Telescope Interface & Diagnostics Team

Catherine Vlahakis – Team Lead

ANASAC f2f Meeting – 31 May 2017

NRAO NSF Associated Universities Inc

Telescope Interface & Diagnostics Team

Overview

- TIDT Activities:
  - Extension & Optimization of Capabilities (EOC)
  - Astronomer on Duty (AoD) shifts
  - Phase 2 Generation (P2G)
  - Diagnostics
  - Other telescope-facing activities

- Team Members:
  - James Di Francesco (P2G), Ed Fomalont (EOC), Todd Hunter (Diagnostics), Harvey Liszt (P2G), Gerald Schieven (P2G), Richard Simon (P2G)

Overview of Telescope Team Activities
Summary

- Status of New Capabilities for Cycle 6+ (Observing Modes)
- AoD shifts
- Phase 2 Generation
- Diagnostics
- Support for Long Baseline Science Readiness

Cycle 6 ObsMode Planning

- Cycle 6 Observing Modes (ObsMode) Meeting held in Santiago from 24 – 26 April, 2017. Preliminary report from that meeting now being circulated for review by Science Ops
- Focus on outward planning for Cycles 6-8; focus shift from major capabilities to major improvements
- Cycle 6 Minimum Requirements:
  - 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 6 configurations similar to Cycle 5
    - 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

Cycle 6 ObsMode Planning

- "Full-Operations" capabilities to be demonstrated before Cycle 7
  - Differential Circular (V) Polarization
  - Wide-field Polarization
  - Total Power Continuum
  - Long Baselines at Higher Frequencies (>Band 7)
  - Repeatable precision observations

- New Capabilities that will be offered for Cycle 6
  - Differential Circular (V) Polarization (and various derivatives)
  - Total Power Continuum using fast-scanning (without formally addressing removal of in-band spectral lines)
  - Data processing using Sessions
  - "High Sensitivity" / "Kitchen Sink" Array (new name TBD) – all bands out to a configuration TBD (probably config-5)
  - Band 5 long baselines

Cycle 6 ObsMode Planning

- Non-Standard Modes for Cycle 6:
  - VLBI
  - Solar
  - Bands 8, 9, 10
  - Bandwidth switching projects (narrow aggregate bandwidth)
  - Full polarization, TDM and FDM
  - Spectral scans
  - User-specified calibration where calibrations are *removed* from the observing strategy
  - "High Sensitivity" / "Kitchen Sink" Array
  - Total Power Continuum observations using fast scanning
  - Stand-alone ACA
  - Astrometry
- "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 6 Observing Modes
Status of New Capabilities: Polarization

- Polarization in Cycle 6
  - Focused effort to demonstrate Circular Polarization for Cycle 6
    - Spurious Stokes V seen, 1% daily variation. Experts have been trying to understand the origin of issues but still unexplained. Polarization Team aiming to collaborate with KVN to get simultaneous test data for better diagnostics.
  - Continue use of Sessions in Cycle 6
- Polarization for Cycle 7+
  - Increased Field of View, & mosaics
    - E.g. need improved primary beam models
  - Short calibration scheme testing ongoing to determine feasibility
    - If successful could reduce the current fixed 3-hour Sessions
  - Bands 8, 9 ,10 (Cycle 7++)

Cycle 6 Observing Modes
Status of New Capabilities: Solar

- For Cycle 6, the following new capabilities are being tested:
  - Bands 7 (& 9)
  - Regional TP fast-scanning (TP continuum an offered mode of Cycle 6)
  - Circular Polarization (testing in coordination with Polarization Team)
  - Sub-second integrations (TDM) for transient science

- For Cycle 7+
  - Generic science sub-arrays
  - Standalone ACA (non-standard mode)

Cycle 6 Observing Modes

Status of New Capabilities: Continuum Total Power

- Continuum TP to be offered in Cycle 6 without formal mitigation for in-band spectral lines
- Plan to formally address in-band spectral lines for Cycle 7
- Work on demonstrating Band 9+10 TP for Cycle 7
- TP improvements under investigation for Cycle 6:
  - Orthogonal maps will be offered if there is a demonstrated improvement over the current uni-directional scanning
  - Ability to specify OFF positions in absolute coordinates
  - Storing of Jy/K in the TMCDB database

Cycle 6 ObsMode Planning

Cycle 6(+) Improvements to Existing Capabilities & Efficiency

- Improvements to minimum time on source and time ratios (e.g. increased minimum time or fraction of the calibration time)
- Time-simultaneous observations: 12m+7m+TP; ability to specify whether data is intended to be combined
- Spectral scan improvements (e.g. same bandpass and flux calibrator, removing 5-tuning limit)
- Scheduling improvements to track hour-angle (Cycle 6/7), leading to uv-coverage recording in Cycle 8+
- Multiple Intents – At least one of BPcal+FluxCal+PCal or BPcal+FluxCal+PCal+Pol must be independent (i.e. you need two distinct calibrator sources). Checksource is additional.
- Optimized phase calibrator cycle times as a function of frequency and baseline length
- Dynamic reporting (and eventually specification) of integration time (Cycle 7+)

Cycle 6++ Planning – ANASAC Involvement?

- EOC time in Cycle 5 is ~10%, as in Cycle 4, 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 6++ Planning – ANASAC Involvement?

- New Capabilities that would benefit from external contribution:
  - Single Dish:
    - Frequency Switching
    - Fast Scanning (Except for Solar)
    - High Frequency (> B8)
    - Nutator
  - Polarization:
    - SD & 7m
    - B9 & B10
    - Wide field, Mosaics & off axis
    - Solar System Objects
    - Zeeman
  - OTFI (large mosaics)

Astronomer on Duty Shifts

- NAASC staff provided Astronomer On Duty support to the JAO in Jan, Mar, Apr, May, 2017, with further shifts scheduled for Jul & Nov
- For 2017, we will be providing expert AoD support for 17 shifts
- In addition, we are training 6 new NA AoDs (6 training shifts)

Phase 2 Generation (P2G)

- P2G check 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
- P2G also support DDT proposals and SB changes approved through Change Requests
- PI-generation of SBs / re-submission of SGs:
  - In Cycle 4, P2G supported PIs through submitting their Phase-II SBs. In Cycle 5 PIs will have to check and submit their SGs
- Improvements to P2G Best Practices, especially for difficult cases we identified (e.g. Long Baseline SBs with multiple sources)

Diagnostics

- Weekly interactions with the JAO (e.g. SCIENCE-ENGINEERING and Control Software Coordination Group (CSCG) meetings)
- Diagnostic issues identified, e.g.:
  - Control/Delayserver problem where some scans got wrong delay center; manifested in images as "ghost" image, source amplitude deficit or imaging artifacts. Issue first reported by a PI. Could potentially affect a significant number of projects though thought to have happened intermittently. Work ongoing to identify and, if needed, fix all affected data.
  - Wrong antenna positions over an extended period were discovered for some antennas. PIs notified / Knowledgebase Article posted.

Support for Cycle 4 Long Baselines
Science-Readiness Preparations

- NA is leading the Array-Readiness and End-to-End tests for Long Baseline PI science observing in Cycle 4 (in motion now). We have not been in a Long Baseline configuration since 2015.
- Long Baseline Array-Readiness:
  - Check-out of the array once antennas have been relocated to the long-baseline pads. Check for technical issues specific to long baselines, e.g. delay jumps, phase slopes, correct use of the remote weather stations, other delay server issues etc.
- E2E validation tests:
  - Carry out representative science-like observations using the long baseline array and remote weather stations and carefully check data for subtle technical issues before starting PI science observing.

www.nrao.edu
science.nrao.edu

The National Radio Astronomy Observatory is a facility of the National Science Foundation operated under cooperative agreement by Associated Universities, Inc.