ALMA – The first year of observations

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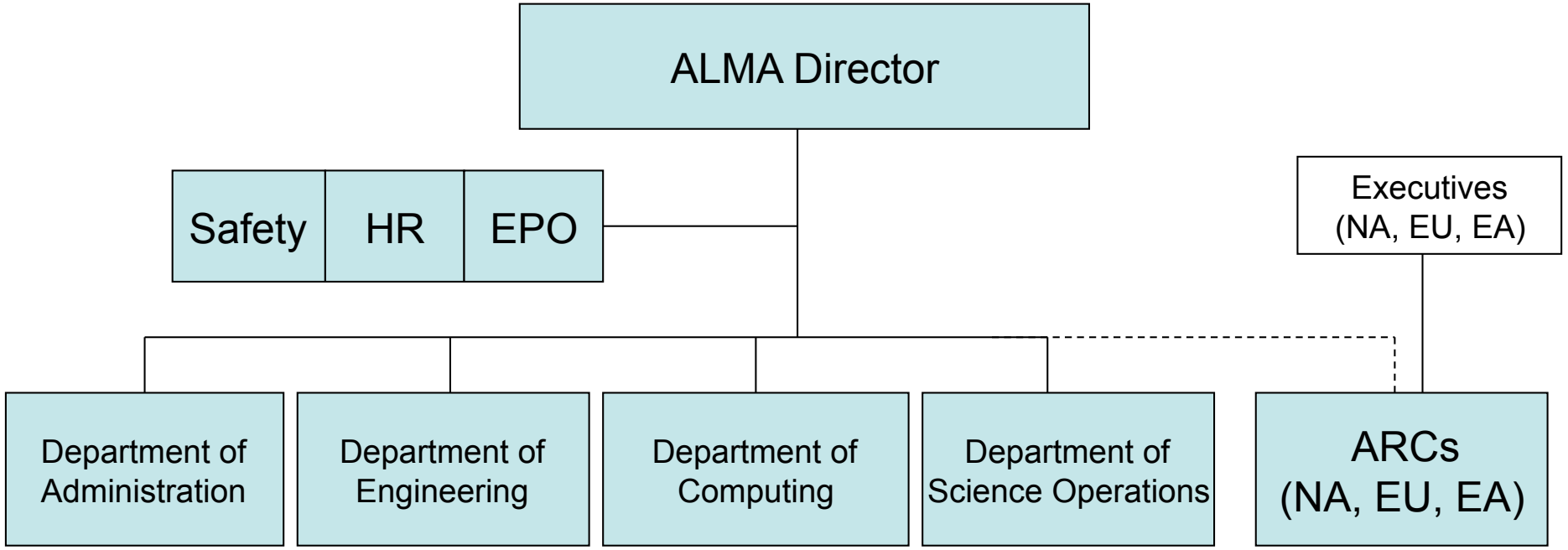
Talk Overview

- Short description of JAO and related governing bodies, and setting the stage for Cycle 0
- Cycle 0 Proposals
- Observations in Cycle 0
- Selected science results

- I am here to listen and learn and listen to how we can improve and to see how ALMA data is presented

The Joint ALMA Observatory (JAO)

- ALMA is operated by the JAO.
- The ALMA Regional Centers (ARCs) form an integral part of JAO operations.



High-level concepts for Science Operations in Cycle 0

- Observations will be done in service observing mode with flexible scheduling.
- Observations 18h/day in 7d period alternated by maintenance (6h) and commissioning (7n) periods.
- All observations are executed in the form of scheduling blocks (SBs), each of which contains all information necessary to schedule and execute the observations.
- All science and calibration raw data are captured and archived
- The default output to the astronomer are reliable data sets, calibrated according to the calibration plan.
- The Joint ALMA Observatory (JAO) is responsible for the data product quality.

Cycle 0 Capabilities

Configurations

band	Frequency[GHz]	Resolution [arcsec]	Max. scale [arcsec]
Compact			
3	100	5.3	21
6	230	2.3	9
7	345	1.55	6
9	675	0.80	3
Extended			
3	100	1.56	10.5
6	230	0.68	4.5
7	345	0.45	3
9	675	0.23	1.5

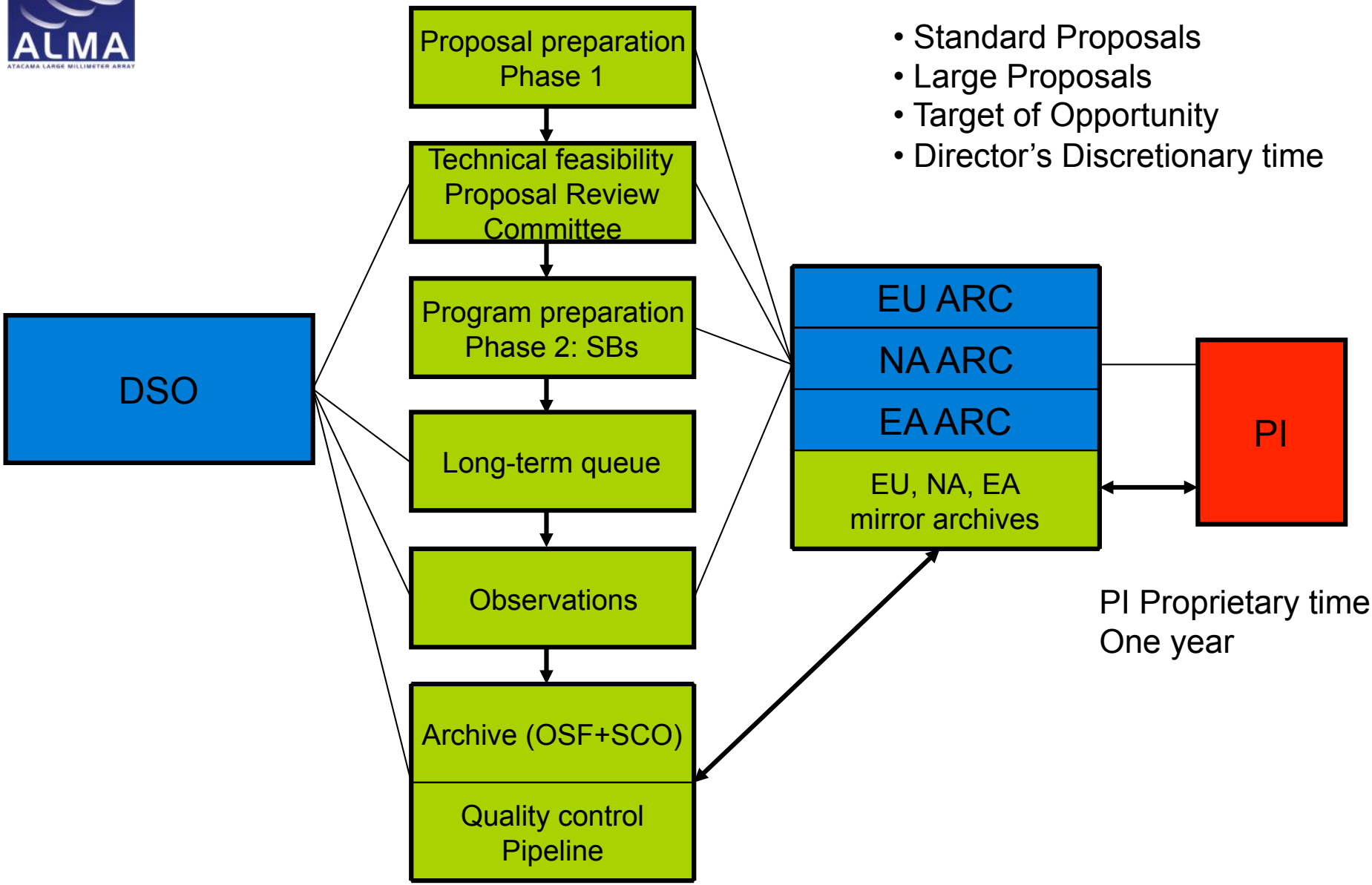
Receiver characteristics

band	Type	Frequency range[GHz]	T_{rx}[K]
3	2SB	84-116	40
6	2SB	211-275	40
7	2SB	275-373	75
9	DSB	602-720	120

Correlator settings

Bandwidth [MHz]	Channel Spacing [MHz]	No. of Channels	Mode
2000	15.6	128	TDM
58.6	0.0153	3840	FDM
117	0.0305	3840	FDM
234	0.061	3840	FDM
469	0.122	3840	FDM
938	0.244	3840	FDM
1875	0.488	3840	FDM

Program flow



Proposals

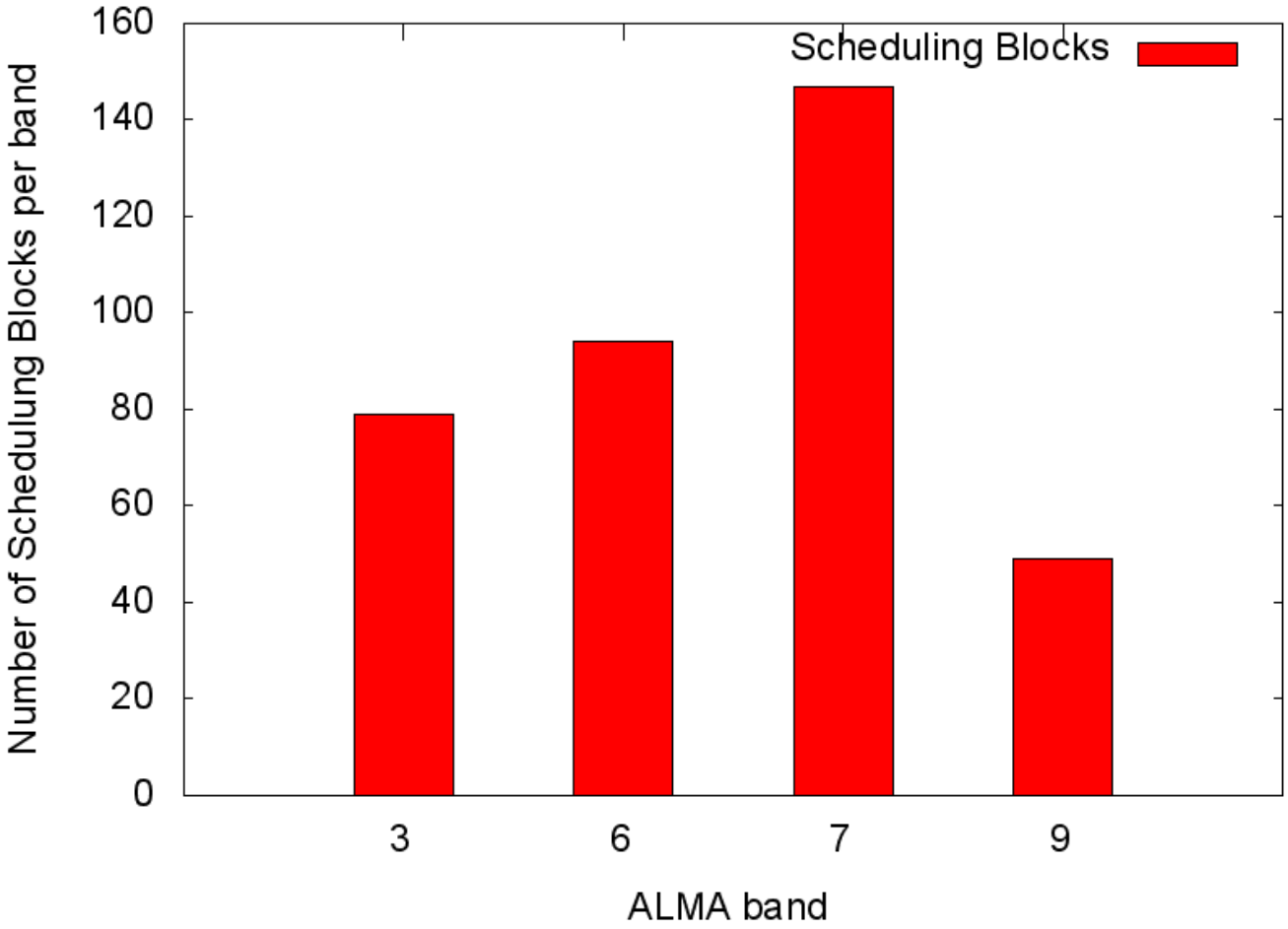
A call for proposals for ALMA Early Science Cycle 0 was published on March 30, 2011, with a submission deadline of June 30. The astronomical community responded enthusiastically: 919 unique proposals were received. Their distribution across the four ALMA science categories was as follows:

- Cosmology and the high redshift universe: 20%
- Galaxies and galactic nuclei: 27%
- ISM, star formation/protoplanetary disks and their astrochemistry, exoplanets: 40%
- Stellar evolution, the Sun and the solar system: 13%

Maria Diaz Trigo will give more details on the proposal review process

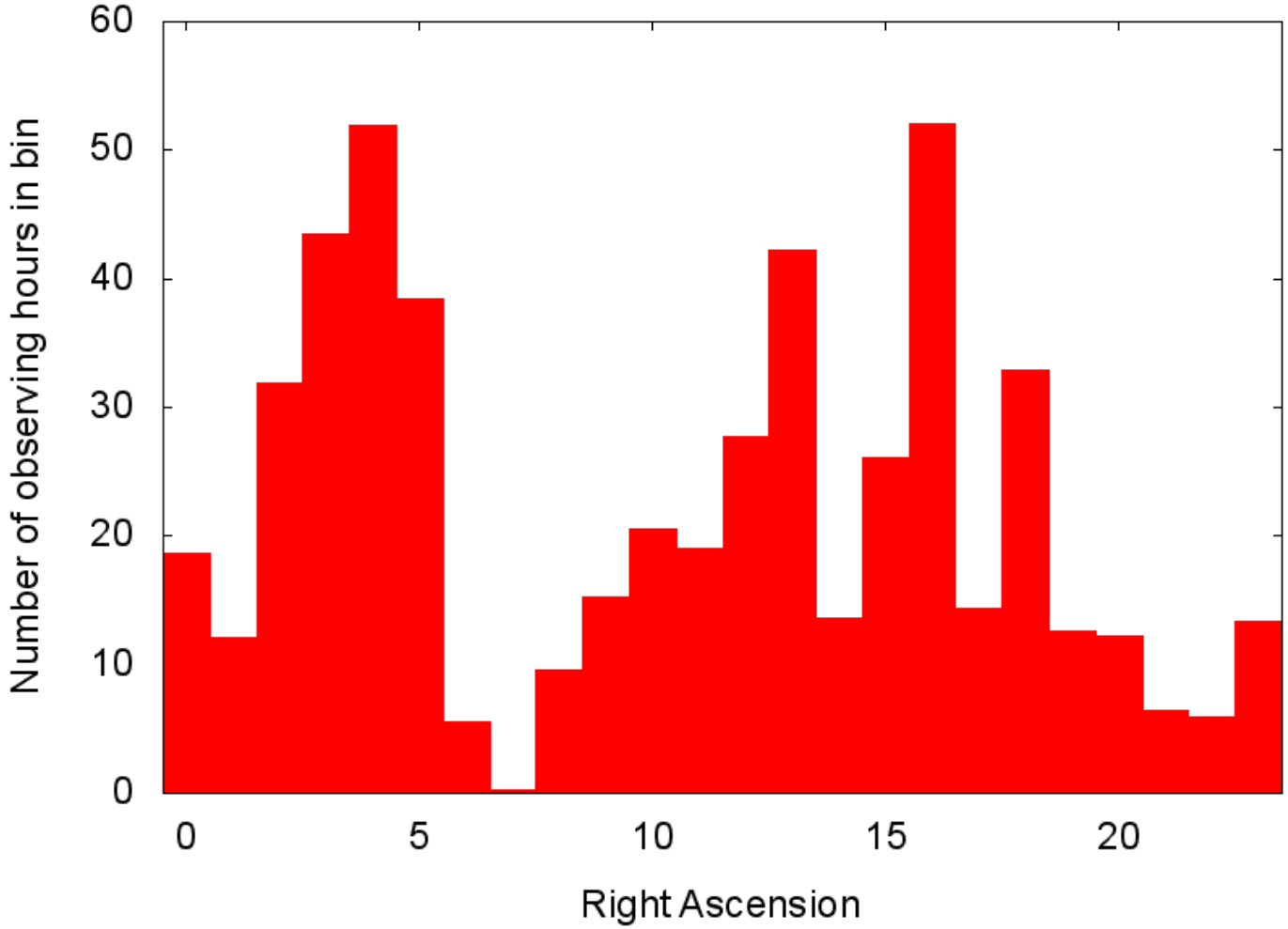
Ultimately, 112 proposals were identified as having the highest priority for completion, and a further 52 as filler projects.

Proposals



The number of SBs in the top 112 accepted proposals as function of ALMA band.

Proposals



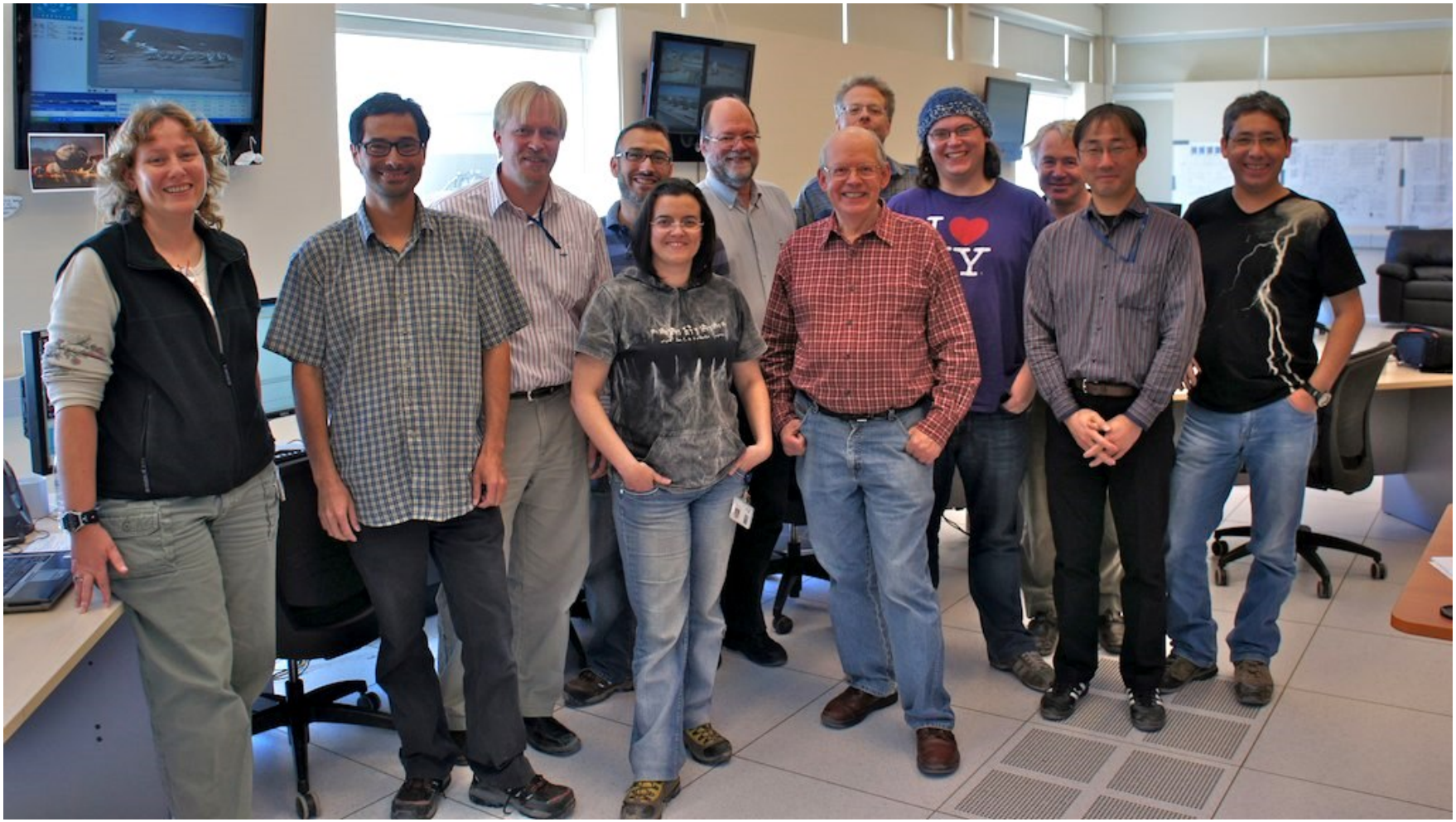
Total estimated requested observing time as function of Right Ascension.

Phase 2

- For the proposals that was accepted: On to phase 2.
- Two things happen in parallel:
  - The project will be assigned to a Contact Scientist and a Phase 2 Generator. This will be covered by Suzanna Randalls talk later.
  - The aot files are downloaded by the DSO lead in order to make observing plans and look on observational pressure.

Cycle 0 – the first observation

September 30th, 2011

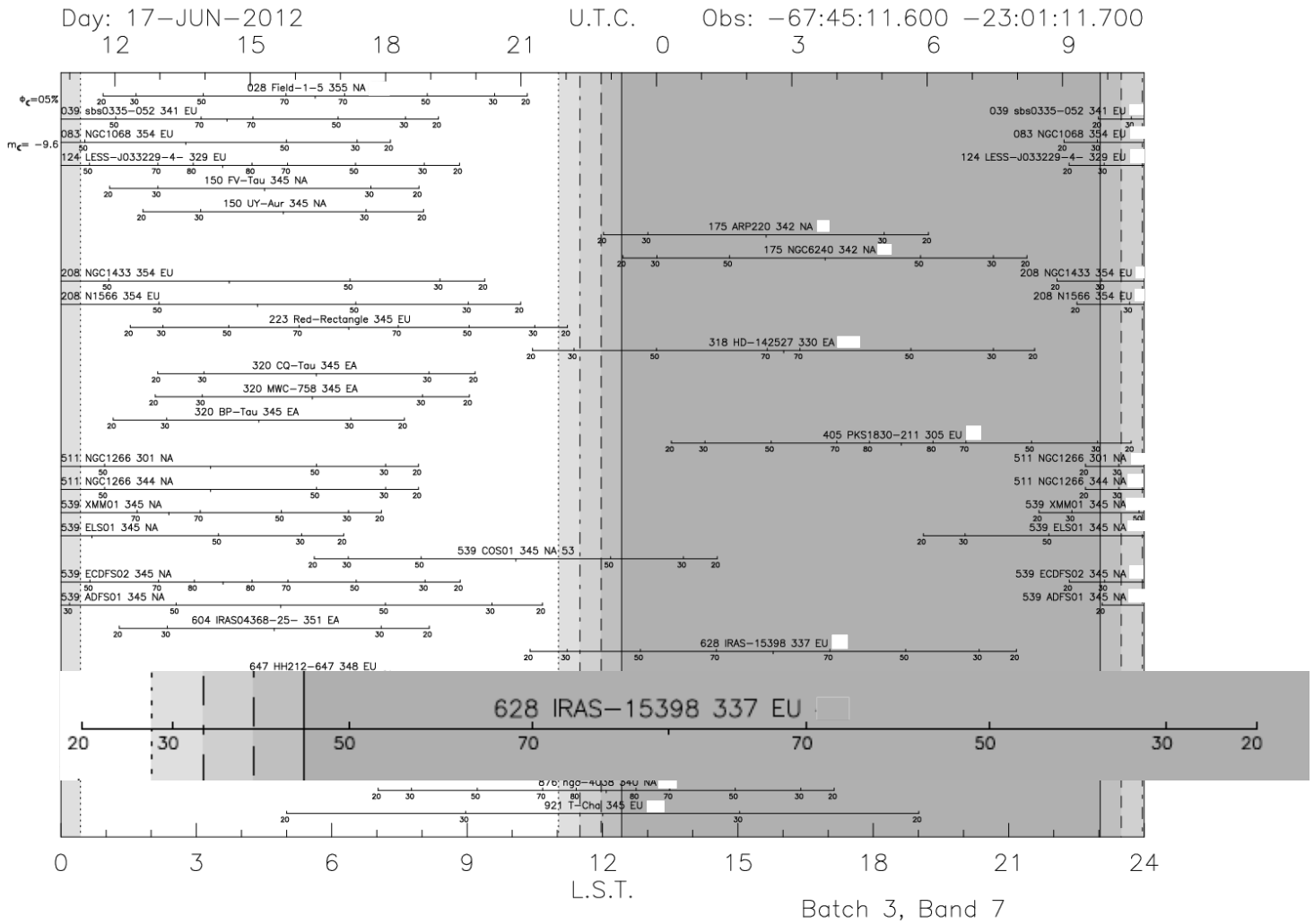


Cycle 0 – how it looks now

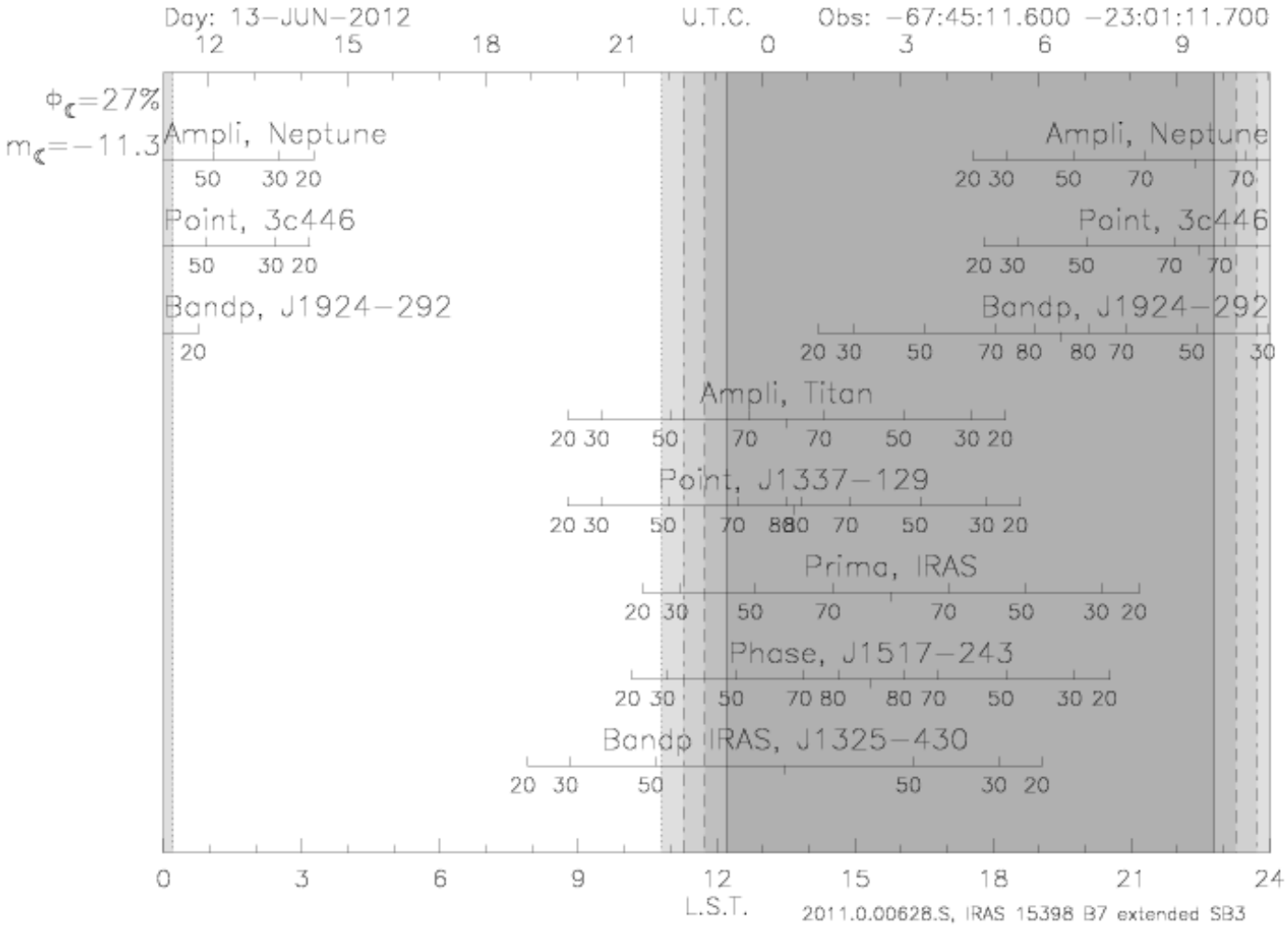
Observations

- Observing blocks of 7 nights
  - Wednesdays regression (computer and antenna), calibration observations (amplitude grid monitoring, and calibration source flux checks)
  - Thursday-Tuesday: Regular observations
- 6 astronomers at the OSF
  - 3 astronomers on duty, 3 support astronomers
    - AoD: Observations and what to do next (Present and future)
    - Support: Quality checks and logs (Past)
  - Morning, Day, Night shift
    - Morning: Wrap up the shift, plan the next
    - Day: Continue planning, start observations
    - Night: Observations

Cycle 0 – Coarse night planning



Cycle 0 - detailed night planning



Cycle 0 - backup plans …

Band 3

- 2100-0300 099 EA) "Group 4-B3-EXTENDED" JIRA:SCOPS-20 One Execution Needed
- 2100-0300 099 EA) "Group 5-B3-EXTENDED" JIRA:SCOPS-20 One Execution Needed
- 0000-0400 476 CH ') "G15.v2.19_109_GHz_Extended" JIRA:SCOPS-72 Two Executions Needed
- 0730-1200 172 NA "NGC253 B3 Extended v1" JIRA:SCOPS-80 One Execution Needed
- 0100-0830 017 EU Any Four SBs. JIRA:SCOPS-122 6 Executions needed in total. SgrB2? ? _T3_B3_extended Done
- 0900-1400 467 EA "SB4-B3-ext" JIRA:SCOPS-61 One Execution Needed
- 0900-1400 099 EA) "Group 1-B3-EXTENDED" JIRA:SCOPS-20 One Execution Needed

Filler Band 3

- 2000-0100 348 NA) "HE2-10" JIRA:SCOPS-238 - *x3* (Ampl. calibrator rises after UT 23:30) **Filler**
- 2100-0200 218 EA) band-3a-ext JIRA:SCOPS-234 One Execution Needed **Filler**
- 2100-0200 218 EA) band-3b-ext JIRA:SCOPS-234 One Execution Needed **Filler**
- 2100-0300 158 NA :) Proj158-Sb1Ext-partial-May2 One Execution Needed JIRA:SCOPS-241 **Filler**
- 2100-0300 158 NA :) Proj158-Sb2faintExt-partial-May4 One Execution Needed JIRA:SCOPS-241 **Filler**
- 2100-0500 035 EU cenA_b3_extended_run_x5 JIRA: SCOPS-195 **Filler**

Band 6

- 2030-0400: 319 EU) "a1689-lotuning " JIRA:SCOPS-40 - Five Executions needed
- 2030-0400: 319 EU) "a1689-hituning " JIRA:SCOPS-40 - Two Executions needed
- 2230-0700: 733 CH) "CO-X-X-Lup-4/3" JIRA:SCOPS-35 - Three different SBs, Each SB needs one execution (CO 2-1 finished, CO 1-1 done once)
- 0000-0300: 767 EA) "IOK-1" JIRA:SCOPS-151 Two Executions Needed
- 2200-0400: 307 EU) "SMM14011 CO8-7 (B6)" JIRA:SCOPS-59 One Execution Needed
- 1200-2000: 273 NA "SN1987A-Band 6" JIRA:SCOPS-50 One Execution Needed *Can not be executed, archive issues:* JIRA:COMP-7513

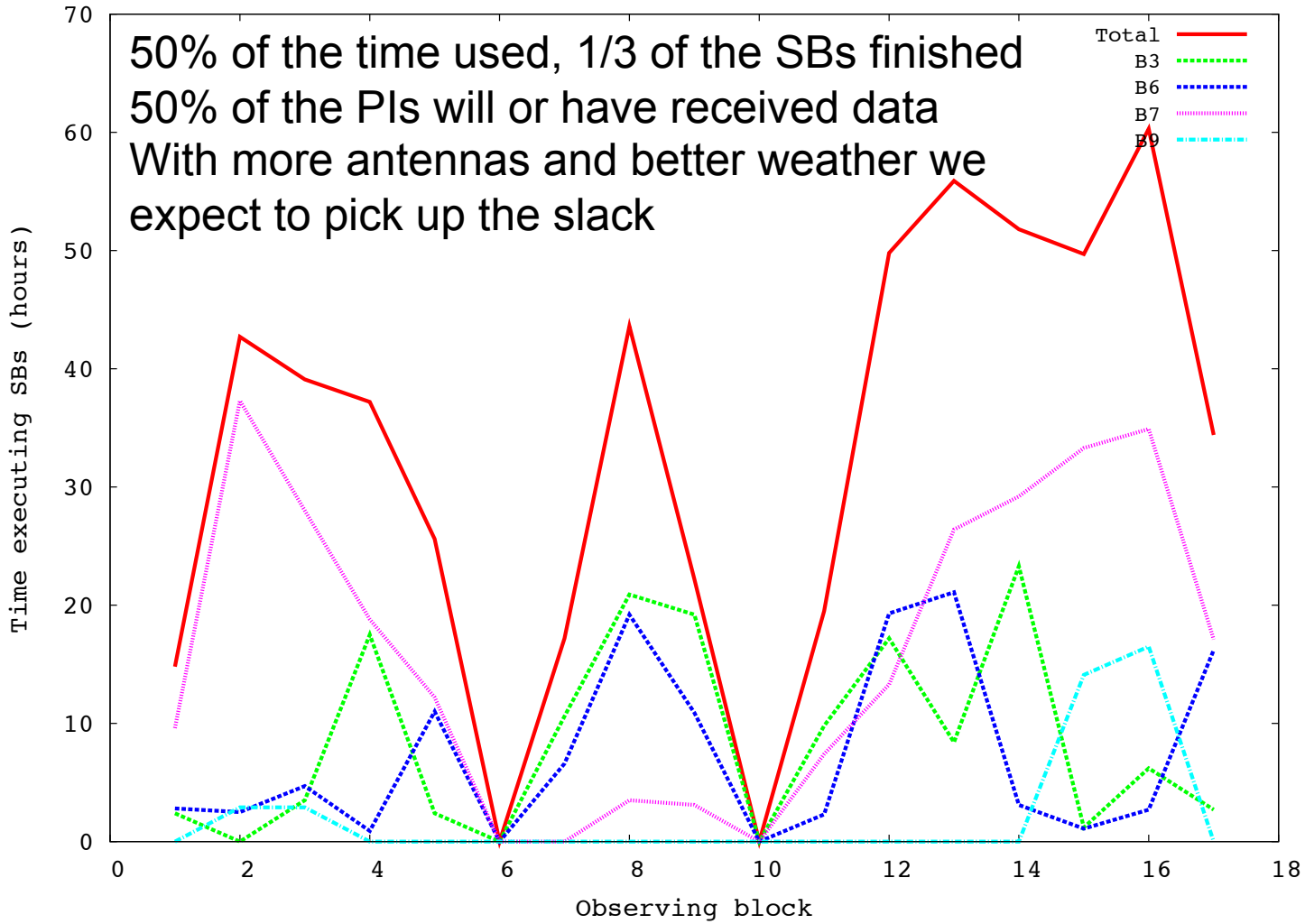
Filler Band 6

- 2100-0000: 005 NA "Chall Band 6 13CO" JIRA:SCOPS-233. Three Executions Needed **Filler**
- 2100-0200: 218 EA band-6a-ext JIRA:SCOPS-234 One Execution Needed **Filler**
- 2100-0200: 218 EA band-6b-ext JIRA:SCOPS-234 One Execution Needed **Filler**
- 0730-1500: 243 NA) "CFHQSJ2329-0301 Band 6" JIRA:SCOPS-243 Two Executions Needed **Filler**
- 0900-1630: 243 NA) "CFHQSJ0210-0456 Band 6" JIRA:SCOPS-243 Three Executions Needed **Filler**

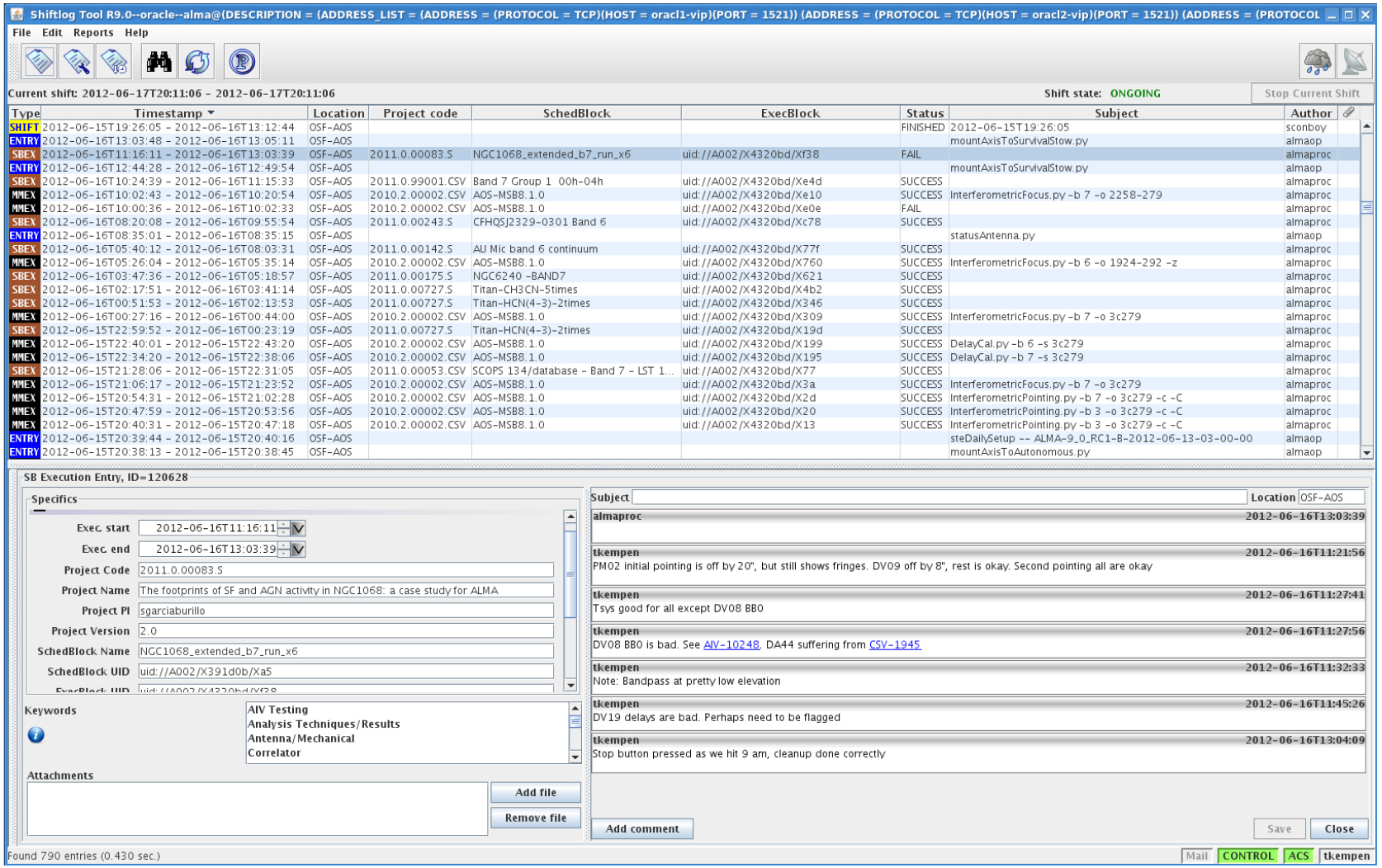
Cycle 0 - Submitting the SB (So, you think you are ready?)

- Is the bandpass calibrator is above 20^{o}?
- Is the amplitude calibrator is above 20^{o}, and not too close to the parent body?
- Is the phase calibrator is above 20^{o}, and within 10^{o} from the science source?
- Is uv-coverage necessary for the science goal? Has the science source been observed before? At what LST?
- Is the atmosphere transparent enough?
- Is the phase stability good enough?
- Are there more than 16 antennas that can lock - at both the pointing and science bands?
- Can the scheduler read the SB?
- And yes, there is more

Improvements in efficiency



Information logging



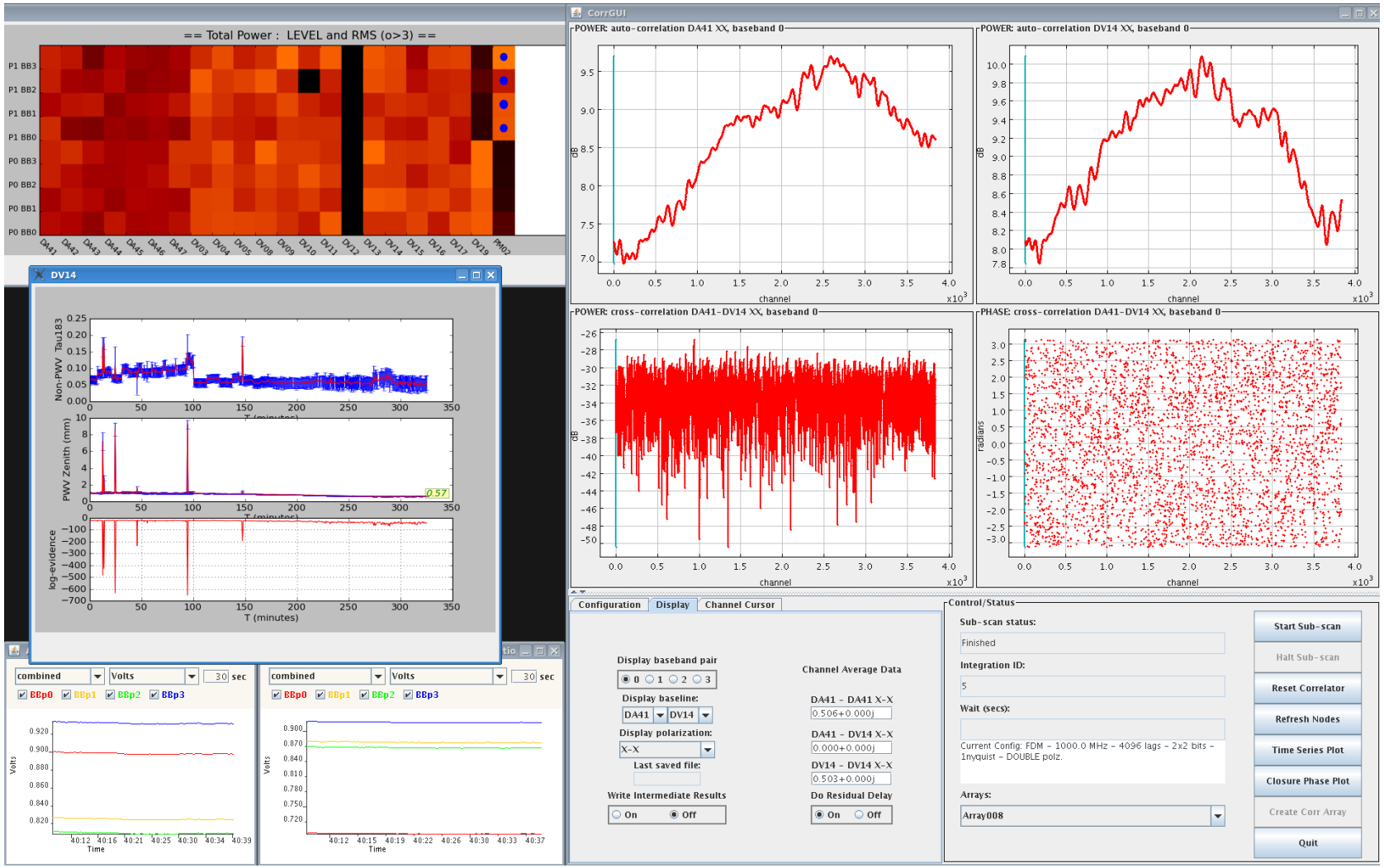
Quality assurance

The goal of ALMA Quality Assurance (QA) is to deliver to the PIs a reliable final data product that has reached the desired control parameters outlined in the science goals, that is calibrated to the desired accuracy and free of calibration or imaging artifacts. The broad classification of this multi-layered QA approach is:

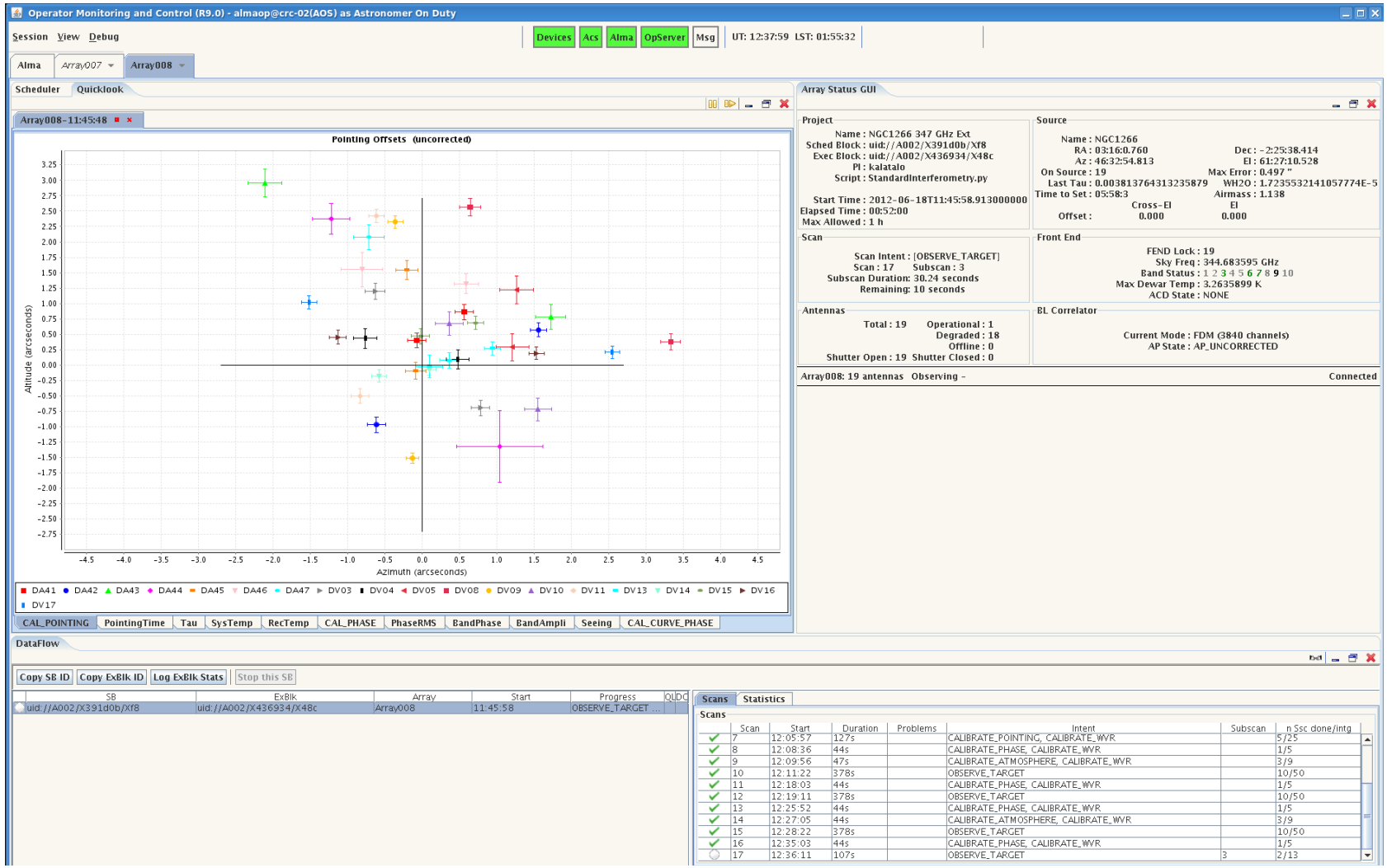
- QA0: is a near-real-time verification of data quality. It deals with rapidly-varying performance parameters (at scales of a scheduling block, or SB, execution length or shorter, such as e.g. phase fluctuations, antenna gain, offset pointing, and focus.) and thus it has to be performed at the time of the observations. Assessment is performed by AoDs (Astronomers on Duty).
- QA1: includes slowly varying (timescales longer than a week, such as e.g.\ baseline measurements, delays, all-sky pointing, and focus curves) array performance parameters. They will all be measured by AoDs executing standard calibration SBs created as specified by the Calibration Plan.
- QA2: Data Reduction. Comparison of data quality to science goals.
- QA3: Post-reduction evaluation of the data products delivered to the PIs, triggered by PIs (or ARC staff)

Liz Humphreys talk will give us more details

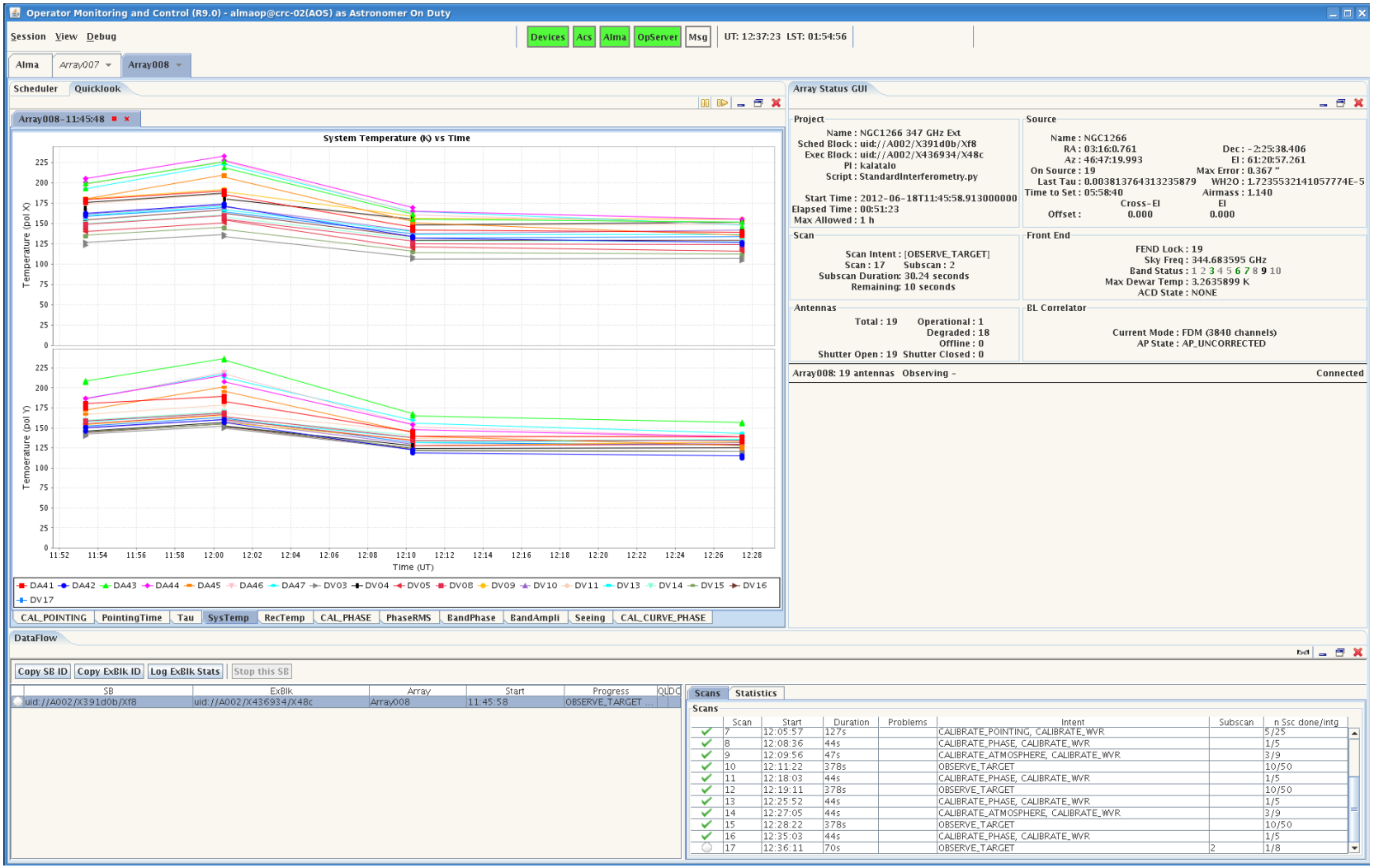
Online QA0


== Total Power : LEVEL and RMS (o>3) ==
DV14
Non-PWV Tau183
PWV Zenith (mm)
log-evidence
T (minutes)
CorrGUI
POWER: auto-correlation DA41 XX, baseband 0
POWER: auto-correlation DV14 XX, baseband 0
POWER: cross-correlation DA41-DV14 XX, baseband 0
PHASE: cross-correlation DA41-DV14 XX, baseband 0
channel
Configuration
Display
Channel Cursor
Display baseband pair
Display baseline:
Display polarization:
Last saved file:
Write Intermediate Results
Channel Average Data
DA41 - DA41 X-X
DA41 - DV14 X-X
DV14 - DV14 X-X
Do Residual Delay
Control/Status
Sub-scan status:
Finished
Integration ID:
Wait (secs):
Arrays:
Array008
Start Sub-scan
Halt Sub-scan
Reset Correlator
Refresh Nodes
Time Series Plot
Closure Phase Plot
Create Corr Array
Quit

Online QA0


Operator Monitoring and Control (R9.0) - almaop@crc-02(AOS) as Astronomer On Duty
Session View Debug
Devices Acs Alma OpServer Msg
UT: 12:37:59 LST: 01:55:32
Alma Array007 Array008
Scheduler Quicklook
Array008-11:45:48
Pointing Offsets (uncorrected)
Altitude (arcseconds)
Azimuth (arcseconds)
DA41 DA42 DA43 DA44 DA45 DA46 DA47 DV03 DV04 DV05 DV08 DV09 DV10 DV11 DV13 DV14 DV15 DV16 DV17
CAL_POINTING PointingTime Tau SysTemp RecTemp CAL_PHASE PhaseRMS BandPhase BandAmpli Seeing CAL_CURVE_PHASE
Array Status GUI
Project
Name : NGC1266 347 GHz Ext
Sched Block : uid://A002/X391d0b/Xf8
Exec Block : uid://A002/X436934/X48c
PI : kalatalo
Script : StandardInterferometry.py
Start Time : 2012-06-18T11:45:58.913000000
Elapsed Time : 00:52:00
Max Allowed : 1 h
Source
Name : NGC1266
RA : 03:16:0.760 Dec : -2:25:38.414
Az : 46:32:54.813 El : 61:27:10.528
On Source : 19 Max Error : 0.497 "
Last Tau : 0.0038137643132358 79 WH2O : 1.7235532141057774E-5
Time to Set : 05:58:3 Airmass : 1.138
Cross-El El
Offset : 0.000 0.000
Scan
Scan Intent : [OBSERVE_TARGET]
Scan : 17 Subscan : 3
Subscan Duration: 30.24 seconds
Remaining: 10 seconds
Front End
FEND Lock : 19
Sky Freq : 344.683595 GHz
Band Status : 1 2 3 4 5 6 7 8 9 10
Max Dewar Temp : 3.2635899 K
ACD State : NONE
Antennas
Total : 19 Operational : 1
Degraded : 18
Offline : 0
Shutter Open : 19 Shutter Closed : 0
BL Correlator
Current Mode : FDM (3840 channels)
AP State : AP_UNCORRECTED
Array008: 19 antennas Observing - Connected
DataFlow
Copy SB ID Copy ExBlk ID Log ExBlk Stats Stop this SB
SB ExBlk Array Start Progress QLDC
uid://A002/X391d0b/Xf8 uid://A002/X436934/X48c Array008 11:45:58 OBSERVE_TARGET ...
Scans Statistics
Scans
Scan Start Duration Problems Intent Subscan n Ssc done/intg
7 12:05:57 127s CALIBRATE_POINTING, CALIBRATE_WVR 5/25
8 12:08:36 44s CALIBRATE_PHASE, CALIBRATE_WVR 1/5
9 12:09:56 47s CALIBRATE_ATMOSPHERE, CALIBRATE_WVR 3/9
10 12:11:22 378s OBSERVE_TARGET 10/50
11 12:18:03 44s CALIBRATE_PHASE, CALIBRATE_WVR 1/5
12 12:19:11 378s OBSERVE_TARGET 10/50
13 12:25:52 44s CALIBRATE_PHASE, CALIBRATE_WVR 1/5
14 12:27:05 44s CALIBRATE_ATMOSPHERE, CALIBRATE_WVR 3/9
15 12:28:22 378s OBSERVE_TARGET 10/50
16 12:35:03 44s CALIBRATE_PHASE, CALIBRATE_WVR 1/5
17 12:36:11 107s OBSERVE_TARGET 3 2/13

Online QA0


Operator Monitoring and Control (R9.0) - almaop@crc-02(AOS) as Astronomer On Duty
Session View Debug
Devices Acs Alma OpServer Msg
UT: 12:37:23 LST: 01:54:56
Alma Array007 Array008
Scheduler Quicklook
Array008-11:45:48
System Temperature (K) vs Time
Temperature (pol X)
Temperature (pol Y)
Time (UT)
DA41 DA42 DA43 DA44 DA45 DA46 DA47 DV03 DV04 DV05 DV08 DV09 DV10 DV11 DV13 DV14 DV15 DV16 DV17
CAL_POINTING PointingTime Tau SysTemp RecTemp CAL_PHASE PhaseRMS BandPhase BandAmpli Seeing CAL_CURVE_PHASE
Array Status GUI
Project
Name : NGC1266 347 GHz Ext
Sched Block : uid://A002/X391d0b/Xf8
Exec Block : uid://A002/X436934/X48c
PI : kalatalo
Script : StandardInterferometry.py
Start Time : 2012-06-18T11:45:58.913000000
Elapsed Time : 00:51:23
Max Allowed : 1 h
Source
Name : NGC1266
RA : 03:16:0.761 Dec : -2:25:38.406
Az : 46:47:19.993 El : 61:20:57.261
On Source : 19 Max Error : 0.367 "
Last Tau : 0.0038137643132358 79 WH2O : 1.7235532141057774E-5
Time to Set : 05:58:40 Airmass : 1.140
Cross-El El
Offset : 0.000 0.000
Scan
Scan Intent : [OBSERVE_TARGET]
Scan : 17 Subscan : 2
Subscan Duration: 30.24 seconds
Remaining: 10 seconds
Front End
FEND Lock : 19
Sky Freq : 344.683595 GHz
Band Status : 1 2 3 4 5 6 7 8 9 10
Max Dewar Temp : 3.2635899 K
ACD State : NONE
Antennas
Total : 19 Operational : 1
Degraded : 18
Offline : 0
Shutter Open : 19 Shutter Closed : 0
BL Correlator
Current Mode : FDM (3840 channels)
AP State : AP_UNCORRECTED
Array008: 19 antennas Observing - Connected
DataFlow
Copy SB ID Copy ExBlk ID Log ExBlk Stats Stop this SB
SB ExBlk Array Start Progress QL DC
uid://A002/X391d0b/Xf8 uid://A002/X436934/X48c Array008 11:45:58 OBSERVE_TARGET
Scans Statistics
Scans
Scan Start Duration Problems Intent Subscan n Ssc done/intg
7 12:05:57 127s CALIBRATE_POINTING, CALIBRATE_WVR 5/25
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13 12:25:52 44s CALIBRATE_PHASE, CALIBRATE_WVR 1/5
14 12:27:05 44s CALIBRATE_ATMOSPHERE, CALIBRATE_WVR 3/9
15 12:28:22 378s OBSERVE_TARGET 10/50
16 12:35:03 44s CALIBRATE_PHASE, CALIBRATE_WVR 1/5
17 12:36:11 70s OBSERVE_TARGET 2 1/8

Online QA0

QA0 online report: uid://A002/Xxxxx/Xxx

05/22/2012

Abstract

Project Code: 2011.0.0XXX.S
Project UID: A002/Xxxxxxx/Xxxx
Time at start (UTC): 2012-02-22T03:45:00
Time at end (UTC): 2012-05-22T04:34:34
Number of Antennas: 19
List of Antennas: 'DA41', 'DA43', 'DA44', 'DA45', 'DV02', 'DV03', 'DV04', 'DV08', 'DV09', 'DV10', 'DV11', 'DV12', 'DV13', 'DV14', 'DV15', 'DV16', 'DV17', 'DV18', 'PM02'

Part I
Summary

1 Phase and amplitude check

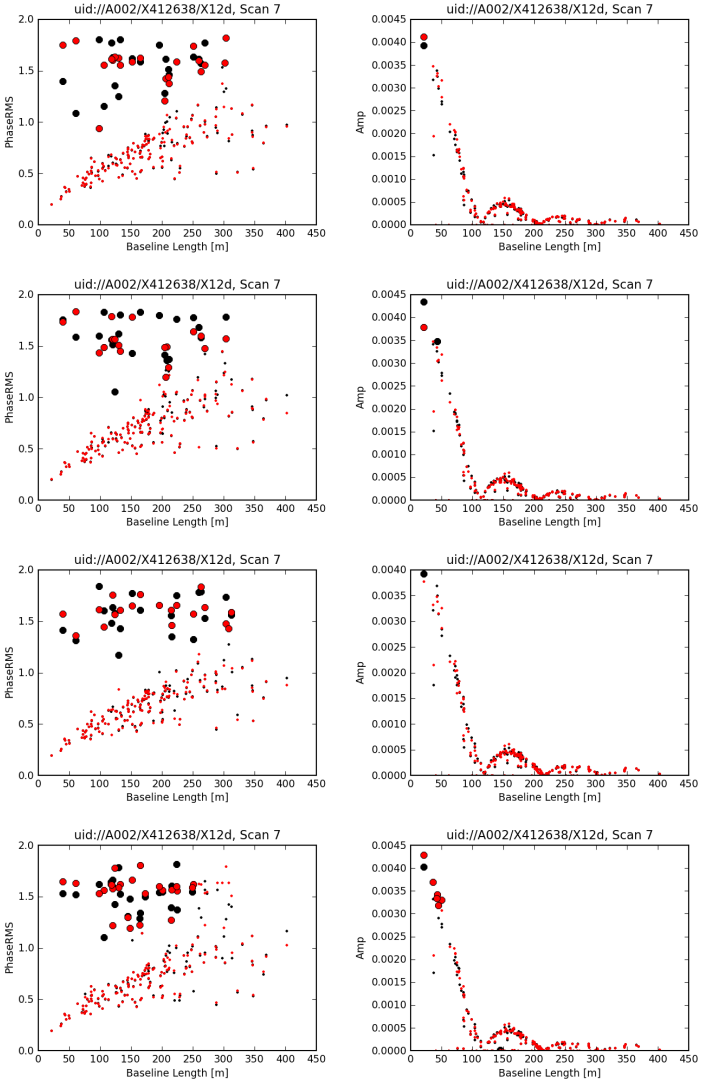
Plots are attached latter. Analysis made in planes phase rms-baseline length and amplitude-baseline length

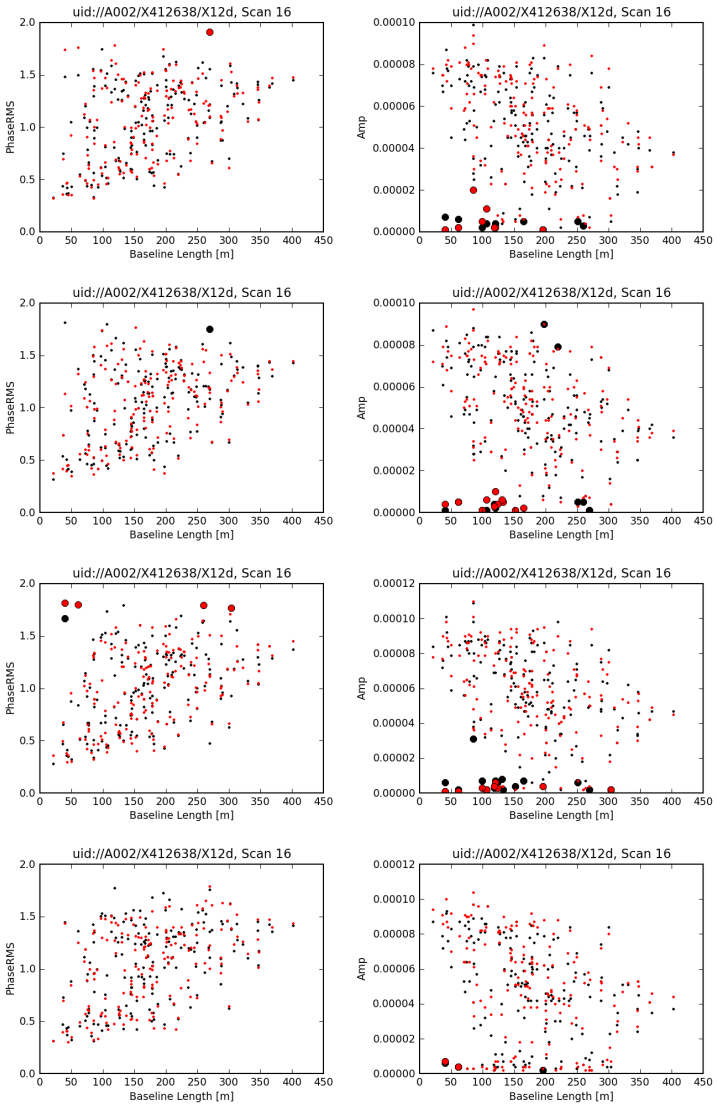
Band ALMA_RB_07

DV18 baselines show systematically higher phase RMS in both polarizations of baseband 1 in scans 4, 7, 10, 20, 22. (5 of 7 scans)

DV18 baselines show outliers in amplitude in both polarizations of baseband 1 in scans 4, 10, 14, 16, 20, 22. (6 of 7 scans)

Online QA0


uid://A002/X412638/X12d, Scan 7
PhaseRMS
Amp
Baseline Length [m]


uid://A002/X412638/X12d, Scan 16
PhaseRMS
Amp
Baseline Length [m]

Cycle 0 – Data reduction

Main steps of data reduction workflow

- Import data into reduction software
- A priori and QA0 flagging
- Phase correction based on data from the Water Vapor Radiometers (WVRs)
- System temperature (Tsys) calibration
- Antenna position correction (antpos) calibration
- Application of the WVR, Tsys and antpos calibration tables
- Split of the science data
- Initial flagging (shadowing, atmospheric lines)
- Putting a model for the spatially-resolved calibrators
- Bandpass calibration
- Gain calibration (phase and amplitude)
- Application of the bandpass and gain calibration tables
- Flux equalization/bootstrapping across observations
- QA2 of calibration
- Imaging
- QA2 of imaging
- Packaging of data and products

www.almaobservatory.org

The Atacama Large Millimeter/submillimeter Array (ALMA), an international astronomy facility, is a partnership of Europe, North America and East Asia in cooperation with the Republic of Chile. ALMA is funded in Europe by the European Organization for Astronomical Research in the Southern Hemisphere (ESO), in North America by the U.S. National Science Foundation (NSF) in cooperation with the National Research Council of Canada (NRC) and the National Science Council of Taiwan (NSC) and in East Asia by the National Institutes of Natural Sciences (NINS) of Japan in cooperation with the Academia Sinica (AS) in Taiwan. ALMA construction and operations are led on behalf of Europe by ESO, on behalf of North America by the National Radio Astronomy Observatory (NRAO), which is managed by Associated Universities, Inc. (AUI) and on behalf of East Asia by the National Astronomical Observatory of Japan (NAOJ). The Joint ALMA Observatory (JAO) provides the unified leadership and management of the construction, commissioning and operation of ALMA.