



# NAASC Software Support Team

**Brian Mason**

*S.Booth, C. Brogan, J.Donovan-Meyer, J.Hibbard, T.Hunter, R. Indebetouw, A.Kepley, I.Yoon*



# Overview

- Major initiatives & results in past year – CASA
- Major initiatives & results – ALMA Pipeline
- Ongoing Research & Investigations
- Specific points raised by ANASAC (2017)
- Algorithms Research & Development Group
- Forward look

# Major Initiatives/Recent Results: CASA

- CASA Visibility Infrastructure Refactor (VIVB2)
  - Improve performance; unify internal interfaces to common MS operations (reduce dev't & maintenance costs going forward)
  - Extensive debugging effort
- New CASA Documentation infrastructure (PLONE)
  - Streamline maintenance of up-to-date (and historical) documentation.
- Support validation & benchmarking of parallelized/high-performance CASA
- Development of automated CLEAN masking (A.Kepley, C.Brogan, I.Yoon)
  - Algorithm dev't
  - CASA specification & validation
  - *Of general use for interferometric data (not just ALMA)*

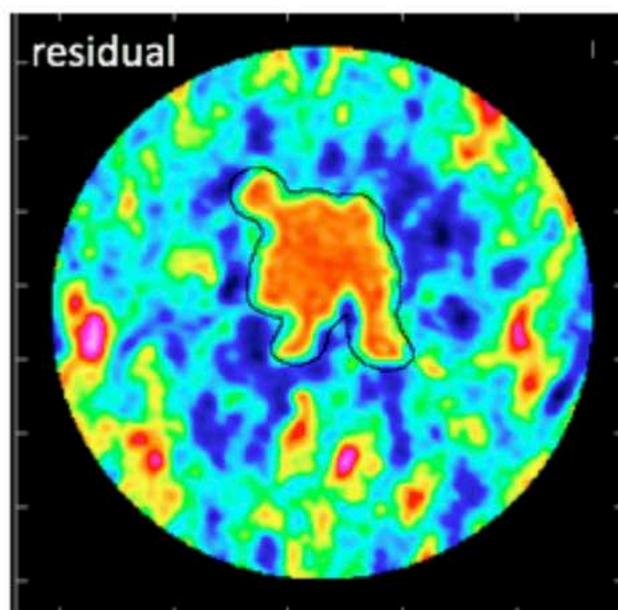
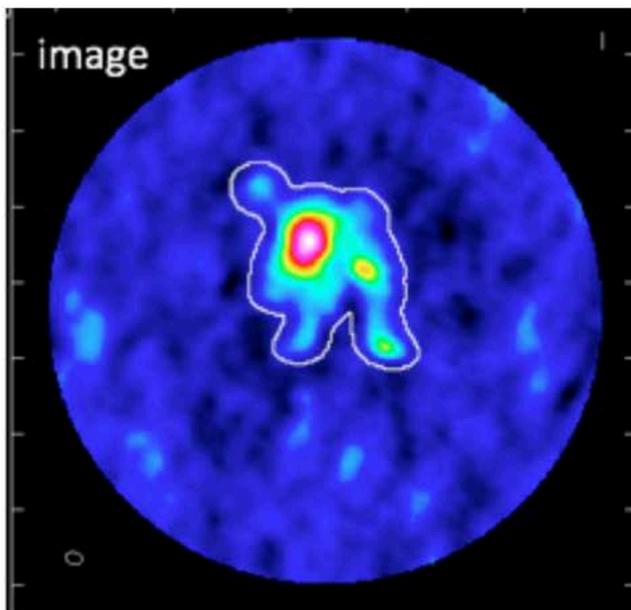
# Major Initiatives/Recent Results: Pipeline

- Integrate Automasking: improve **quality** (e.g. more accurate & robust noise estimate); enable future capabilities (e.g., self-cal in pipeline)
- Improved image/cube size mitigation (2017 ANASAC reco.)
  - Increase pixel & channel size; decrease FOV & # of cubes.
  - Reduced threshold for invoking
- Make special “QA2 cube” when PI-requested “Bandwidth for Sensitivity” differs significantly from native cube resolution (to streamline QA2).
  - Take advantage of newly propagated line names and rest freqs.

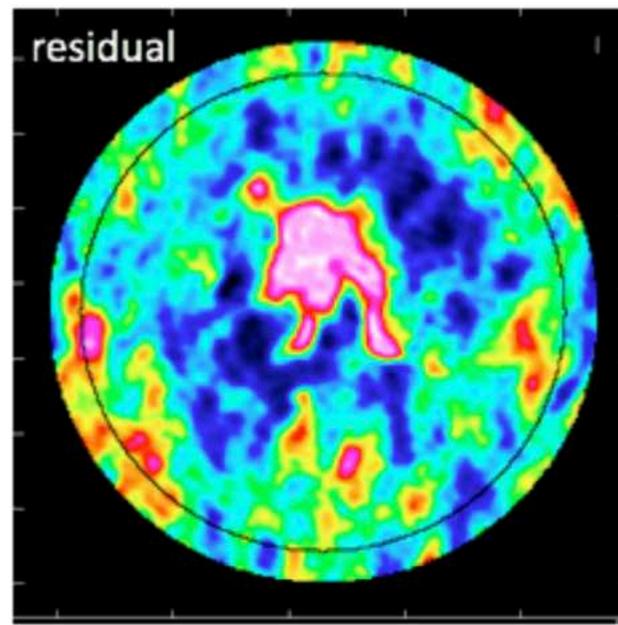
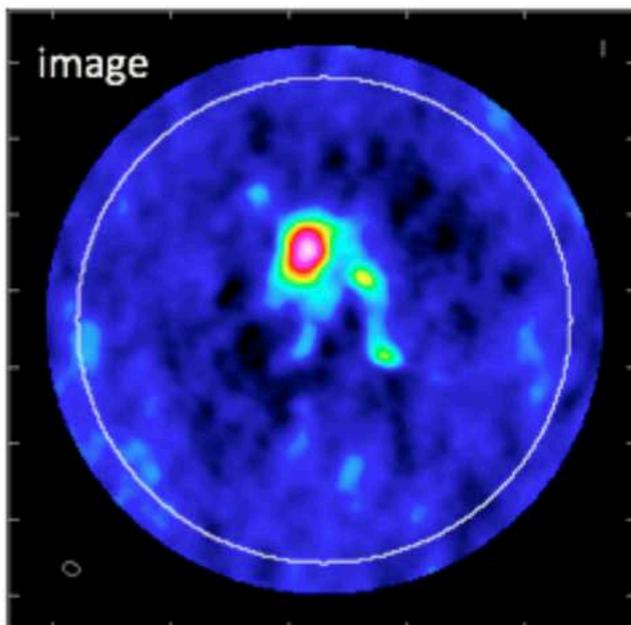
# Major Initiatives/Recent Results: Pipeline (2)

- Calibrator visibility amplitude outlier flagging (BP, PHASE, FLUX)
  - ID bad Ant's and BL's, transfer flagging to science target
- Sensitivity & resolution estimates before imaging (C5), using representative source & frequency (newly propagated)
  - to reduce / accelerate imaging rework.
- Low SNR calibration heuristics (catch error conditions; reduce manual rework)
- findContinuum heuristic improvements: more robust; new “all continuum” option.
- numerous other small improvements & bug fixes.
- ... + single-dish PL improvements under purview of NAOJ

Cycle 5 pipeline  
with automasking



Cycle 4 pipeline  
with primary beam  
mask



# Research & Investigations - Ongoing

- Optimizing beam size in Imaging PL for QA2 to handle observational variance (robust, maybe taper) -- led by Brogan
  - Add to image precheck stage
- PL QA interface (“weblog”) improvements – led by Hibbard
- Automasking speed improvements – led by Kepley
  - better convergence criteria; “smarter” individual channel cleaning
- Parallel/HPC CASA – Yoon, in collaboration with Emonts+
- Other
  - Combination (ALMA+GBT) – led by Kepley
  - 7m+12m: automask parameters ... for future PL, and as guidance to users.
  - Polarization – Brogan, Hunter; Moellenbrock
    - Pipeline-calibrate field-center, 12m, linear pol
    - Circular

# Administrative, day-to-day, & cross-functional work

- Supervise & carry out CASA Validation (= Science / User) testing
- Contribute to *many* activities ALMA-wide
  - Pipeline working group
  - New ALMA Software Subsystem Coordination Group
  - Observing Modes / next cycle planning
  - Data reduction workflow
  - WVR Phase Correction Investigation (J. Donovan-Meyer)
  - Polarization investigation (C. Brogan, T. Hunter)
  - SPW phase instability ID'd, diagnostics devised & deployed in weblog (most of team)

# UC 2017 Comments & Concerns:

- “further improvements of the [imaging] pipeline should be a priority to ensure efficient data verification and delivery.”
  - Automasking
  - QA2 cube
  - ”image precheck” in weblog (beam size / robust preview)
  - Improved flagging, low SNR calibration, find.Cont. heuristics
  - Ongoing weblog & QA metrics effort
- “The existing policy to image all channels out to the size of the primary beam is for example not practical for large baseline and/or high spectral resolution projects and needs to be revisited.”
  - Improved large-cube mitigations

# Algorithm Research & Development Group (ARDG) work in support of ALMA (S. Bhatnagar et al.)

- **Underway:**
  - Wide-field, full-polarization mosaic imaging with ALMA:ALMA Development study (S.Bhatnagar, B.Kirk, P.Jagannathan, P.Cortez, C.Hull, S.Kameno, U.Rao, C.Brogan, T.Hunter)
  - Joint wideband single-dish interferometric imaging (U.Rau & N.Naik) – nearly complete, publication imminent.
- **New initiatives:**
  - Automation of pipeline data QA using Machine Learning/AI – ARDG-led collaboration with University ML group. Similar, more narrowly scoped efforts underway in the ALMA project.
  - Optimal Imaging with multi-scale interferometric telescopes: current weighting schemes in highly non-optimal when wide range of spatial scales is involved. Led by NRAO/ARDG scientists.

# Next 180 Days/Future

- Summer/early Fall
  - **Testing of Cycle 6 pipeline** & undergirding new functionality
  - Support end to end testing (August 2018)
  - Support deployment (Sept/Oct 2018) & cycle 6 start. Potential for mid-cycle patch if critical issues arise.
- Fall: **Requirements capture for Cycle 7 pipeline**. Top priority is **streamlining QA**. John Hibbard is leading this effort in collaboration with the Pipeline Working Group, the JAO, Data Reduction Managers, and other stakeholders.
- **Transition to SRDP** (late summer?): many of the same team members will be matrixed in under newly hired SRDP Project Scientist.

# Next 180 Days/Future: Challenges

- Staffing deltas
  - Some CASA dev't effort has shifted to ARDG; new pipeline lead developer (due to retirement)
  - Some science effort has been redeployed to ALMA Dev't (correlator) & ngVLA
  - CASA Scientific Testing Manager on family medical leave summer / fall – temporary fill-in plan in place
  - With SRDP ramp-up/re-org, ALMA-specific effort may decrease somewhat, but the work is synergistic
- Managing technical risk in Cy6 PL validation due to staffing fluctuations
  - Keep team intact through Cy6 PL validation
  - Temporarily back-fill CASA testing role with me, PL scientists; CASA SsS

# Future: 1 year+

- CASA:
  - Continue to focus on increased performance: memory usage, parallelization
  - Migrate to Python 3 (dual 2.7/3 releases in 2019; deprecate 2.7 in 2020)
- ALMA Pipeline
  - Add new modes (e.g.: sessions, polarization, maximum collecting area array, total power continuum)
  - Take maximum advantage of CASA performance improvements (not a “freebie”)
  - Python 3 migration
  - SRDP interface & operations

# Summary: NAASC Software Support Team

- ALMA Cycle 5 & 6 calibration & imaging pipelines advance the state of the art in terms of quality, efficiency, defect detection & handling.
  - With a few exceptions, at this point the pipeline itself is not the main pace-setter for QA2 & data delivery
  - Cycle 7 will shift greater focus to streamlining QA/weblog workflow
- We continued to support the delivery of key, new CASA infrastructure (VI2; documentation; parallel/HPC) & capabilities (autoboxing – not limited to ALMA)
  - Parallel/HPC dev't will likely continue to be a significant focus in the next few releases, for CASA & PL.
- Successes of the past few years pave the way for SRDP



[science.nrao.edu](http://science.nrao.edu)  
[public.nrao.edu](http://public.nrao.edu)  
[ngvla.nrao.edu](http://ngvla.nrao.edu)

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