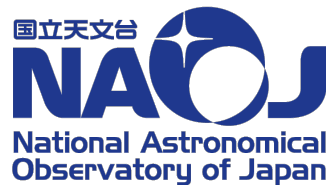


CASA/Pipeline Updates

Kotomi Taniguchi, Takeshi Nakazato,
Kanako Sugimoto, Satoko Takahashi (NAOJ)
on behalf of CASA and Pipeline teams

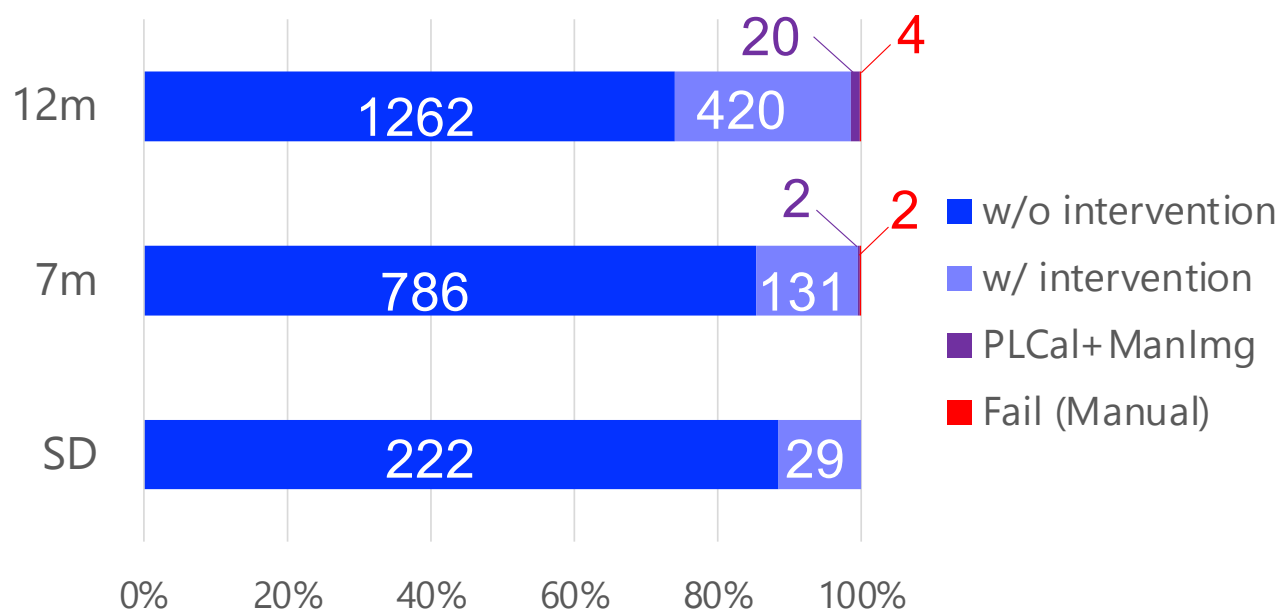




Operation of Cycle 11 Pipeline

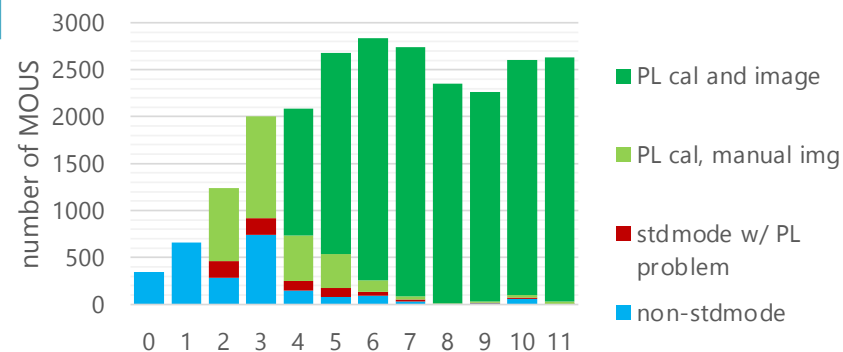
Data processing with pipeline goes very well

Cycle 11 Pipeline Statistics

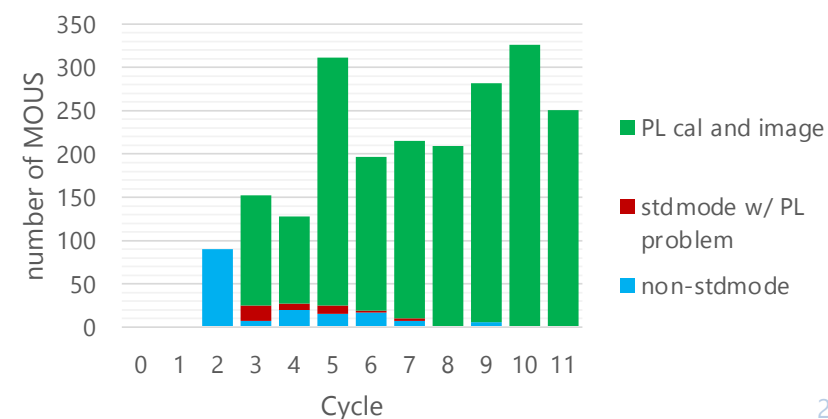


(As of Dec. 4 2025)

Interferometry Pipeline



Single Dish Pipeline

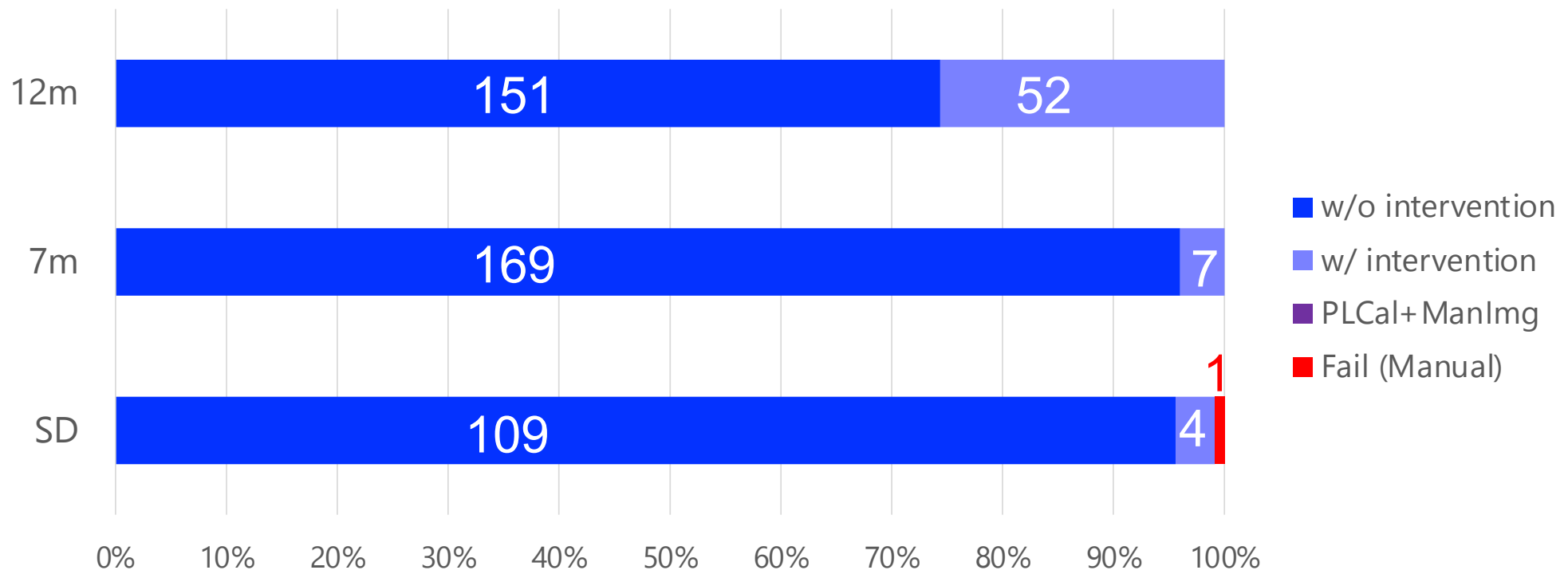




Operation of Cycle 12 Pipeline

Good start :) A new function (P12) works well to prevent crash the SDPL

Cycle 12 Pipeline Statistics



2025/12/15-17

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(As of Dec. 4 2025)

3



CASA and Pipeline Releases

CASA (https://casa.nrao.edu/casa_obtaining.shtml)

- Incremental release (every 2-3 months)
- Modular (pip wheels) and monolithic (tar-ball)
- CASA 6.7.0 (Feb. 2025), CASA 6.7.2 (Oct. 2025)



Pipeline (<https://almascience.nao.ac.jp/processing/science-pipeline>)

- One release/year/project
- Packaged with CASA as a tar-ball
- **2025.1.0.35 + CASA 6.6.6.17 for ALMA Cycle 12, Nobeyama**





Highlights of CASA Updates (1/3)

- Please see Release Information of casadocs for details
 - CASA 6.7.2
<https://casadocs.readthedocs.io/en/v6.7.2/notebooks/introduction.html>

Infrastructure

- Update on platform support: see Compatibility / Testing page for detail
 - **Python 3.10 is no longer supported** in the latest release, CASA 6.7.2
 - **Python 3.12 is the primary version for both modular and monolithic releases**
 - macOS ARM native build is available, **dropped support of macOS Intel**
- iclean is available (https://casadocs.readthedocs.io/en/stable/notebooks/interactive_clean.html)
- ATM (atmosphere) library updated to ALMA Cycle 12

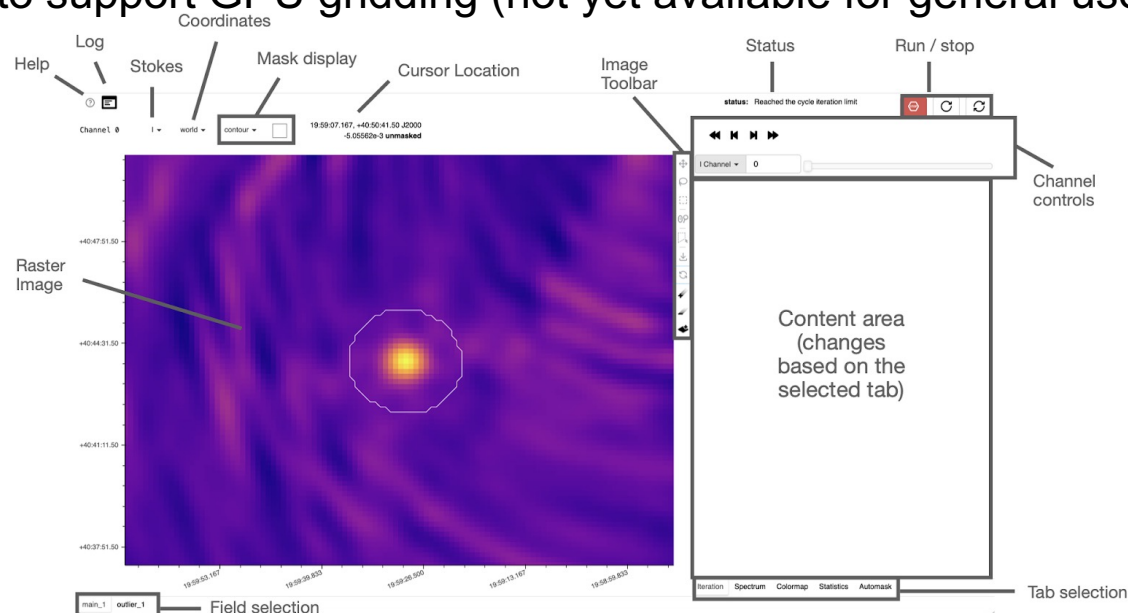




Highlights of CASA Updates (2/3)

Interferometry

- **iclean**: new interactive clean widget. (CASA 6.7.2)
- **msuvbinflag**: new experimental task to flag outliers in the UV plane. (CASA 6.7.2)
- **tclean**: initial work to support GPU gridding (not yet available for general use). (CASA 6.7.0)





Highlights of CASA Updates (3/3)

Single-Dish

- Sinusoidal fitting has been fully implemented
 - Sinusoidal fitting has been fully implemented. It is now fully compatible with Pipeline usecase.
- Deprecating sdimaging is planned in the next CASA release (CASA ver. 6.7.3, expected in early Feb, 2026).
- End-to-end test for the development purpose
 - Calibration and imaging processes following manual procedure to check new functionality before each release.





Highlights of Pipeline Updates (1/3)

- Please see [User's Guide](https://almascience.nao.ac.jp/processing/science-pipeline) for details of PL
(<https://almascience.nao.ac.jp/processing/science-pipeline>)

Atacama Large Millimeter/submillimeter Array
In search of our Cosmic Origins

About Science Proposing Observing Data Processing Tools Documentation Help

Overview and Pipeline

ALMA calibrates and images PI data following the "Quality Assurance level 2" or QA2 process. Most (>95%) of ALMA PI data is now processed by the pipeline through calibration and imaging, with the remainder processed manually by ALMA staff (the fraction processed manually was larger in earlier cycles). Pipeline and manual processing both use CASA. All data are reviewed by a data analyst before delivery, to ensure quality and that the PI-requested angular resolution and sensitivity are achieved.

The processed data are packaged for distribution through the archive, and as described in the [ALMA QA2 Data Products Document](#), products include images, but not calibrated visibilities.

For pipeline-processed data, the most useful resource is the pipeline weblog, included in the qa/ directory of a product package, which contains a very detailed log, with heuristics, quality assurance, and plots of the processing steps and outcomes. The Pipeline User's Guide (links below) describes in detail how the pipeline works, and the User's Guide version corresponding to the pipeline version listed in the weblog is the most accurate for that version. A list of known issues at the time of publication is included in the User's Guide, and a living version is maintained [here](#).

Users can recover calibrated visibilities by several methods:

- by running scriptForPI.py contained in the archived QA2 package. In general, one must run that script in nearly the same version of CASA used to originally calibrate the data as noted below (CASA task parameters and inputs may have changed). For pipeline-processed data, one can use the latest accepted version of CASA, with some exceptions for older data as noted in the Table below. See the [ALMA QA2 Data Products Document](#) for more details on running scriptForPI.py and its options.
- For Cycle 5 and later data, by running hifa_restoredata.py in the latest CASA - see instructions on the [Reimaging Help Page](#).
- by request to the helpdesk, staff at your AIC will restore the visibilities and provide them to you for download. ([Knowledgebase Instructions](#))

For all data analysis other than restoring older calibrated visibilities, ALMA strongly recommends using the most recent version of CASA that has been accepted by ALMA for data processing (see Table below). These accepted versions of CASA also contain the data processing pipeline, which the user can rerun themselves, as described in the Pipeline User's Guide. Additionally, CASA guides describing interferometric pipeline re-imaging and single-dish pipeline data processing examples are available at:

Interferometric: https://casaguides.nrao.edu/index.php/ALMA_Imaging_Pipeline_Reprocessing
Single-Dish: [https://casaguides.nrao.edu/index.php/Single-Dish_\(Total_Power\)_Data_Processing_with_Pipeline](https://casaguides.nrao.edu/index.php/Single-Dish_(Total_Power)_Data_Processing_with_Pipeline)

In general, pipeline tasks from any pipeline release should run successfully on data from that cycle or earlier. Using the most recent pipeline version will include improved calibration, flagging, and imaging heuristics that should improve the products, resulting in differences from previous versions (from modest to significant, depending on how early the original version was). To get the identical results as an archived pipeline product, one should use the version of CASA+PL that was used to produce the archived product.

The pipeline is not officially validated on MacOS.

Pis are strongly requested to note the versions of both CASA and of the Pipeline in their publications, or that the data were calibrated manually by ALMA staff, to provide a clear record of what heuristics were used to process the data. Pis who wish to cite the recent journal articles on CASA and the Pipeline can find them here:
CASA: <https://ui.adsabs.harvard.edu/abs/2022PASP...134A4501C>
Pipeline: <https://ui.adsabs.harvard.edu/abs/2023PASP...135G4501H>

CASA versions accepted for ALMA data processing:

CASA version	Pipeline branch and version	Pipeline Documentation	Description	used in operations	tarball for most modern OS available for each	versions that can be used to restore these data ¹
6.6.6-17	2025.1.0.35	User's Guide Reference Manual 2025 Pipeline 2025 known issues	Cycle 12	2025-09-29	casa-6.6.6-17-pipeline-2025.1.0.35-py3.10.e18.tar.xz casa-6.6.6-17-pipeline-2025.1.0.35-14.0-arm64-py310.dmg	most recent
6.6.1.17	2024.1.0.8	User's Guide Reference Manual 2024 Pipeline 2024 known issues	Cycle 11	2024-09-30 ~ 2025-09-29	casa-6.6.1-17-pipeline-2024.1.0.8-py3.8.e18.tar.xz casa-6.6.1-17-pipeline-2024.1.0.8-12.0-py38.dmg	most recent
6.5.4.9	2023.1.0.124	User's Guide Reference Manual 2023 Pipeline 2023 known issues	Cycle 10	2023-09-30 ~ 2024-09-29	casa-6.5.4-9-pipeline-2023.1.0.124-py3.8.tar.xz casa-6.5.4-9-pipeline-2023.1.0.124-11.0-py38.dmg	most recent

Documentation

Download

Updates since the last Users MTG

1. Summary of which PL/CASA can process for each cycle

2. Examples of data processing (TP is new)

Another useful documentation: [ALMA QA2 Data Products for Cycle 12](#)

2025/12/15-17

ALMA/45m/ASTE Users Meeting 2025

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Mirroring Package Provided by EA-ARC

Download will finish faster from the following URLs

CASA only (mac OS) : <https://alma-dl.mtk.nao.ac.jp/ftp/casa/distro/casa/release/>

CASA only (Linux) : <https://alma-dl.mtk.nao.ac.jp/ftp/casa/distro/casa/release/rhel/>

Pipeline : <https://alma-dl.mtk.nao.ac.jp/ftp/casa/distro/casa-pipeline/release/linux/>

Please select CASA packages corresponding your OS versions



Highlights of Pipeline Updates (2/3)

Interferometry

- Calibration improvements: The calibration of data with **faint (low SNR) calibrator sources**, including high frequency (HF), long baseline, and Band-to-Band (B2B), has been extended to handle more severe cases that previously failed to calibrate (next slide)
- Self-calibration; It covers **mosaic targets**, and its heuristics for long baseline data have been improved
- IQUV science target imaging capabilities have been introduced and added to the polarization recipes
- Some improvements, bug fix
 - ✓ QAscores have been improved for hifa_bandpass and the Amp/Ph-Freq component of hif_applycal

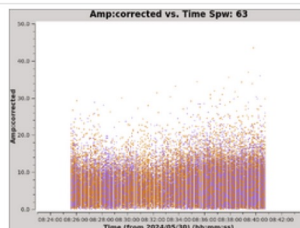




Calibration improvements: HF/Long Baseline/B2B

low SNR refactor for BP/DGC

PL2024

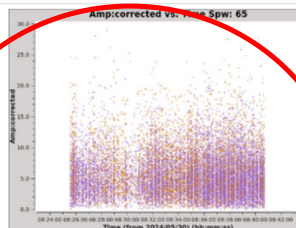


Spectral Window 63

Intents: BANDPASS

Calibrated data before flagging.

Missing solves, lost data at phase-up



Spectral Window 65

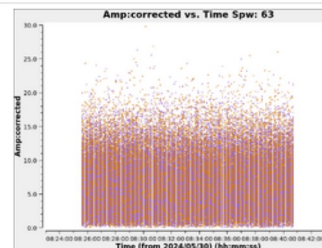
Intents: BANDPASS

Calibrated data before flagging.

Phase-up on bandpass calibrator

Measurement Set	Phase-up Solution Parameters	
	Type	Interval
uid__A002_X1181695_X437c.ms	Phase only	56.826s

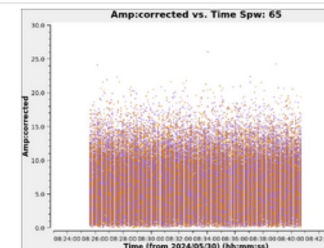
PL2025



Spectral Window 63

Intents: BANDPASS

Calibrated data before flagging.



Spectral Window 65

Intents: BANDPASS

Calibrated data before flagging.

Spectral Window Phase Offsetting and Phase-up on the Bandpass Calibrator

Measurement Set	Phase-up Solution Parameters		
	Type	Interval	Combine
uid__A002_X1181695_X437c.ms	Phase only	Infinite	False
uid__A002_X1181695_X437c.ms	Phase only	18.144	True

uid__A002_X1181695_X437c.ms: computing optimal solint based on aggregate bandwidth.
Using combine='spw' and phaseup solint of '18.144' in MS uid__A002_X1181695_X437c.ms

Using aggregate BW, needs only 18s for SNR =20 phase-up



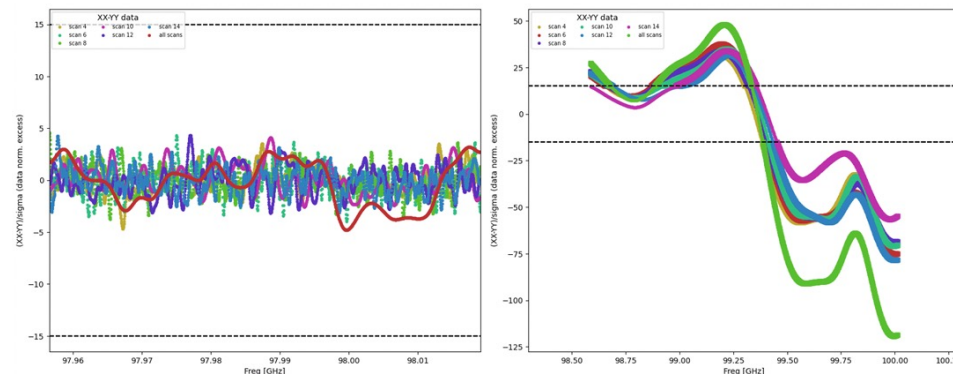


Highlights of Pipeline Updates (3/3)

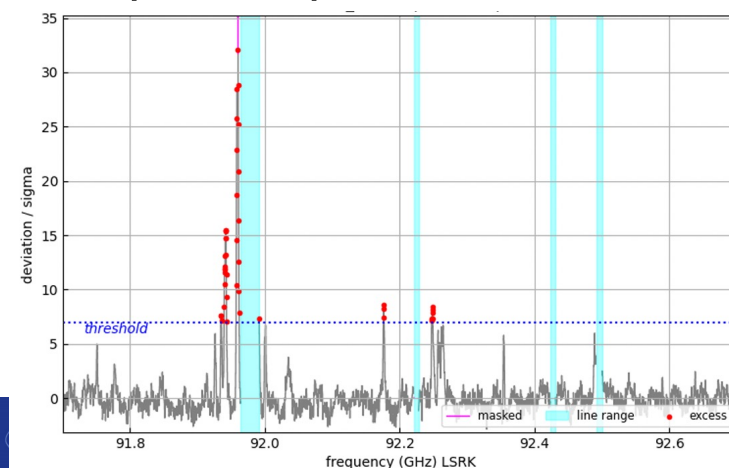
Single-Dish

- New QA scores; calibrated amplitude vs. time; residual emission in line-free channels of images
- New plots; Jy/K as a function of time; amplitude vs time
- **Allow per-spw specification of fitfunc and fitorder** (see details in [CASA guide](#))
- Bug fix; calculation of theoretical rms etc.

Analysis of difference between two polarization



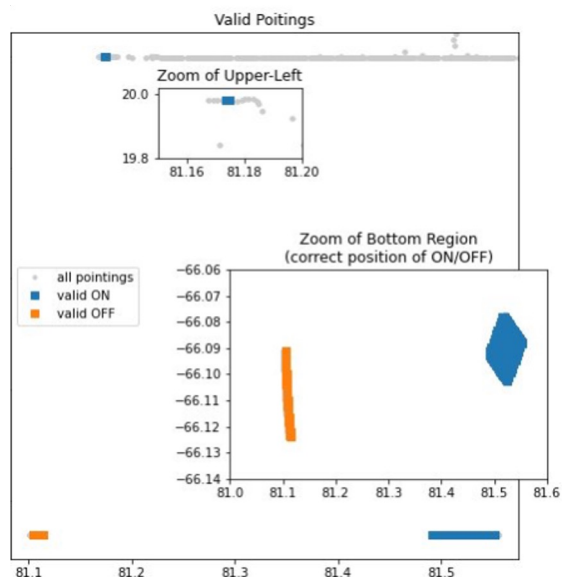
Diagnostic plot for possible missed line



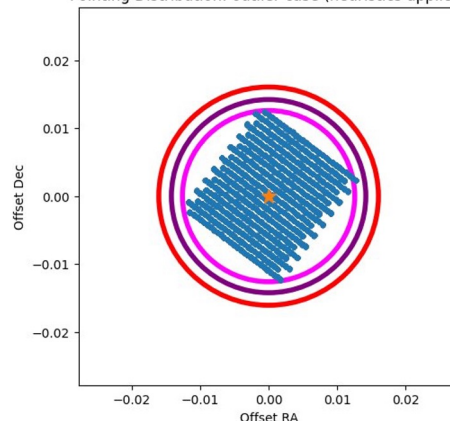


New function to flag outlier pointing data

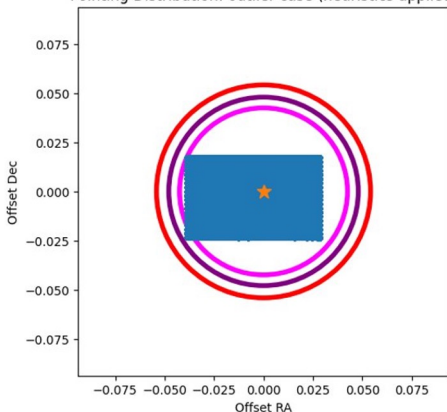
PL try to create a large map and crashed



Pointing Distribution: outlier case (heuristics applied)



Pointing Distribution: outlier case (heuristics applied)



Outside of the red circles, data points would be flagged as outliers

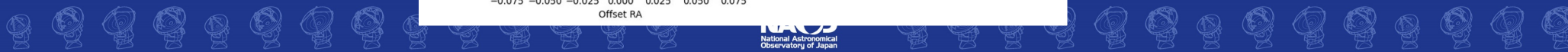
inner circle: $\text{median_dist} * \sqrt{\pi}$
middle circle: $\text{median_dist} * 2$
outer circle: $\text{median_dist} * \sqrt{13 * \pi / 8}$

QA Score: 0.83 Pointing outliers detected in "uid___A002_Xfb5463_Xfc27.ms", Field "LHA_120-N49", Antenna "PM03". Flagged time range is 2022/07/13/14:31:12.224000-2022/07/13/14:31:12.928000. Max separation from nominal field center is 86.07 deg. [All QA Scores \(2 blue, 12 green\)](#)

Score	Reason
0.89	10.79% data in uid___A002_Xfb5463_Xfc27.ms flagged by online, shadow, qa0, qa2, before and template flagging agents
0.83	Pointing outliers detected in "uid___A002_Xfb5463_Xfc27.ms", Field "LHA_120-N49", Antenna "PM03". Flagged time range is 2022/07/13/14:31:12.224000-2022/07/13/14:31:12.928000. Max separation from nominal field center is 86.07 deg.
0.97	6.79% data in uid___A002_Xfa2f45_X19140.ms flagged by online, shadow, qa0, qa2, before and template flagging agents
1.00	No pointing outliers detected in "uid___A002_Xfa2f45_X19140.ms".
0.97	6.68% data in uid___A002_Xfb5463_X49ff.ms flagged by online, shadow, qa0, qa2, before and template flagging agents
1.00	No pointing outliers detected in "uid___A002_Xfb5463_X49ff.ms".

inner circle: $\text{median_dist} * \sqrt{\pi}$
middle circle: $\text{median_dist} * 2$
outer circle: $\text{median_dist} * \sqrt{13 * \pi / 8}$

Details will be presented by Nakazato-san in SPIE





Plans of Pipeline and CASA releases in 2026

CASA 6.7

- Bug fixes and user facing issues
- Stress testing toward WSU
- (IF) **simobserve**: users can choose correlator efficiency
- (SD) Setting a new task to retrieve Jy/K data from observatory hosted database, aiming to be ready for Pipeline 2026.

Pipeline 2026

- (IF) Imaging refactor
- (TP) Implementation of sinusoidal baseline fitting
- Improve the QA scoring accuracy for efficient observations and data delivers (automation)
= Fast Feedback (FFB) project, Fast/Slow Lanes

No new development is planned for the legacy CASA and pipeline, rather efforts move to RADPS-ALMA toward the ALMA Wideband Sensitivity Upgrade (WSU) and ngVLA

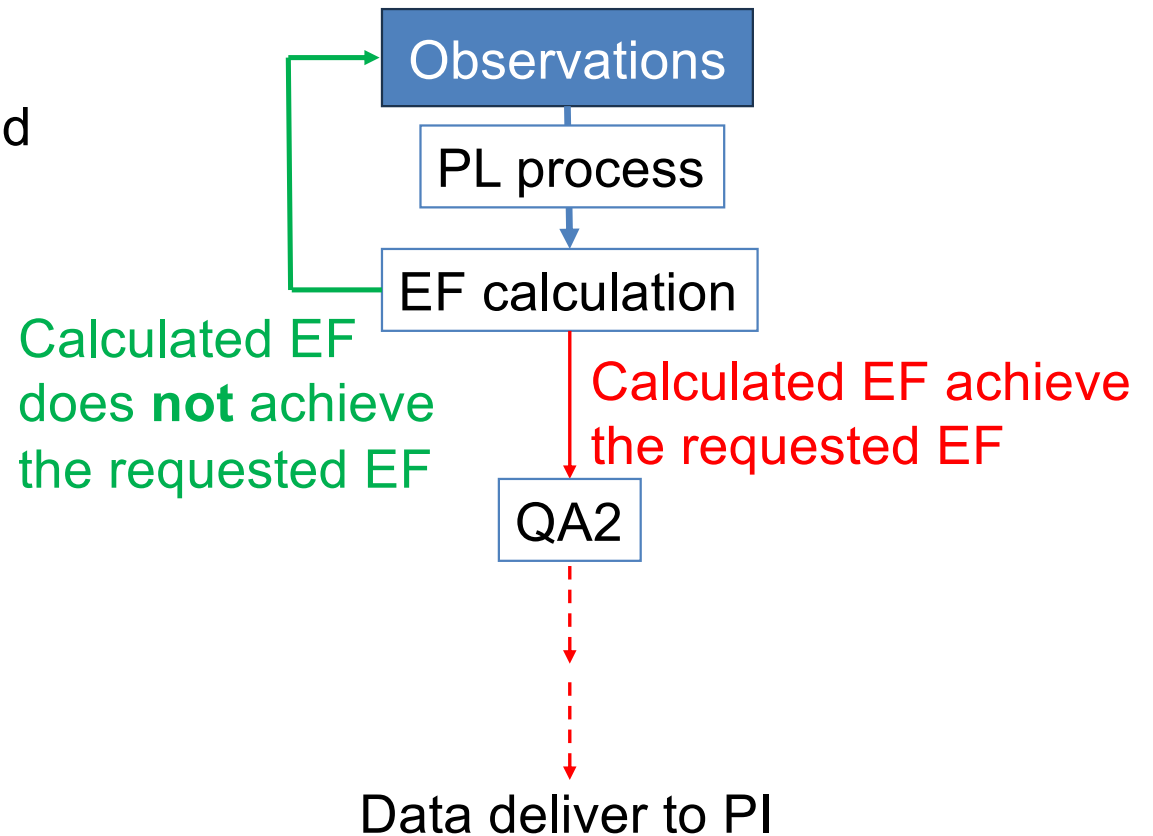




Fast Feedback

• Fast Feedback (FFB)

- ✓ Execution Fraction (EF) is calculated using PL outputs
- ✓ Obtain more accurate EF than the former calculation method
- ✓ Possibility to request additional observations when current array configuration is still in place
- ✓ Judging of necessity of additional observations becomes much faster



Under testing



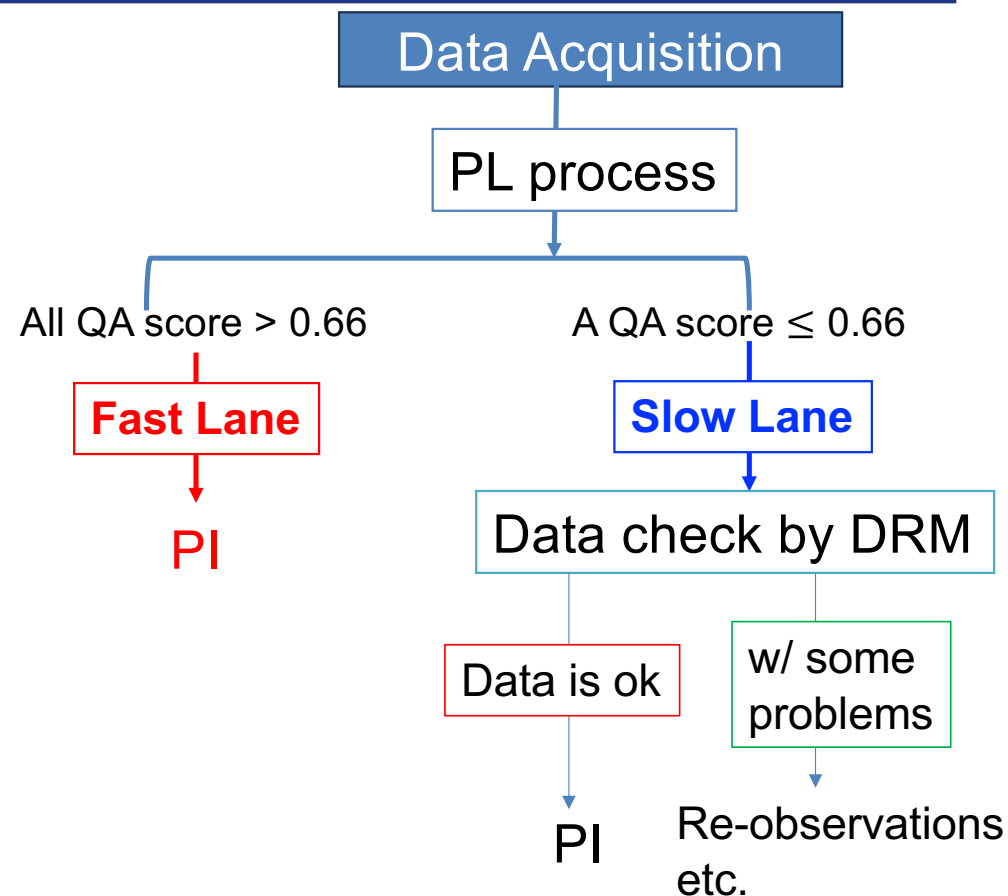


Fast/Slow Lanes Projects

- **Fast Lane/Slow Lane**

- ✓ The data will be delivered to PI without checking by DRM, if all of the QA scores are enough high judged by PL; go to Fast lane
- ✓ If the data set has a low QA score, the data will be checked by DRM; go to Slow lane
- ✓ PI can get data sooner after observations

IF is starting
TP is under statistical studies





RADPS

= Radio Astronomy Data Processing System

Primary Objective:

Develop a data processing system that supports production and use of high-level data products for ALMA-WSU and the ngVLA

Secondary Objective:

Support the continued evolution of radio astronomy data processing through a widely accessible package enabling specialization and innovation at facilities and universities

Progress:

- ✓ System Requirements Review was completed in Feb. 2025
- ✓ Prototyping is ongoing
- ✓ Preliminary Design Review is scheduled in July 2026



Thank you for your attention

