
Control System and Observing Modes at the IRAM 30m
http://www.iram-institute.org
→ Science users → 30m telescope

People · NCS

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Juan Peñalver • Salvador Sanchez • Walter Brunswig

People · other

TAPAS
designed and developed by IAA-CSIC & IRAM Granada
currently maintained by Pablo Mellado

Pool Observations
IRAM Granada staff
current pool managers: Claudia Marka • Israel Hermelo

* in the past


Telescope
30 m diameter
80 to 350 GHz

Instruments

Heterodyne	EMIR	4 bands	dual polarization	2 bands simultaneously
	HERA	1.3 mm band	dual polarization	9 pixels
Backends	BBC	continuum		
	NBC	continuum		
	WILMA	autocorrelator		
	FTS		100,000s of channels	
	VESPA	autocorrelator	high resolution	
	/XPOL		polarimetry	
Continuum	NIKA 2	2 and 1.2 mm	dual polarization	5,000 pixels
	own backend / data acquisition		http://ipag.osug.fr/nika2/Welcome.html	
Special	VLBI	pulsars		
Test	HEMT	etc.		
Data volume	up to	1 Terabyte / day possible		
	currently	30 Terabyte / year (mainly FTS)		
	archive	100 Terabyte		

Switching Modes

- controlled by TTL hardware signals

Beam	Wobbler	Frequency	Total Power
chopper wheel	2ndary	for heterodyne	

Observing Modes

- antenna movements

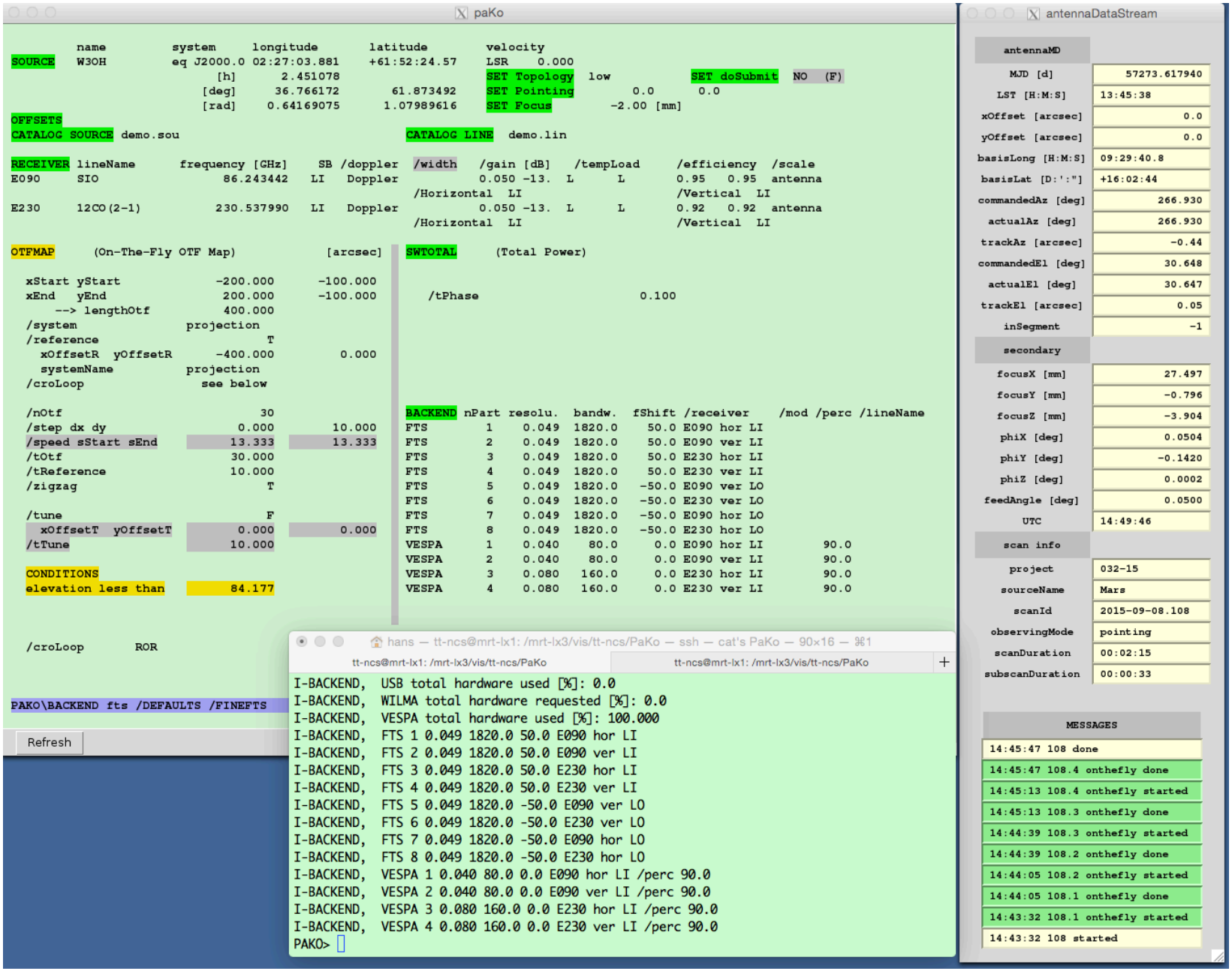
Calibrate	Pointing	Focus	Tip
for heterodyne	cross scans		

Track	OnOff	OTF map	Lissajous OTF
1 antenna position	2 positions	many positions	curves / for NIKA

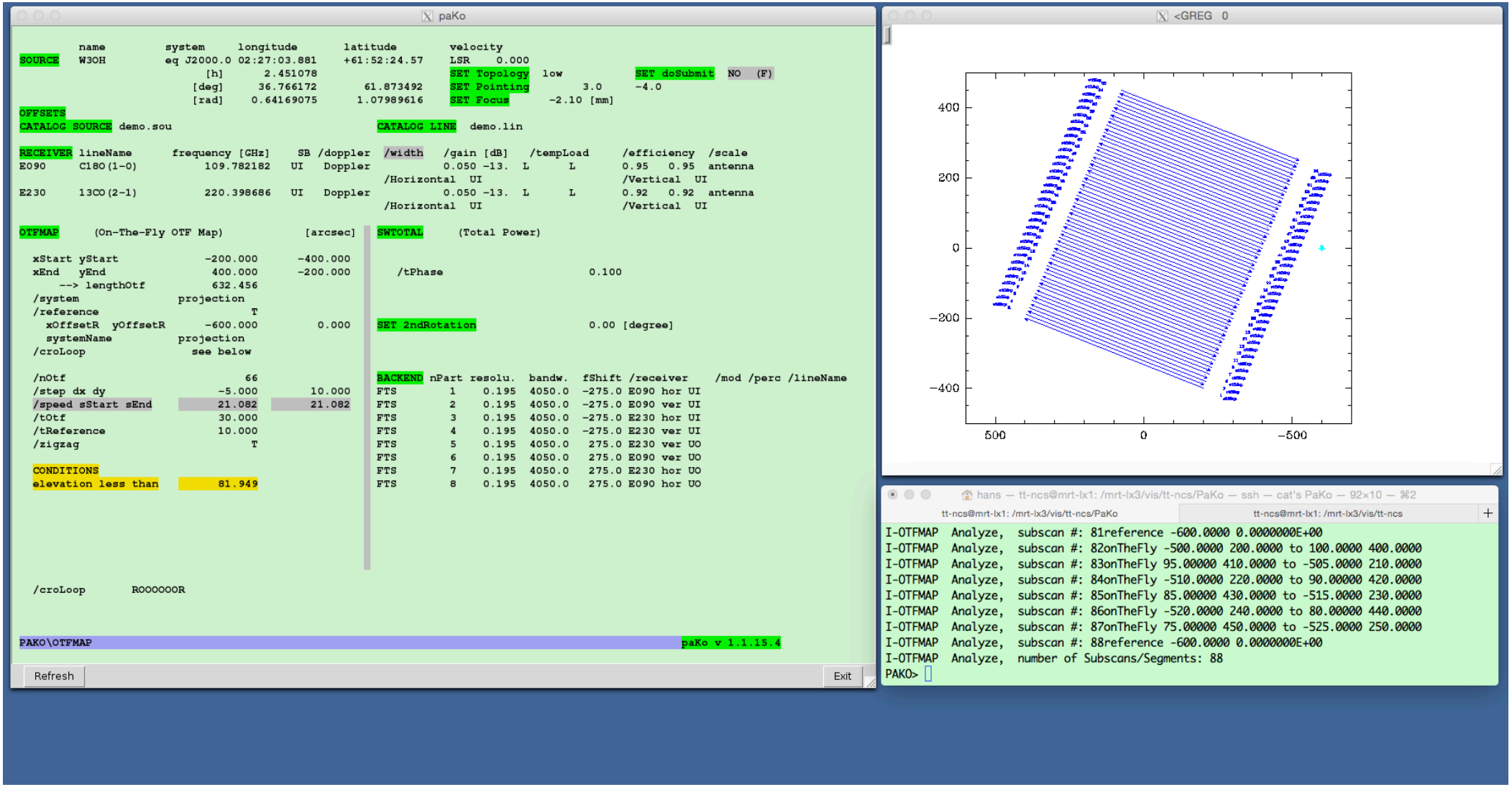
VLBI

DIY → flexible subscan sequences

- any Switching Mode can be combined with any Observing Mode
  not all combinations are useful/used yet


paKo
name system longitude latitude velocity
SOURCE W3OH eq J2000.0 02:27:03.881 +61:52:24.57 LSR 0.000
[h] 2.451078 SET Topology low SET doSubmit NO (F)
[deg] 36.766172 61.873492 SET Pointing 0.0 0.0
[rad] 0.64169075 1.07989616 SET Focus -2.00 [mm]
OFFSETS
CATALOG SOURCE demo.sou
CATALOG LINE demo.lin
RECEIVER lineName frequency [GHz] SB /doppler /width /gain [dB] /tempLoad /efficiency /scale
E090 SIO 86.243442 LI Doppler 0.050 -13. L L 0.95 0.95 antenna
/Horizontal LI /Vertical LI
E230 12CO(2-1) 230.537990 LI Doppler 0.050 -13. L L 0.92 0.92 antenna
/Horizontal LI /Vertical LI
OTFMAP (On-The-Fly OTF Map) [arcsec]
xStart yStart -200.000 -100.000
xEnd yEnd 200.000 -100.000
--> lengthOtf 400.000
/system projection
/reference T
xOffsetR yOffsetR -400.000 0.000
systemName projection
/croLoop see below
/nOtf 30
/step dx dy 0.000 10.000
/speed sStart sEnd 13.333 13.333
/tOtf 30.000
/tReference 10.000
/zigzag T
/tune F
xOffsetT yOffsetT 0.000 0.000
/tTune 10.000
CONDITIONS
elevation less than 84.177
/croLoop ROR
PAKO\BACKEND fts /DEFAULTS /FINEFTS
Refresh
SWTOTAL (Total Power)
/tPhase 0.100
BACKEND nPart resolu. bandw. fShift /receiver /mod /perc /lineName
FTS 1 0.049 1820.0 50.0 E090 hor LI
FTS 2 0.049 1820.0 50.0 E090 ver LI
FTS 3 0.049 1820.0 50.0 E230 hor LI
FTS 4 0.049 1820.0 50.0 E230 ver LI
FTS 5 0.049 1820.0 -50.0 E090 ver LO
FTS 6 0.049 1820.0 -50.0 E230 ver LO
FTS 7 0.049 1820.0 -50.0 E090 hor LO
FTS 8 0.049 1820.0 -50.0 E230 hor LO
VESPA 1 0.040 80.0 0.0 E090 hor LI 90.0
VESPA 2 0.040 80.0 0.0 E090 ver LI 90.0
VESPA 3 0.080 160.0 0.0 E230 hor LI 90.0
VESPA 4 0.080 160.0 0.0 E230 ver LI 90.0
hans — tt-ncs@mrt-lx1: /mrt-lx3/vis/tt-ncs/PaKo — ssh — cat's PaKo — 90×16 — ⌘1
tt-ncs@mrt-lx1: /mrt-lx3/vis/tt-ncs/PaKo
tt-ncs@mrt-lx1: /mrt-lx3/vis/tt-ncs/PaKo
I-BACKEND, USB total hardware used [%]: 0.0
I-BACKEND, WILMA total hardware requested [%]: 0.0
I-BACKEND, VESPA total hardware used [%]: 100.000
I-BACKEND, FTS 1 0.049 1820.0 50.0 E090 hor LI
I-BACKEND, FTS 2 0.049 1820.0 50.0 E090 ver LI
I-BACKEND, FTS 3 0.049 1820.0 50.0 E230 hor LI
I-BACKEND, FTS 4 0.049 1820.0 50.0 E230 ver LI
I-BACKEND, FTS 5 0.049 1820.0 -50.0 E090 ver LO
I-BACKEND, FTS 6 0.049 1820.0 -50.0 E230 ver LO
I-BACKEND, FTS 7 0.049 1820.0 -50.0 E090 hor LO
I-BACKEND, FTS 8 0.049 1820.0 -50.0 E230 hor LO
I-BACKEND, VESPA 1 0.040 80.0 0.0 E090 hor LI /perc 90.0
I-BACKEND, VESPA 2 0.040 80.0 0.0 E090 ver LI /perc 90.0
I-BACKEND, VESPA 3 0.080 160.0 0.0 E230 hor LI /perc 90.0
I-BACKEND, VESPA 4 0.080 160.0 0.0 E230 ver LI /perc 90.0
PAKO>
antennaDataStream
antennaMD
MJD [d] 57273.617940
LST [H:M:S] 13:45:38
xOffset [arcsec] 0.0
yOffset [arcsec] 0.0
basisLong [H:M:S] 09:29:40.8
basisLat [D:':"] +16:02:44
commandedAz [deg] 266.930
actualAz [deg] 266.930
trackAz [arcsec] -0.44
commandedEl [deg] 30.648
actualEl [deg] 30.647
trackEl [arcsec] 0.05
inSegment -1
secondary
focusX [mm] 27.497
focusY [mm] -0.796
focusZ [mm] -3.904
phiX [deg] 0.0504
phiY [deg] -0.1420
phiZ [deg] 0.0002
feedAngle [deg] 0.0500
UTC 14:49:46
scan info
project 032-15
sourceName Mars
scanId 2015-09-08.108
observingMode pointing
scanDuration 00:02:15
subscanDuration 00:00:33
MESSAGES
14:45:47 108 done
14:45:47 108.4 onthefly done
14:45:13 108.4 onthefly started
14:45:13 108.3 onthefly done
14:44:39 108.3 onthefly started
14:44:39 108.2 onthefly done
14:44:05 108.2 onthefly started
14:44:05 108.1 onthefly done
14:43:32 108.1 onthefly started
14:43:32 108 started

pako screen



pako screen 2

Observing Modes • Operation Modes

traditional – observing astronomer at PV

remote observer

VLBI

observing pools

monitoring of source fluxes, polarization etc.

[service observing]

Note: there is always a telescope operator on site
usually also a staff astronomer on duty (AOD) and a cook

Observing Pools

flexibility in particular to respond to weather conditions

~ dozen projects

typically a few weeks

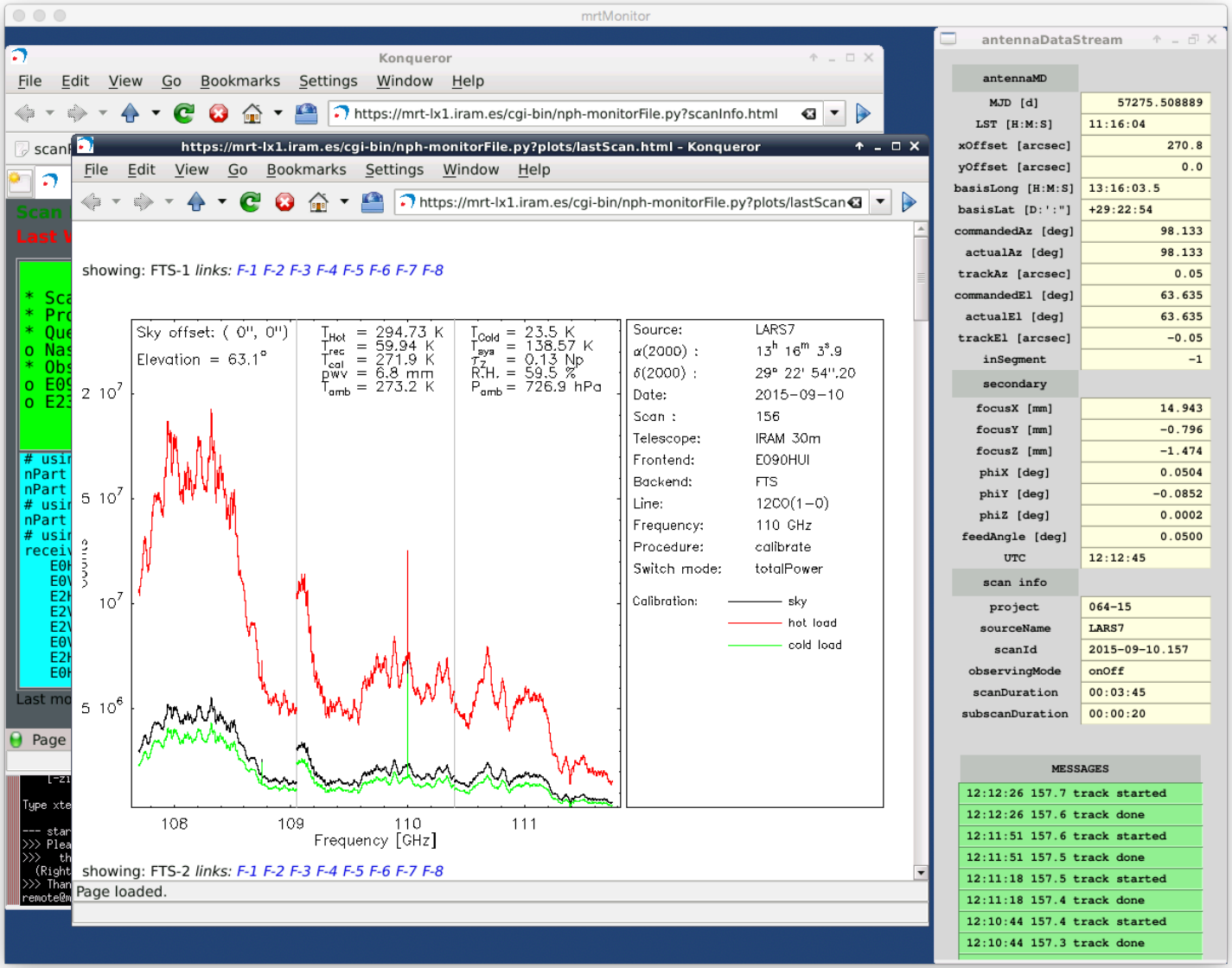
restricted to standard observations

separate execution queues according to (weather) requirements

observations done by some astronomers from the projects + AOD + pool managers

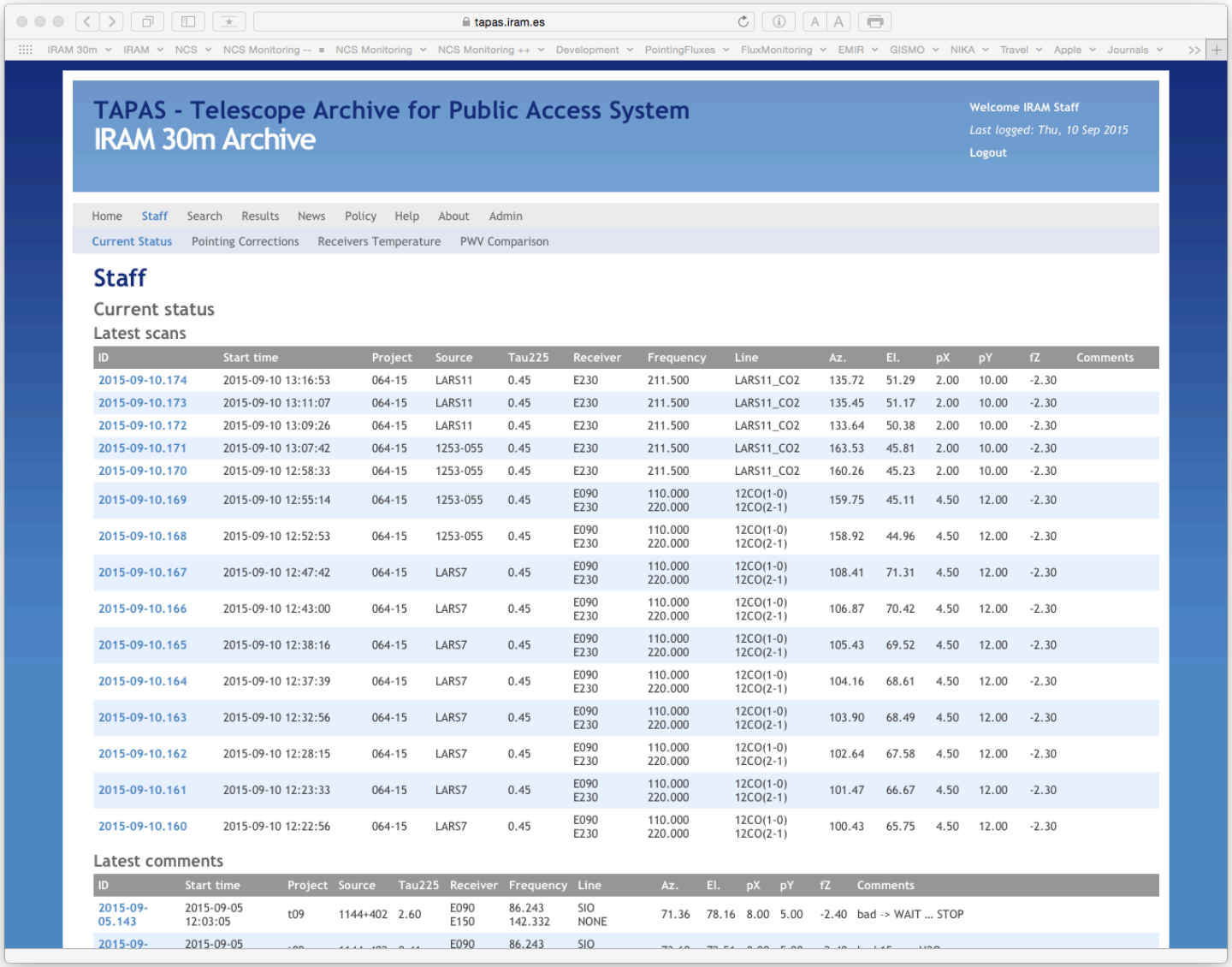
→ generally better chance to complete projects than in fixed scheduling

Monitoring



VNC www monitoring – auto updating or static antenna Data Stream Viewer

Tapas

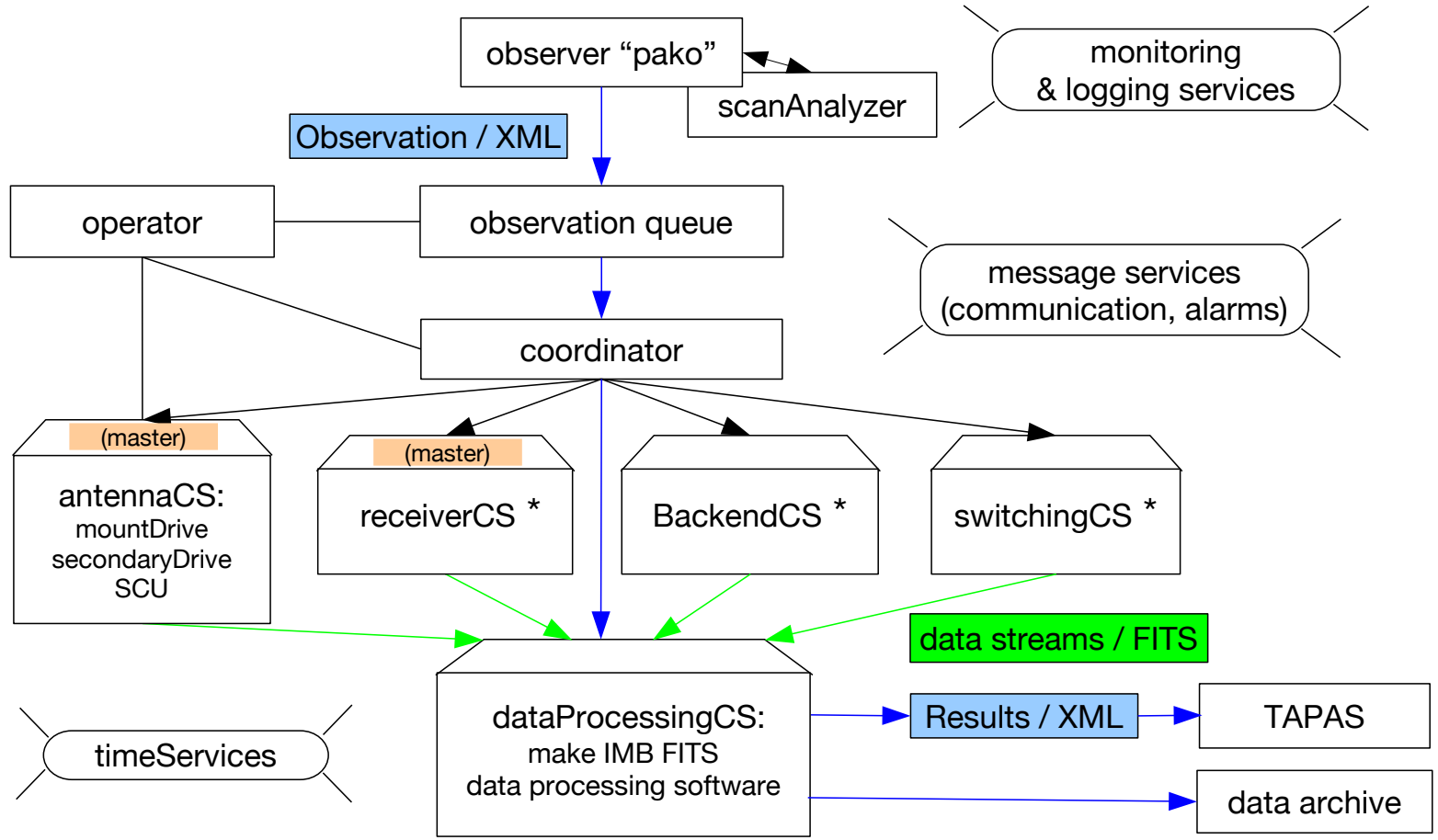


ID	Start time	Project	Source	Tau225	Receiver	Frequency	Line	Az.	El.	pX	pY	fZ	Comments
2015-09-10.174	2015-09-10 13:16:53	064-15	LARS11	0.45	E230	211.500	LARS11_CO2	135.72	51.29	2.00	10.00	-2.30	
2015-09-10.173	2015-09-10 13:11:07	064-15	LARS11	0.45	E230	211.500	LARS11_CO2	135.45	51.17	2.00	10.00	-2.30	
2015-09-10.172	2015-09-10 13:09:26	064-15	LARS11	0.45	E230	211.500	LARS11_CO2	133.64	50.38	2.00	10.00	-2.30	
2015-09-10.171	2015-09-10 13:07:42	064-15	1253-055	0.45	E230	211.500	LARS11_CO2	163.53	45.81	2.00	10.00	-2.30	
2015-09-10.170	2015-09-10 12:58:33	064-15	1253-055	0.45	E230	211.500	LARS11_CO2	160.26	45.23	2.00	10.00	-2.30	
2015-09-10.169	2015-09-10 12:55:14	064-15	1253-055	0.45	E090 E230	110.000 220.000	12CO(1-0) 12CO(2-1)	159.75	45.11	4.50	12.00	-2.30	
2015-09-10.168	2015-09-10 12:52:53	064-15	1253-055	0.45	E090 E230	110.000 220.000	12CO(1-0) 12CO(2-1)	158.92	44.96	4.50	12.00	-2.30	
2015-09-10.167	2015-09-10 12:47:42	064-15	LARS7	0.45	E090 E230	110.000 220.000	12CO(1-0) 12CO(2-1)	108.41	71.31	4.50	12.00	-2.30	
2015-09-10.166	2015-09-10 12:43:00	064-15	LARS7	0.45	E090 E230	110.000 220.000	12CO(1-0) 12CO(2-1)	106.87	70.42	4.50	12.00	-2.30	
2015-09-10.165	2015-09-10 12:38:16	064-15	LARS7	0.45	E090 E230	110.000 220.000	12CO(1-0) 12CO(2-1)	105.43	69.52	4.50	12.00	-2.30	
2015-09-10.164	2015-09-10 12:37:39	064-15	LARS7	0.45	E090 E230	110.000 220.000	12CO(1-0) 12CO(2-1)	104.16	68.61	4.50	12.00	-2.30	
2015-09-10.163	2015-09-10 12:32:56	064-15	LARS7	0.45	E090 E230	110.000 220.000	12CO(1-0) 12CO(2-1)	103.90	68.49	4.50	12.00	-2.30	
2015-09-10.162	2015-09-10 12:28:15	064-15	LARS7	0.45	E090 E230	110.000 220.000	12CO(1-0) 12CO(2-1)	102.64	67.58	4.50	12.00	-2.30	
2015-09-10.161	2015-09-10 12:23:33	064-15	LARS7	0.45	E090 E230	110.000 220.000	12CO(1-0) 12CO(2-1)	101.47	66.67	4.50	12.00	-2.30	
2015-09-10.160	2015-09-10 12:22:56	064-15	LARS7	0.45	E090 E230	110.000 220.000	12CO(1-0) 12CO(2-1)	100.43	65.75	4.50	12.00	-2.30	

ID	Start time	Project	Source	Tau225	Receiver	Frequency	Line	Az.	El.	pX	pY	fZ	Comments
2015-09-05.143	2015-09-05 12:03:05	t09	1144+402	2.60	E090 E150	86.243 142.332	SIO NONE	71.36	78.16	8.00	5.00	-2.40	bad -> WAIT ... STOP
2015-09-	2015-09-05				E090	86.243	SIO						

Log • Record • Supervise

NCS 30m • Top Level Overview of System Architecture



Notes: only *some major* connections are indicated by lines.
Arrows show information flow from observer's commands to data.
Revision 2015-09-10, 1.2, HU

Hardware

General Use Computers • Servers • Supermicro • AMD / Intel • Linux/Debian

- mrt-lx1 (observe)
  - observation specification • device coordination • high level control
  - monitoring • remote observing support
- mrt-lx3 (vis)
  - data calibration and display
- mrt-lx2 (astro)
  - project archive • offline data analysis

Local Device Control • Motorola • Intel • Linux

antenna	local control with VME based processors and interfaces
backends	diskless processors for VESPA, WILMA • backend access via VME
	FTS • backend access via device LAN
receivers	
EMIR	VME processors • device access via CAN bus
HERA	VME processor with IRAM-built VME boards
others devices	controlled via VME interfaces, ethernet

Walter Brunswig https://mrt-lx1.iram.es/mainWiki/NcsArchitecture#Control_Hardware

Software Concepts and Communication

observation specification in XML	← created by paKo
devices deliver data streams →	time-tagged data • FITS
backend and other data are merged →	IMB FITS
data calibration software (IRAM)	MIRA and MRT Cal
support of other data calibration and processing, e.g., for bolometers	IMB FITS
coordinator and device control	
NCS Messages	message exchange tool Elvin
software servers based on	SOAP and RPC Python and C

XML	description of observations • logs • results → TAPAS
FITS	data streams and merged data
NCS messages	synchronization • coordination • monitoring • logs • alarms
UDP	data
Linux	NFS

Walter Brunswig https://mrt-lx1.iram.es/mainWiki/NcsArchitecture#Software_Concepts

Software Tools and Data Formats

SIC	Gildas command language
XML	in particular VOTable
FITS	
Python	
mySQL / Django	TAPAS
FORTRAN 90/95	
C	
Linux	
VNC	monitoring • remote observations
VPN	monitoring • remote observations