



# Telescope Interface & Diagnostics Team

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# Telescope Interface & Diagnostics Team

## Team Overview

### TIDT Activities:

- Diagnostics & Interaction with the JAO
  - Extension & Optimization of Capabilities (EOC)
  - Astronomer on Duty (AoD) shifts
  - Phase 2 Generation (P2G)
  - Other telescope-facing activities
- Team Members:
    - James Di Francesco (P2G), Ed Fomalont (EOC), Todd Hunter (Diagnostics), Harvey Liszt (P2G), Anish Roshi (Diagnostics), Gerald Schieven (P2G), Richard Simon (P2G)
      - Plus: Antonio Hales (Diagnostics – 2-month visit from JAO, Feb-Mar 2018)

# Telescope Interface & Diagnostics Team

## Talk Outline

- Completion/summary statistics for Cycles 4 & 5
- Diagnostics & JAO Interaction
- Status of New Capabilities for Cycle 7+ (Observing Modes)
- AoD Shifts
- Phase 2 Generation

# Completion Statistics for Cycle 4

## Cycle 4 Project Completion

		Completion Rate		
Grade	N	Completed	Partial	No Data
A + DDT	151	74%	16%	11%
B	336	54%	29%	16%
C	229	26%	36%	38%
Supplemental	36	69%	31%	0%

- Total numbers, over all Executives

# Completion Statistics for Cycle 4

## Cycle 4 MOUS Completion: 12-m Array

		Observing time (hours)		Completion Rate		
Grade	N	Requested	Observed	Completed	Partial	No Data
A + DDT	535	1108	861	82%	3%	15%
B	972	2012	1306	70%	4%	26%
C	801	1349	506	45%	2%	53%

- Total numbers, over all Executives

# Completion Statistics for Cycle 4

## Cycle 4 MOUS Completion: 7-m Array

		Observing time (hours)		Completion Rate		
Grade	N	Requested	Observed	Completed	Partial	No Data
A + DDT	24	157	185	92%	0%	8%
B	134	563	640	94%	0	6%
C	150	609	652	93%	2%	5%

- Total numbers, over all Executives

# Completion Statistics for Cycle 4

## Cycle 4 MOUS Completion: Total Power Array

		Observing time (hours)		Completion Rate		
Grade	N	Requested	Observed	Completed	Partial	No Data
A + DDT	16	120	125	94%	6%	0%
B	58	283	272	50%	17%	33%
C	71	440	371	86%	5%	8%

- Total numbers, over all Executives

# Completion Statistics for Cycle 5 to date

## Cycle 5 Project Completion

		Completion Rate (all Execs)			NA Completion Rate			
Grade	N	Compl.	Partial	No Data	N	Compl.	Partial	No data
<b>A + DDT</b>	<b>145</b>	29%	34%	37%	39	18%	60%	22%
<b>B</b>	<b>301</b>	25%	38%	38%	100	18%	51%	31%
<b>C</b>	<b>297</b>	8%	32%	60%	90	7%	29%	64%

- Completion rates to date have strong dependence on required configurations



# Completion Statistics for Cycle 5 to date

## Cycle 5 MOUS Completion: 12-m Array

		Observing time (hours)		Completion Rate (all Execs)			NA Completion Rate		
Grade	N	Requ.	Obs.	Compl.	Partial	No Data	Compl.	Partial	No Data
A + DDT	729	1397	587	44%	2%	54%	40%	7%	54%
B	1201	2670	978	41%	2%	57%	46%	3%	51%
C	939	2103	418	23%	1%	75%	19%	1%	80%

- Completion rates to date have strong dependence on required configurations

# Diagnostics & JAO Interaction

- Weekly interactions with the JAO (e.g. SCIENCE-ENGINEERING and Control Software Coordination Group (CSCG) meetings)
- Diagnostic issues identified / QA3 investigations, e.g.:
  - Position offset caused by observation at low elevation
  - Misconfigured weather station at the end of Cycle 2 (during Long Baseline Campaign preparation)
  - Only one  $T_{\text{sys}}$  measurement on phase calibrator in certain cases
- Close involvement with the JAO on defining a modified Long Baseline configuration plan at the end of Cycle 4/start of Cycle 5, to recover from weather downtime impact and maximize observing time during the long reconfigurations. Provided modified configurations, simulations and recommended relocation order.

# ObsMode 7 (Cycle 7-8)

- Observing Modes (ObsMode) 7 (Cycles 7+): Focus on outward planning for Cycles 7-8. As for Cycle 6, focus shift from major capabilities to major improvements. NAASC staff major part of process
- F2F meeting held in Santiago from 24 – 26 April, 2018. Preliminary report from that meeting circulated for review by Science Ops.
- Cycle 7 Minimum Requirements (no change from Cycle 6):
  - 43 12-m Array Elements + (10 7-m Array Elements + 3 Total Power Array Elements) = 56 total number of Array Elements.
  - Approximately 10 array "configurations"
    - Cycle 7 configurations similar to Cycle 6
    - No dedicated configurations - we will be "through" that configuration on date reported
  - Anticipated 4300 hours of 12-m array time and 3000 hours of ACA time available for PI science

# ObsMode 7 (Cycle 7-8) Priorities: F2F Input

- EOC/Performance
  - Data processing throughput
  - Longest baselines (16 km) @ Band 7
  - Polarization (mosaicking, performance improvement, full stokes)
  - 12m High Frequency (long baselines, Band-to-Band)
  - Total Power Continuum & Total Power High Frequency Spectral Line
- Pipeline/Standard Mode
  - High Frequency 12m & 7m (incl. Band-to-Band and long baselines)
  - Sessions
  - Polarization
  - Maximum Collecting Area Array
- Other/Planning
  - Improved data rates
  - Scheduling improvements
  - Spectral scan improvements

# ObsMode 7 (Cycle 7-8) Priorities: Outcomes

- New/Improved Capabilities planned for Cycle 7
  - Band 7 out to 16 km (C43-9 and C43-10)
  - Performance improvements to Polarization (in particular Circular/Stokes V)
  - Generic Total Power Continuum out to Band 8 (continuum default tunings)
  - Improved Spectral Scans as Standard mode (~30% efficiency improvement)
  - Solar & VLBI in Band 7
- New Capabilities with a Cycle 8+ goal
  - Band-to-Band phase transfer → improved High Frequency observing and Bands 8-10 at long baselines
  - Total Power Continuum in Bands 9 & 10
  - Total Power Spectral Line in Bands 9 & 10
  - Maximum Collecting Area Array
  - Polarization improvements including: expanded FOV (wide-field, mosaicking), Zeeman, Pipeline/Standard Mode

# Cycle 7 Non-Standard Modes

- Non-Standard Modes for Cycle 7:
  - VLBI
  - Solar
  - Bands 9 & 10
  - Band 7 C43-9/C43-10 (some cases may be Standard mode depending on phase calibrator availability or necessity of a cone search; TBD)
  - Bandwidth switching projects (narrow aggregate bandwidth)
  - Polarization
  - User-specified calibrations
  - Astrometry
- Stand-alone ACA for Standard Modes only
- “Non-standard” does not specifically imply that the data cannot be calibrated through the ALMA Pipeline but rather that they pose a significant burden on observatory resources.

# Cycle 7++ ObsMode Planning

- Cycle 7++ Improvements to efficiency & performance
  - Spectral scan improvements by ~30% observing efficiency (Cycle 7)
  - Optimized phase calibrator cycle times as a function of frequency and baseline length
  - Improved use of check sources
  - Dynamic reporting of integration time (Cycle 7) and phase calibrator selections & cycle times (Cycle 7+)
  - Dynamic selection of integration times and phase calibrator parameters (Cycle 8+)
  - Increased maximum execution length
    - Would allow for the possibility of larger mosaics
  - Improved data rates
  - Data throughput improvements (see presentations by Mark Lacy & Tony Remijan)

# Cycle 8++ Planning – ANASAC Involvement?

- EOC time in Cycle 6 is ~10%, as in Cycle 5, which still needs to include all ONLINE software testing and validation on site.
- Still several modes that need expert input on where data have been collected but need to be analyzed
- Long/Short term visitor and sabbatical support is available for interested researchers to visit the NAASC/Chile
- Edits to the use of “test data” or “commissioning data” policy are possible so using data for student thesis or technical data is possible



# Cycle 8++ Planning – ANASAC Involvement?

- Science use cases for Maximum Collecting Area Array
- New Capabilities that would benefit from external contribution:
  - Single Dish:
    - Frequency Switching
    - High Frequency ( $> B8$ )
  - Polarization:
    - SD & 7m
    - Bands 9 & 10
    - Solar System Objects
    - Zeeman
  - OTFI/Large mosaics

# Astronomer on Duty Shifts

- NAASC staff provided Astronomer On Duty support to the JAO in Nov & Dec 2017 and Jan, Mar, & Apr 2018, with further shifts in Cycle 5 scheduled for Jun, Jul, & Aug 2018.
- For Cycle 5, we are providing expert AoD support for 15 shifts
- In addition, we have trained/re-trained 2 NA AoDs (re-training required if shifts not repeated every 12 months)

# Phase 2 Generation (P2G)

- P2G review and/or edit all SBs prior to setting to Ready to run on the telescope. SBs that currently need specific P2G attention include:
  - Long Baselines, High Frequency, Full Polarization, Total Power, Narrow Bandwidth, Re-submissions, External Ephemeris, Multiple Tunings, Time-Constrained, Targets of Opportunity, Solar
- P2G also support DDT proposals and SB changes approved through Change Requests, additional revived ACA projects, etc.
- Phase-II - PI submission of Science Goals:
  - In Cycle 5, P2G supported PIs through checking and submitting their Phase-II SGs. SBs were then automatically generated by the Observatory after the Phase-II deadline.
- Improvements to P2G Best Practices, especially for difficult cases we identified (e.g. Long Baseline SBs with multiple sources and High Frequency Long Baseline SBs)

# Telescope Interface & Diagnostics Team

## Summary

- NAASC Telescope Team continues to provide support to the JAO and continues to act as liaison between NAASC staff and the JAO and vice versa, particularly in areas of:
  - Diagnostics
  - Observing Modes & EOC
  - AoD Shifts and training shifts
  - Phase 2 Generation
  - Plus any other telescope-facing activities



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# Supplemental Material

# Cycle 7+ Observing Modes

## Status of Long Baseline Improvements

- For Cycle 7:
  - Plan to offer Band 7 out to 16 km (C43-9 & C43-10)
  - Band 7 C43-8, C43-9, C43-10 may become Standard Mode in certain cases where a suitable phase calibrator is available without a cone search (TBD)
  - Optimized phase calibration (calibrator cycle times and separations)
- Ongoing investigation for Cycle 8+
  - Bands 8-10 at the longest baselines. Requires commissioning of the Band-to-Band technique and further optimization of phase calibrator selection/parameters & Go/No-go

# Cycle 7+ Observing Modes

## Status of Total Power Improvements

- For Cycle 7:
  - Plan to offer TP Continuum through Band 8 at the continuum default tunings, using Lissajous scan pattern
- Ongoing investigation for Cycle 8+
  - Basket-weave scan pattern
  - TP Continuum in Bands 9 & 10 (needs development of sideband separation technique for continuum)
  - TP Spectral Line in Bands 9 & 10 (needs verification of current sideband separation technique, amplitude calibration etc.)



# Cycle 7+ Observing Modes

## Status of Polarization Improvements

- Performance improvements for Cycle 7:
  - Improvements to Stokes V accuracy / Circular Polarization
  - Stability improvements (cross-hand phase, D-term phase)
- Ongoing investigation for Cycle 8+
  - Mosaicking/wide-field
  - Short calibration scheme
- Ongoing investigation for Cycle 9+
  - Pipeline/Standard Mode (continuum and spectral line)
  - ACA-only
  - Zeeman