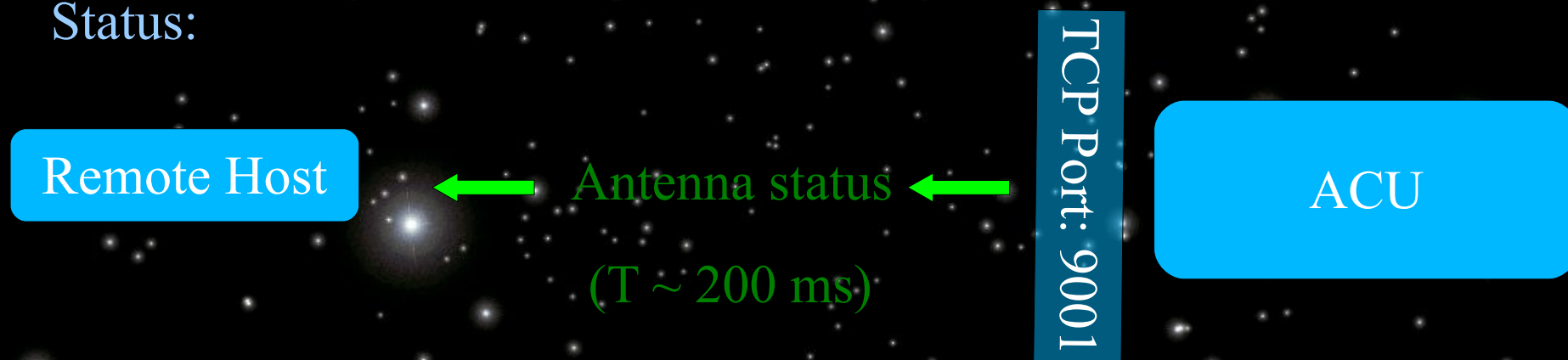
Description of status words and fields

How to command and read the ACU remotely

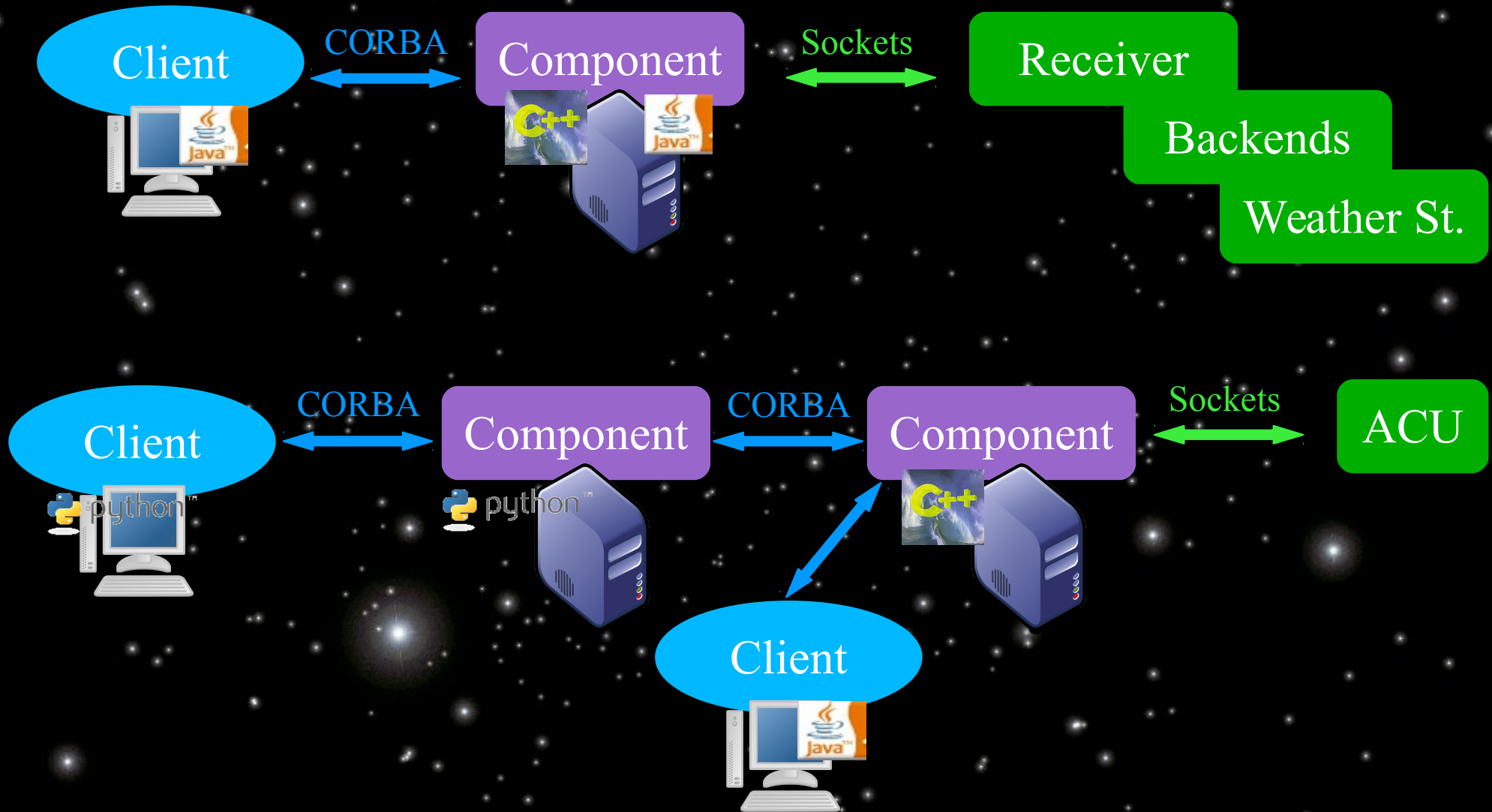
Commands:



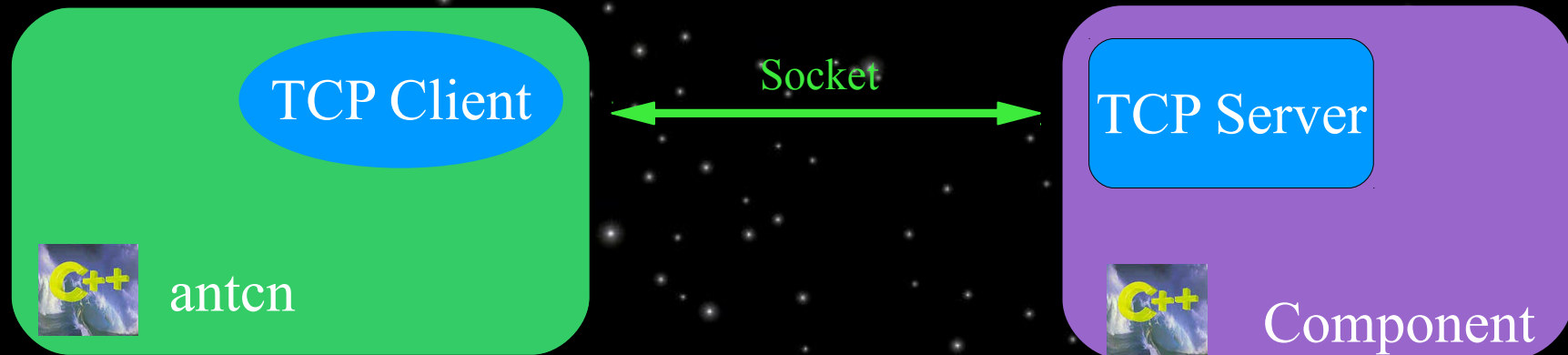
Status:



Our side: remote commanding and reading



The Field System connection



1 Shared memory: semaphores (new source, new LO, stow antenna, ...)
variables

2 Semaphore activated → Send structure & ID=1
Semaphore deactivated ← Structure back & ID=0

3 Update shared memory

Exporting the code

- Used at:

Ishioka (for the commissioning phase - Toyo)

- Will be used at:

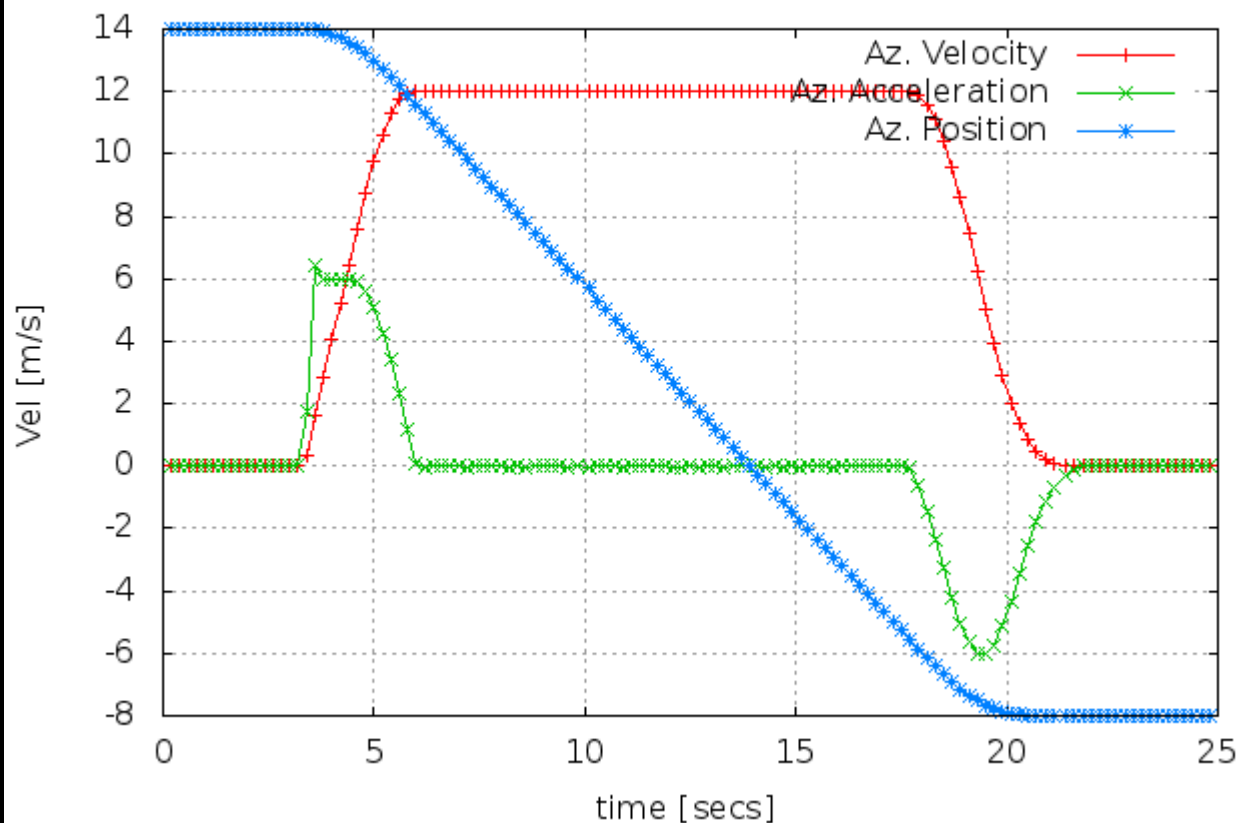
Ny Alesund

Other antennas by MT-Mechatronics ?

- Connection to Field System easily adapted to a twin telescope
- Code is free for public institutions

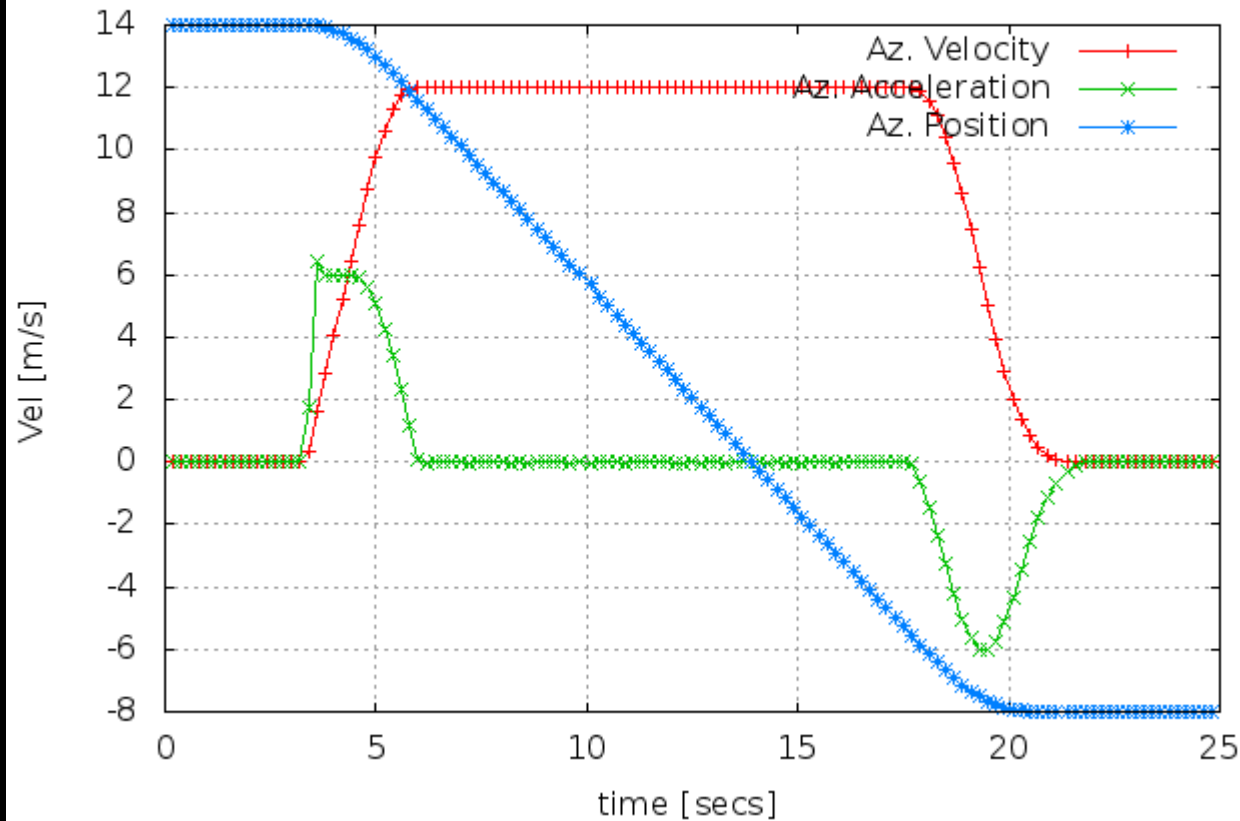
Some commissioning tests without receiver

Velocity & Acceleration Azimuth axis
225 degs. -> 45 degs.

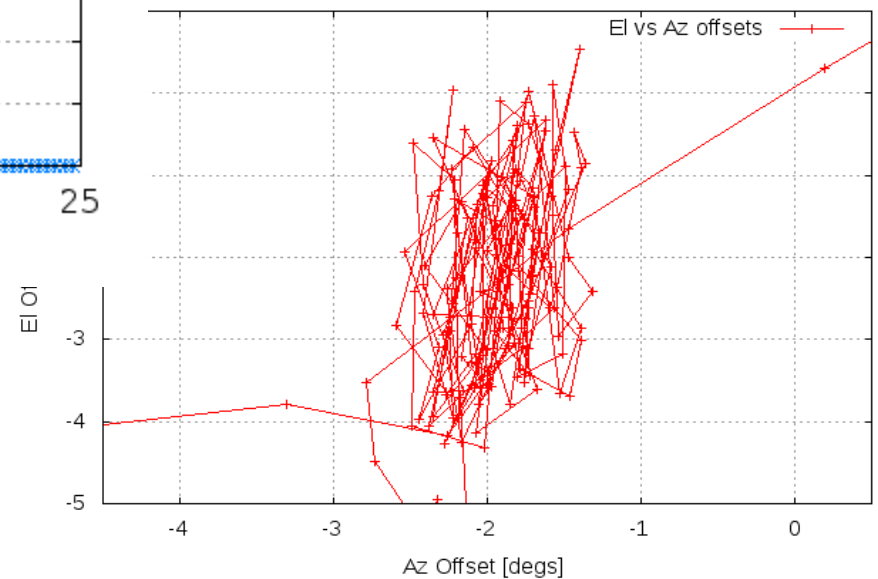


Some commissioning tests without receiver

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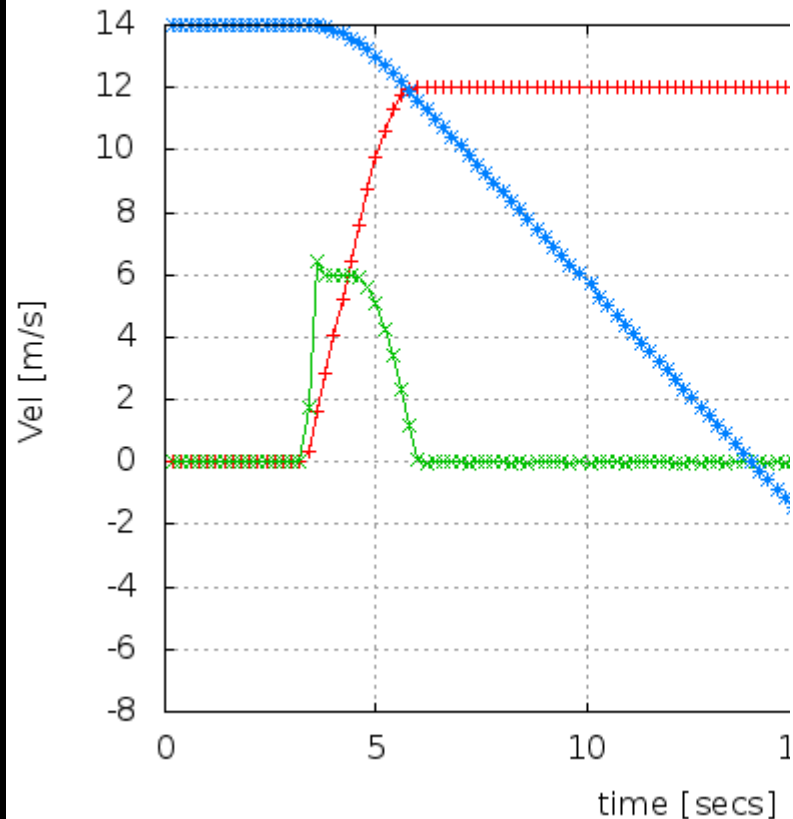


Horizontal offsets while tracking [Horizontal coords table]

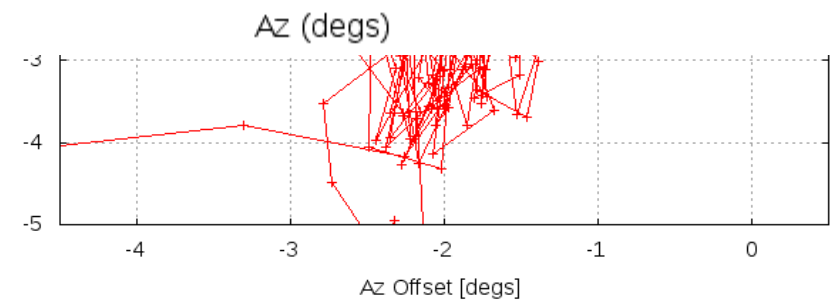
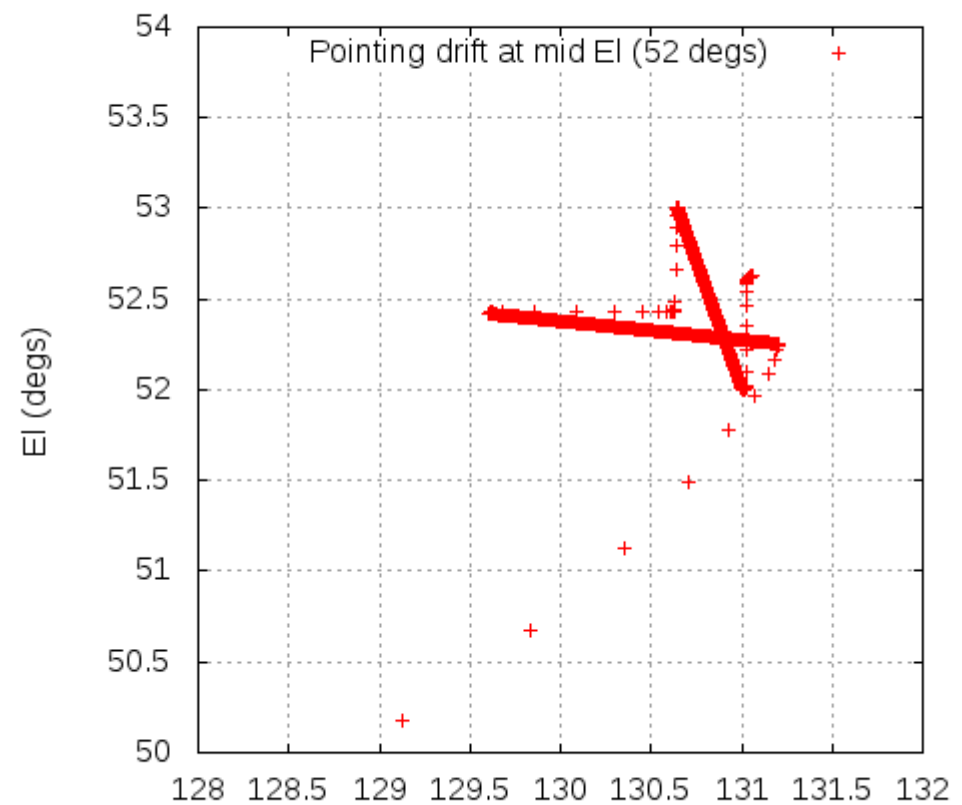


Some commissioning tests without receiver

Velocity & Acceleration A
225 degs. -> 45 c



Test to check if offset tables use Az or CoLA



Local connection and data transport

Data is transferred via optical fiber to the 40m backends room

Current backends: Continuum detectors

VLBI backends: DBBC + Mark5B+



Multimode fiber

Data / Control

Monomode fiber

IF (2.5 GHz)

+

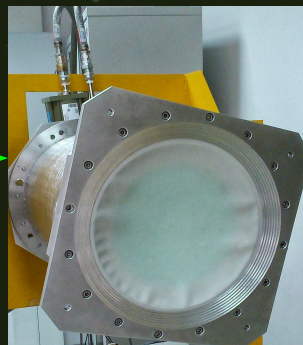
5 MHz, IRIG-B,
80 Hz

Data Path

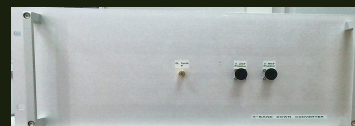
13.2 m



Receiver



IF



Optical Tx.



40 m

Switch/Router



1-4 Gb/s

Correlator

Mark 5B+



DBBC



Optical Rx.



Cont. Det.



VLBI equipment

Currently

- 1 x DBBC2 (4 IFs)
2 x 500 MHz (2 VSI)
- 1 x Mark5B+
Max: 2 Gbps (1 x 512 MHz)
- Phase cal (5 MHz pulses)
- Cable measurement

Next months

- 2 x DBBC2 with Fila10G
2 x 4 x 1 GHz (VDIF)
- 1 (or 2) x Mark6
Max: 16 Gbps
- Phase cal (5 MHz pulses)
- Cable measurement

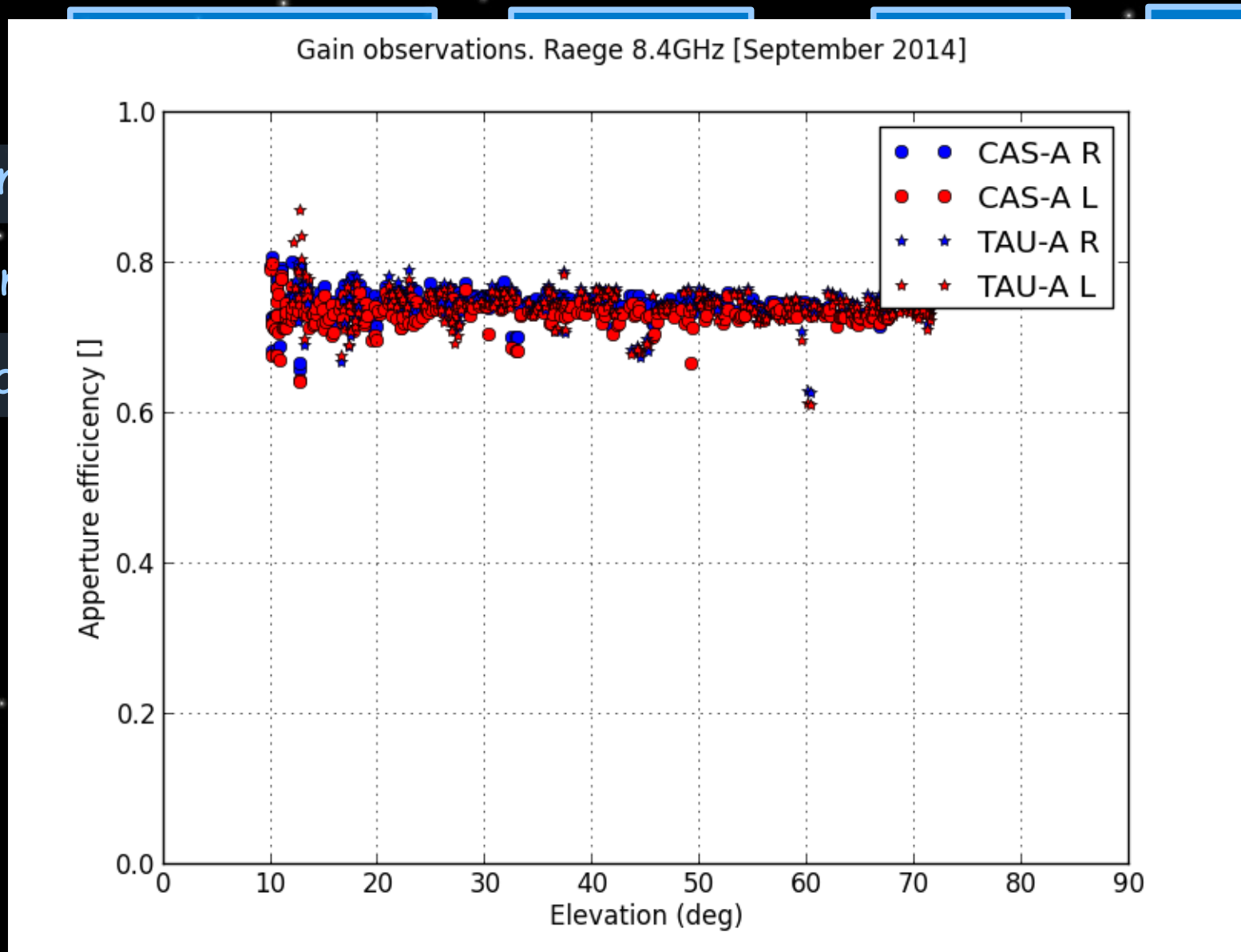
The three band receiver

	Freq. Range GHz	BW (MHz)	Pol	LO (GHz)
S band	2.2 - 2.7	500	RCP/LCP	1.7
X Band	7.0 - 9.5	950	RCP/LCP	0.1-20 / 20 mHz
Ka band	28.0 - 33.0	500	RCP/LCP	0.1-20 / 20 mHz

Main characteristics of the antenna

	Efficiency	SEFD (Jy)	T _{sys} (K)	HPBW('')
S band	~70 %	1700	40	~2550
X Band	~70 %	1600	40	~675
Ka band	~55 %	2700	70	~190

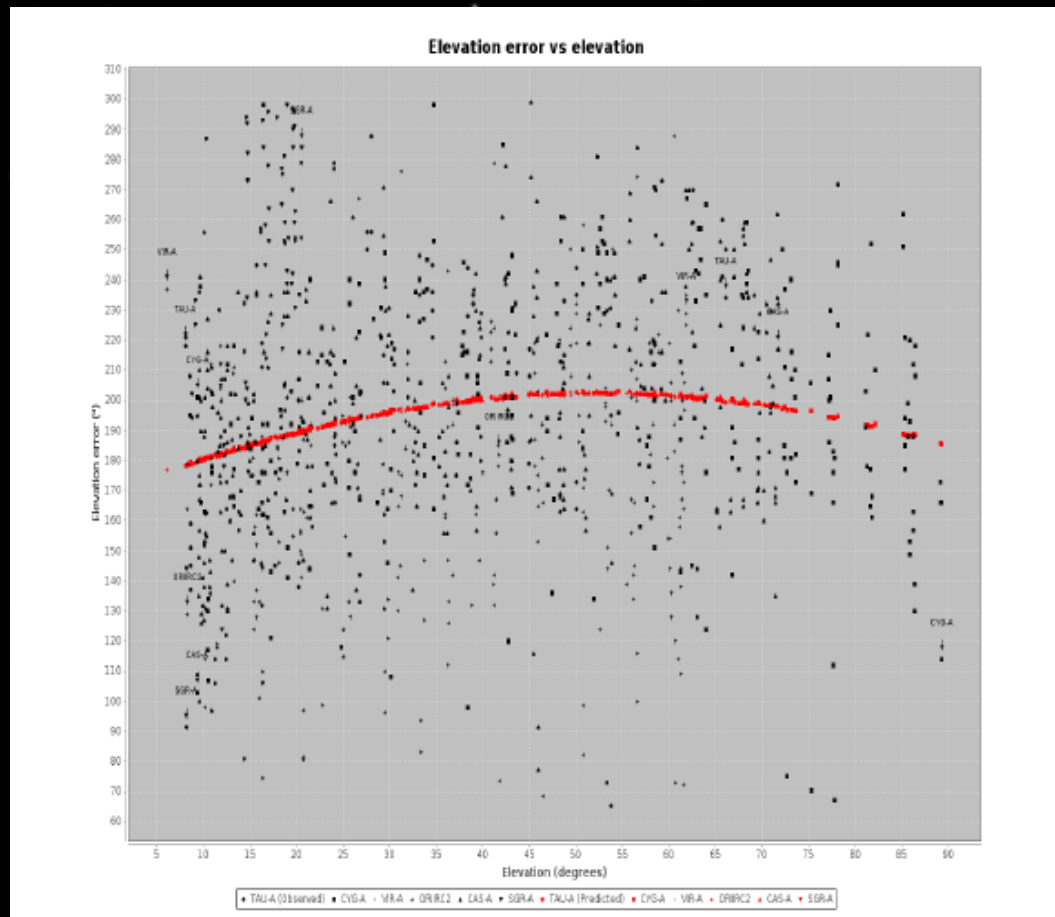
Main characteristics of the antenna



Main characteristics of the antenna

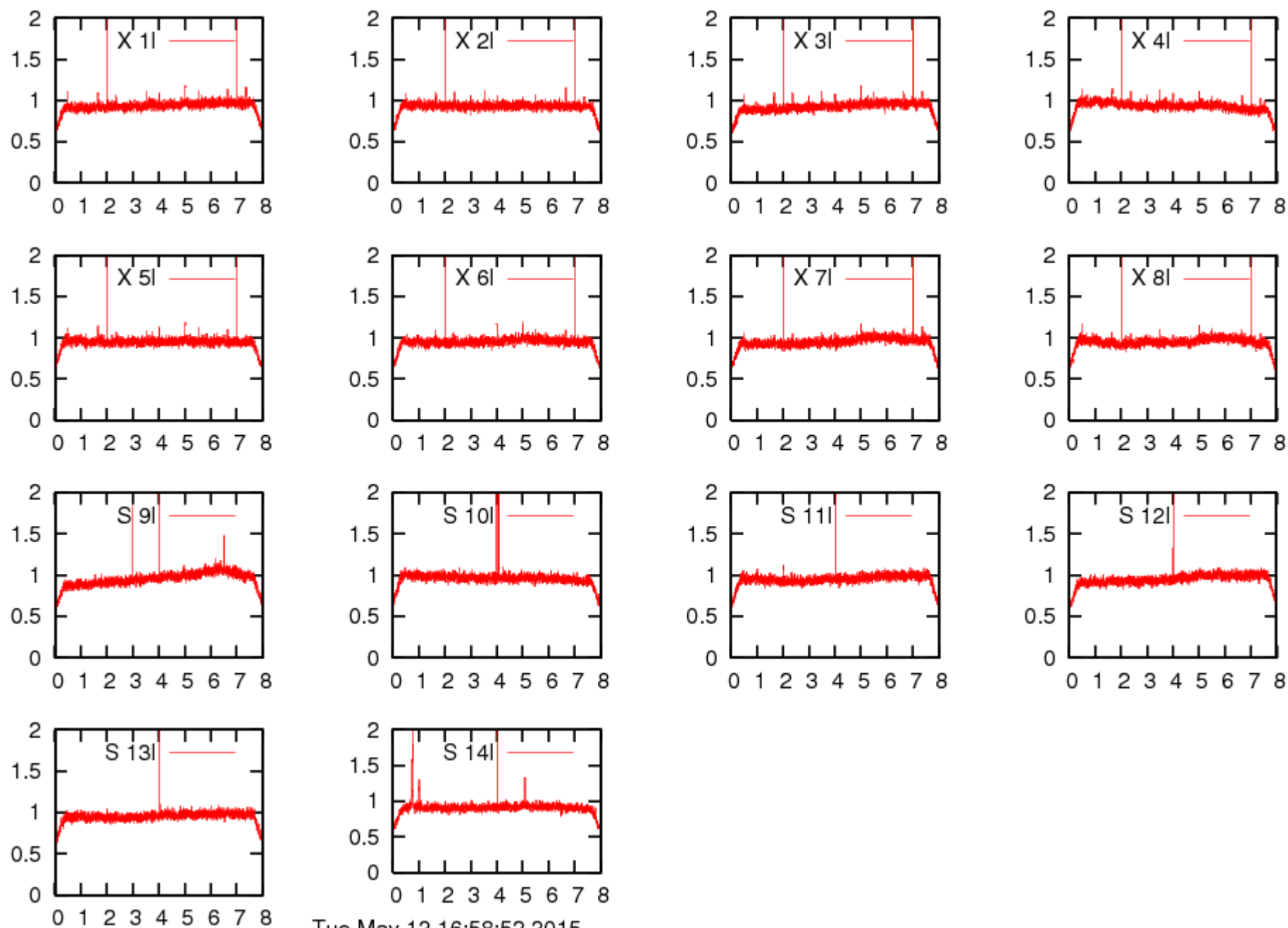
Pointing RMS for the whole sky: $\sim 40''$ (X band)

Pointing accuracy: $10''$

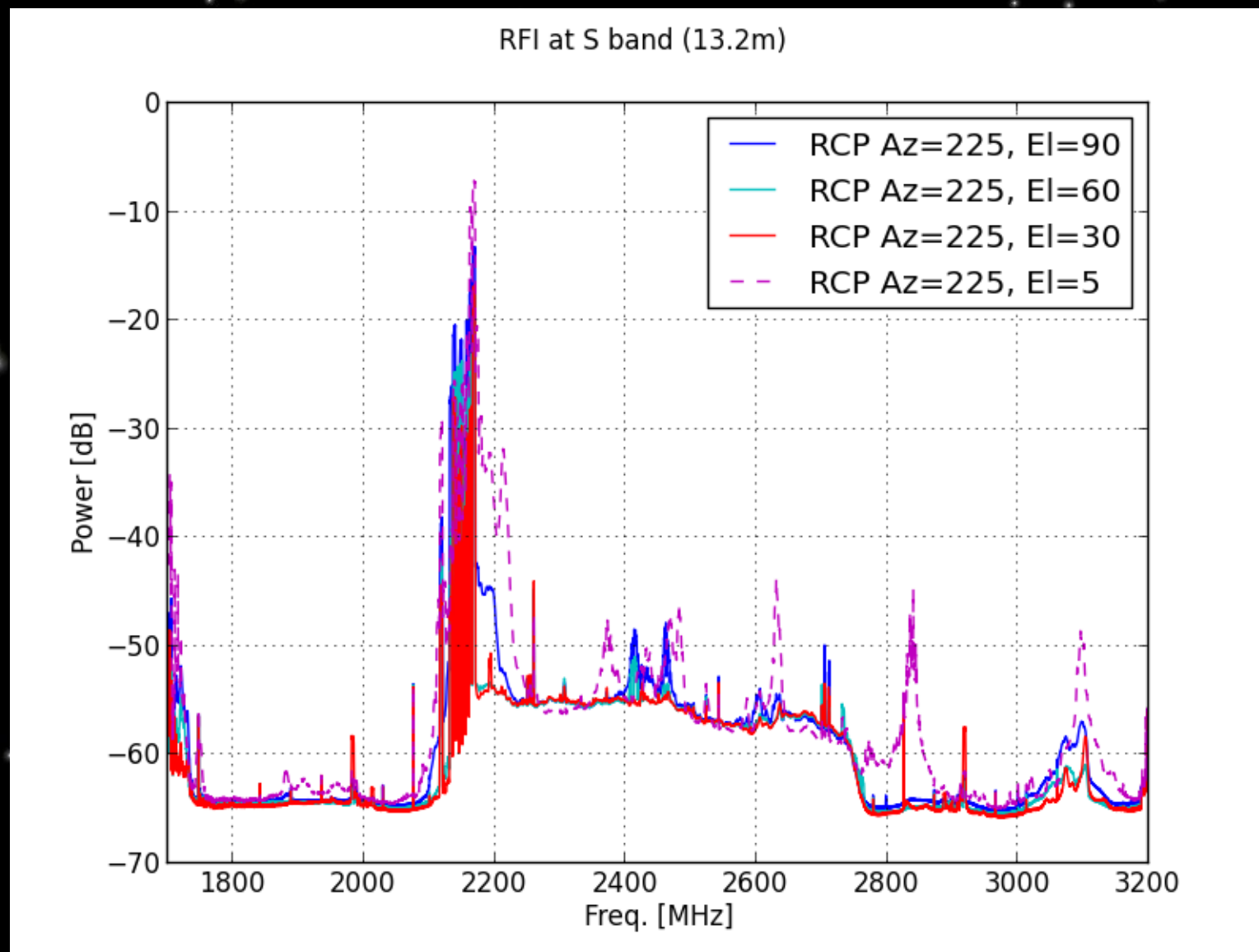


An extreme case of pointing model correction at 8 GHz

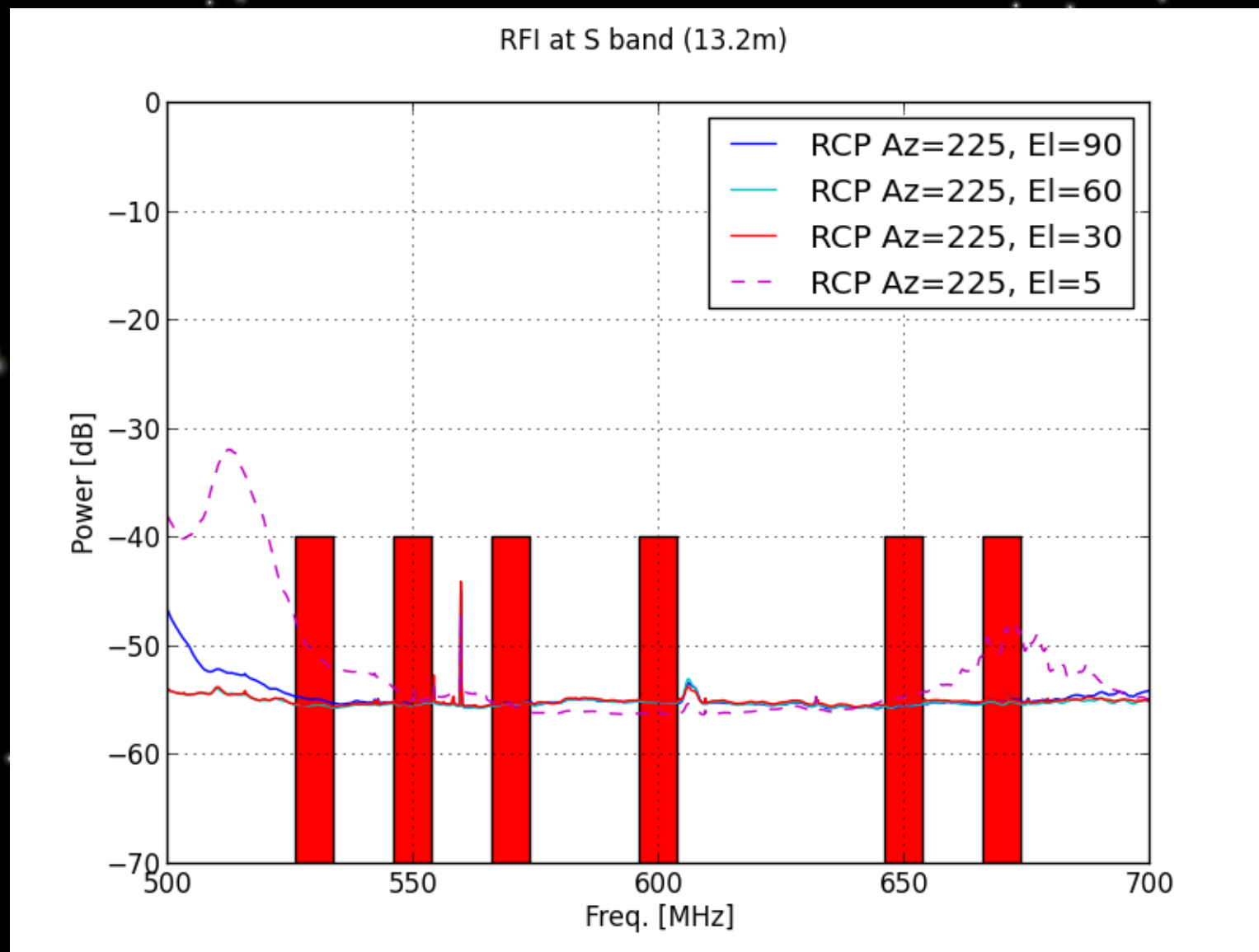
RFI, a problem at low frequencies



RFI, a problem at low frequencies



RFI, a problem at low frequencies



In the IVS network

● Experiments:

R4663 (first fringes, only X band)

R1675, R1677, R1678, R1679, R1680 (S + X bands)

● Since April 14, 2015: once per week R1 + R4 sessions

● R1675 produced first coordinates (Leonid Petrov):

Postfit residuals were in a range of 20-30 ps. That is usual for this kind of experiments.

Here are results:

Uncertainties:

1845. RAEGYEB	7389 EURA	X Comp	4848831105.43 mm	0.430 mm	3.977 mm	3.977 mm	global
1846. RAEGYEB	7389 EURA	Y Comp	-261629794.91 mm	0.088 mm	3.704 mm	3.704 mm	global
1847. RAEGYEB	7389 EURA	Z Comp	4122976237.47 mm	0.474 mm	3.130 mm	3.130 mm	global
1848. RAEGYEB	7389 EURA	X Velo	-1.95 mm/yr	7.961 mm/yr	0.284 mm/yr	0.284 mm/yr	global
1849. RAEGYEB	7389 EURA	Y Velo	21.31 mm/yr	1.445 mm/yr	0.385 mm/yr	0.385 mm/yr	global
1850. RAEGYEB	7389 EURA	Z Velo	14.98 mm/yr	5.092 mm/yr	0.156 mm/yr	0.156 mm/yr	global

Velocities were tied to YEBES40M velocities.

In the IVS network

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R1675, R1677, R1678, R1679, R1680 (S + V)

Thank you, Bonn correlator!!
(A. Bertarini, L. Laporta)

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[illegible]



Thank You !!