ALMA Pipeline products and restoring calibrated data

Twentieth Synthesis Imaging Workshop
15 – 22 May 2024

Atacama Large Millimeter/submillimeter Array
Expanded Very Large Array
Robert C. Byrd Green Bank Telescope
Very Long Baseline Array

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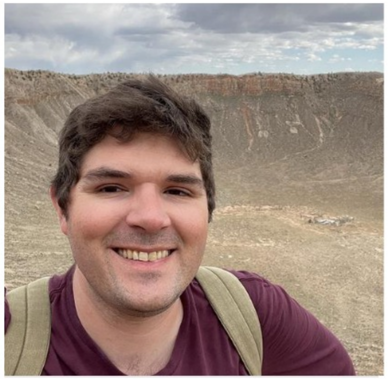

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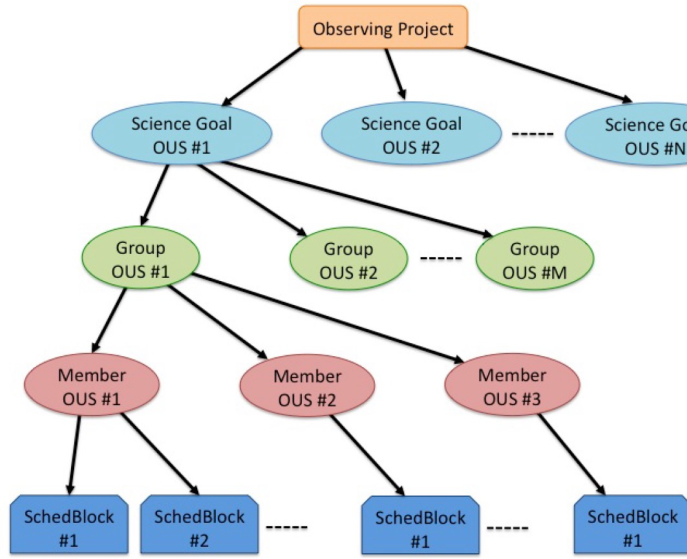
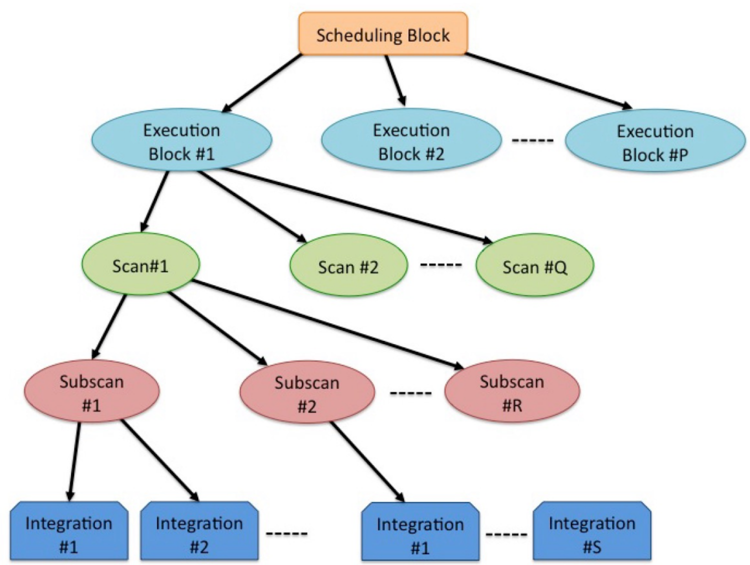
Outline

- **ALMA Data Reduction Overview**
- ALMA archive and data products
  - Download data from *Archive Query* and *Request Handler* tools on the ALMA Science Portal
  - What's in your downloaded dataset?
- Tutorial example – Review & Restore Calibration
  - ALMA Pipeline
    - The Pipeline Weblog-Calibration and Imaging Information
    - How to restore the calibrated measurement set
  - How to re-run the pipeline, if needed
  - How to re-do imaging
- Science Ready Data Products Initiative (SRDP)
  - Automated Self-Calibration

ALMA observing project hierarchy



(SB)



(EB or ASDM: ALMA Science Data Model)

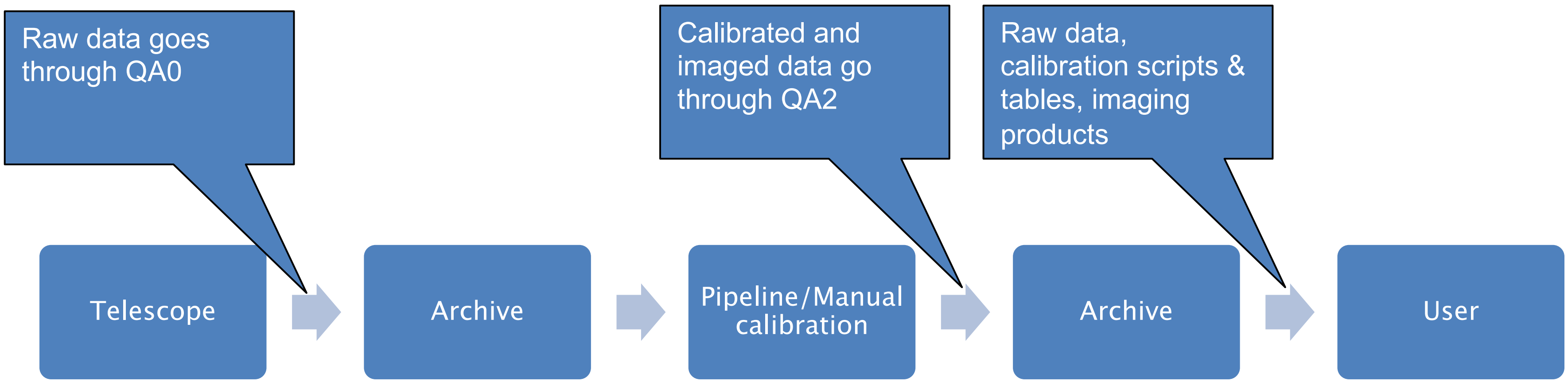
Different data reduction paths for ALMA data

- Manually calibrated and imaged (non-standard datasets, e.g. solar observations, VLBI etc.) ~2% (NA)
- Pipeline calibrated and imaged (most standard datasets) ~98% (NA) – fast lane/slow lane
- Pipeline calibrated and manually imaged (e.g. PL cannot image because the data products are too large; Full Polarization)
- Pipeline calibrated and imaged, with additional subset imaging using PL scripts (different robust, manually identified continuum)
- Each MOUS is processed separately, different MOUSes may have different data reduction paths

Obtaining calibrated measurement sets

- Archive stores only raw data, calibration tables, scripts, products, etc.
- Calibrated visibilities for PIs:
  - NA ARC: PIs get a download link through the Helpdesk (https://help.almascience.org/) once their data is delivered, with 30 days to download the file
  - EU ARC: Request through the Helpdesk
  - EA ARC: PI gets a download link
- For non-proprietary data, calibrated measurement sets can be requested through the Helpdesk at any time
- For Cycle 5 and later, NRAO's SRDP initiative (later slides)
- Download archive files and restore calibrated measurement set manually (this tutorial)

Introduction to ALMA pipeline (PL)



Introduction to ALMA pipeline (PL)

- Used to calibrate ALMA interferometric (IF) and single-dish (SD) data – has different recipes for different types of observations
- Automated calibration and imaging
- Modular calibration and imaging tasks within CASA, put together based on standard prescriptions or recipes
- Produces a WebLog – a collection of webpages with diagnostic messages, tables, figures and Quality Assurance (QA) scores
- User's guide and other useful documentation: https://almascience.nrao.edu/processing/science-pipeline

Standard interferometric calibration and imaging recipe for ALMA

```
__rethrow_casa_exceptions = True
context=h_init()
try:
   hifa_importdata(dbservice=False, vis=['uid___A002_X877e41_X452'], session=['session_1']) ## Uses flux.csv
   hifa_flagdata() ## Uses *flagtemplate.txt
   hifa_fluxcalflag()
   hif_rawflagchans()
   hif_refant()
   h_tsyscal()
   hifa_tsysflag()
   hifa_antpos() ## Uses antennapos.csv
   hifa_wvrgcalflag()
   hif_lowgainflag()
   hif_setmodels()
   hifa_bandpassflag()
   hifa_bandpass()
   hifa_spwphaseup()
   hifa_gfluxscaleflag()
   hifa_gfluxscale()
   hifa_timegaincal()
   hifa_targetflag()
   hif_applycal()
   hif_makeimlist(intent='PHASE,BANDPASS,AMPLITUDE')
   hif_makeimages()
   hif_makeimlist(per_eb=True, intent='CHECK')
   hif_makeimages()
   hifa_imageprecheck()
   hif_checkproductsize(maxproductsize=350.0, maxcubesize=40.0, maxcubelimit=60.0)
   hifa_renorm()
   hifa_exportdata()
# Start of pipeline imaging commands
   hif_mstransform()
   hifa_flagtargets() ## Uses *flagtargetstemplate.txt
   hif_makeimlist(specmode='mfs')     ## Uses cont.dat
   hif_findcont() ## Modifies cont.dat
   hif_uvcontsub()
   hif_makeimages() ## Uses cont.dat
   hif_makeimlist(specmode='cont') ## Uses cont.dat
   hif_makeimages() ## Uses cont.dat
   hif_makeimlist(specmode='cube') ## Uses cont.dat
   hif_makeimages() ## Uses cont.dat
   hif_makeimlist(specmode='refBW') ## Uses cont.dat
   hif_makeimages() ## Uses cont.dat
finally:
   h_save()
```

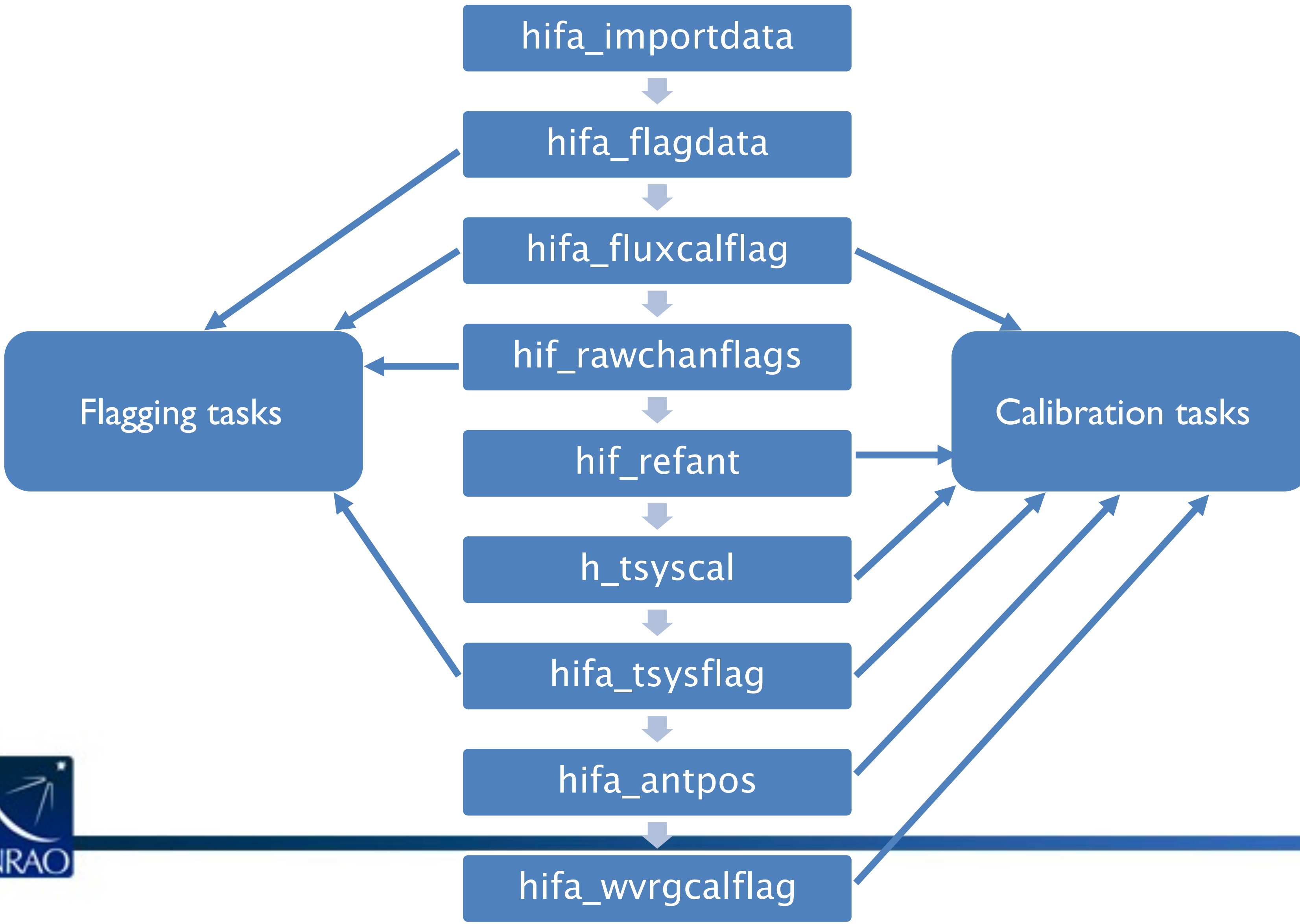
Calibration tasks;
indicates the use of pipeline helper files

Imaging tasks;
indicates the use of pipeline helper files

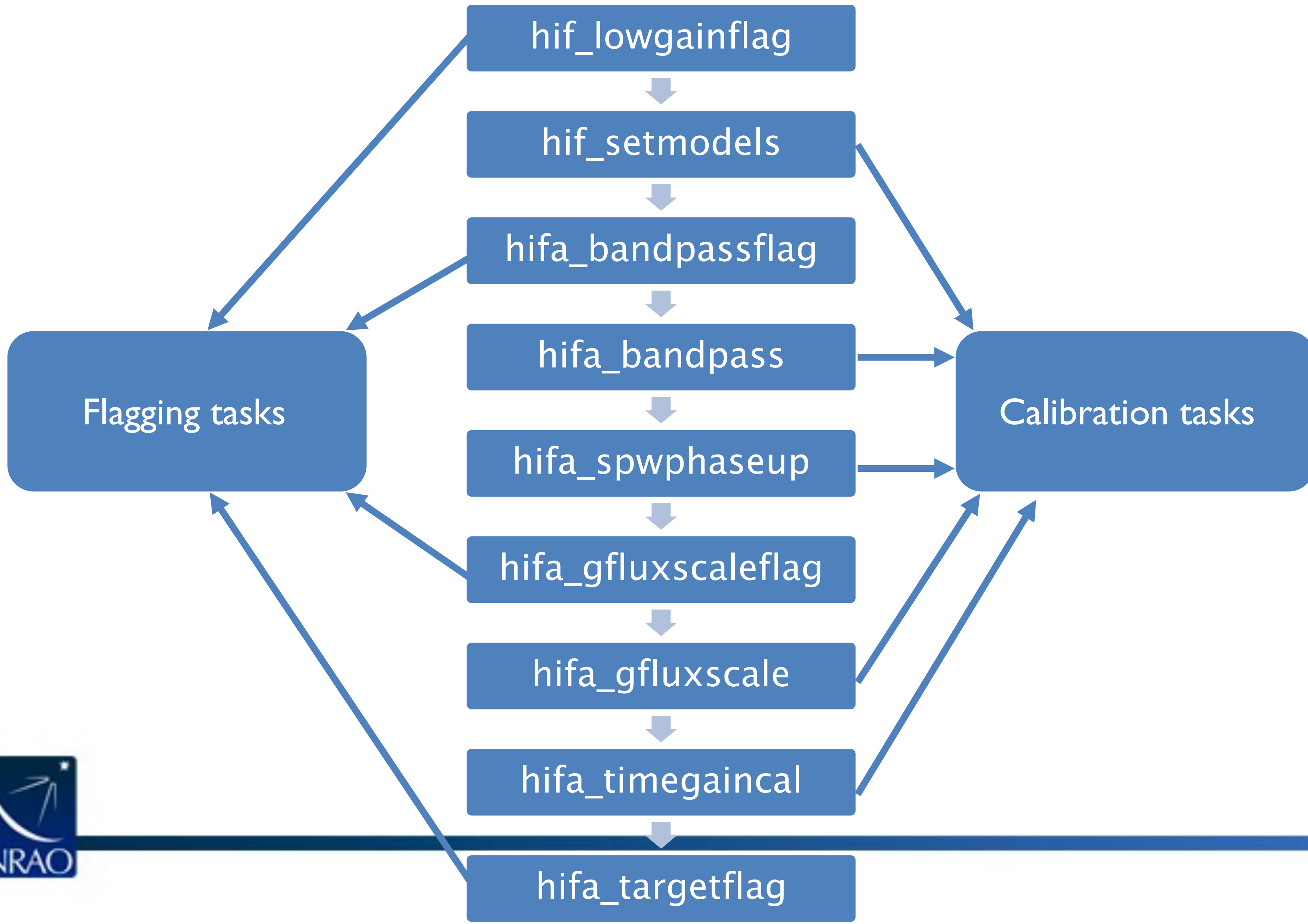
Note about pipeline tasks

- Task name examples – h_tsyscal, hif_applycal, hifa_antpos, hsd_image
- hif and hifa – interferometric tasks, hifa – ALMA, hifv – VLA
- hsd – single dish tasks
- h – common to all pipelines
- h_init – initializes pipeline, creates new pipeline context
- h_save – saves context
- h_resume – resumes specified or last context to resume pipeline run

Standard calibration recipe



Standard calibration recipe



Standard calibration recipe

hif_applycal

↓

hif_makeimlist(calibrators)

↓

hif_makeimages

↓

hif_makeimlist(check source)

↓

hif_makeimages

↓

hifa_imageprecheck

↓

hif_checkproductsize

↓

hifa_renorm

↓

hifa_exportdata

Standard imaging recipe

- hif_mstransform
- ↓
- hifa_flagtargets
- ↓
- hif_makeimlist(specmode='mfs')
- ↓
- hif_findcont
- ↓
- hif_uvcontsub
- ↓
- hif_makeimages
- ↓
- hif_makeimlist(specmode='cont')
- ↓
- hif_makeimages

Continuum subtraction

Standard imaging recipe

hif_makeimlist(specmode='cube')

↓

hif_makeimages

↓

hif_makeimlist(specmode='RefBW')

↓

hif_makeimages

↓

hif_selfcal

↓

hifa_exportdata

↓

h_save

Imaging steps repeated if Self-Cal is applied

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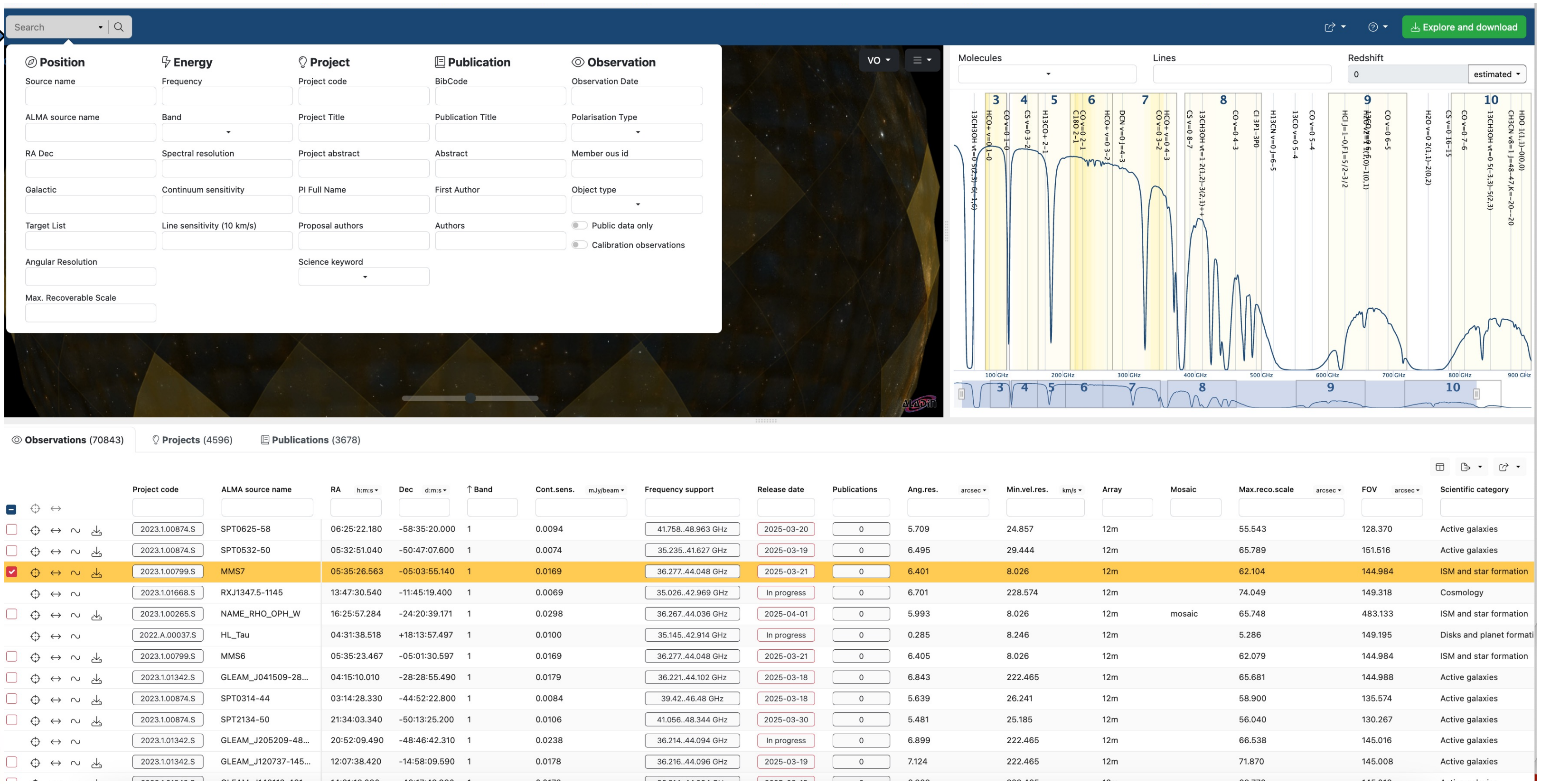
Exploring the ALMA Archive

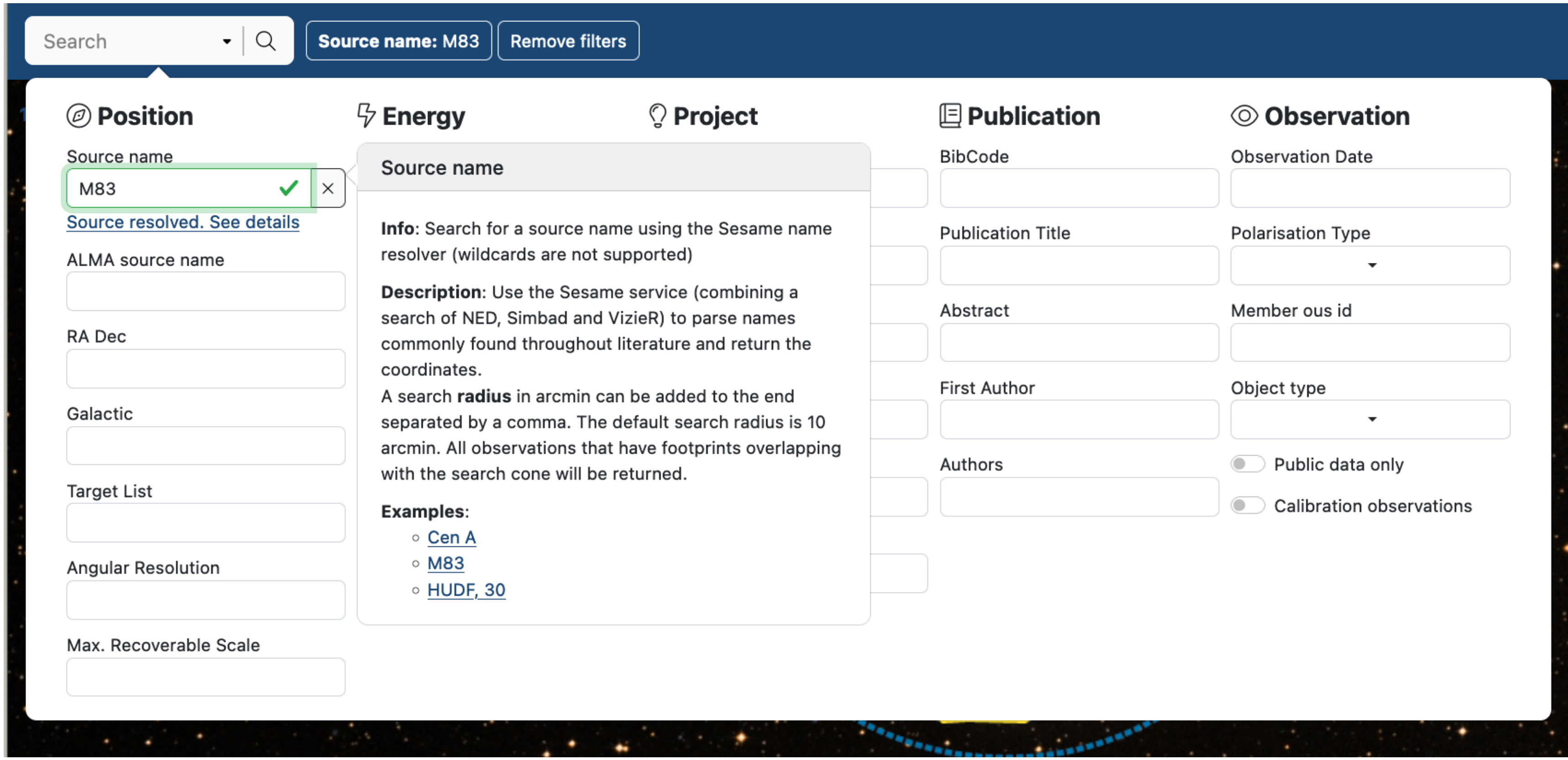
- All projects start with the ALMA Archive – proprietary or public
- New archive interface
  - http://almascience.nrao.edu/aq

Searching the Archive

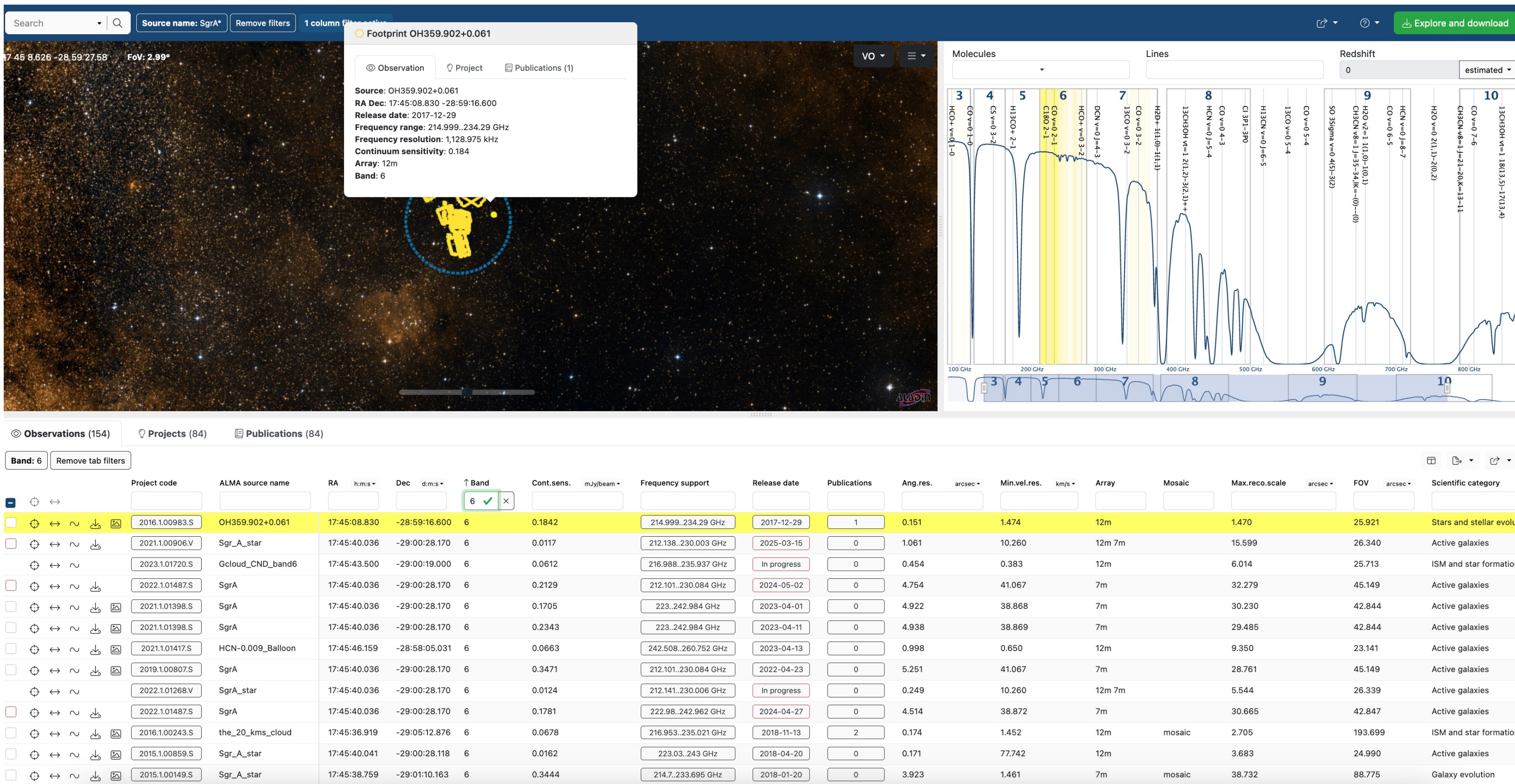
- Filter columns based on target, project, or publication
- Hover over the top left search bar for expanded search fields



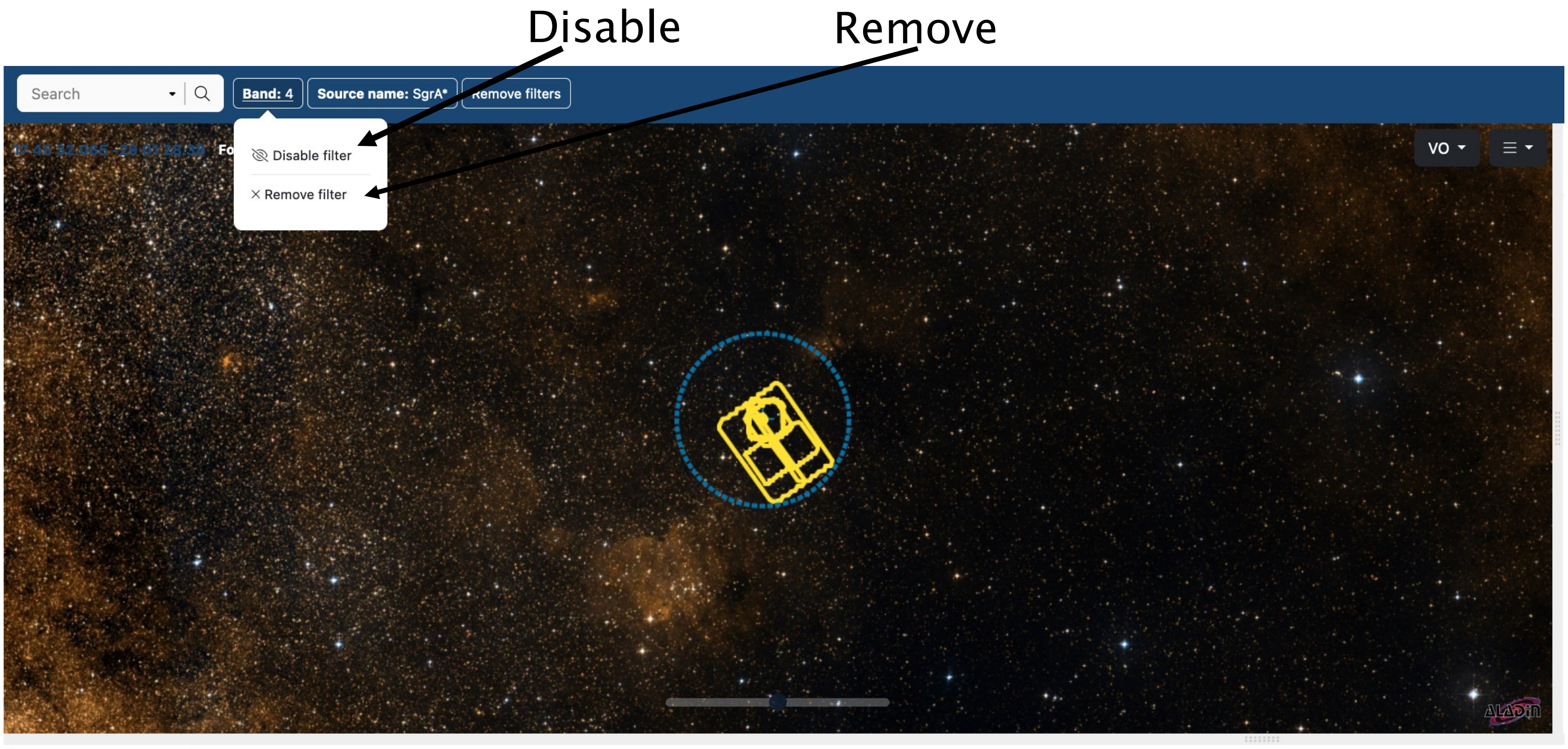
Search for your Favorite Source



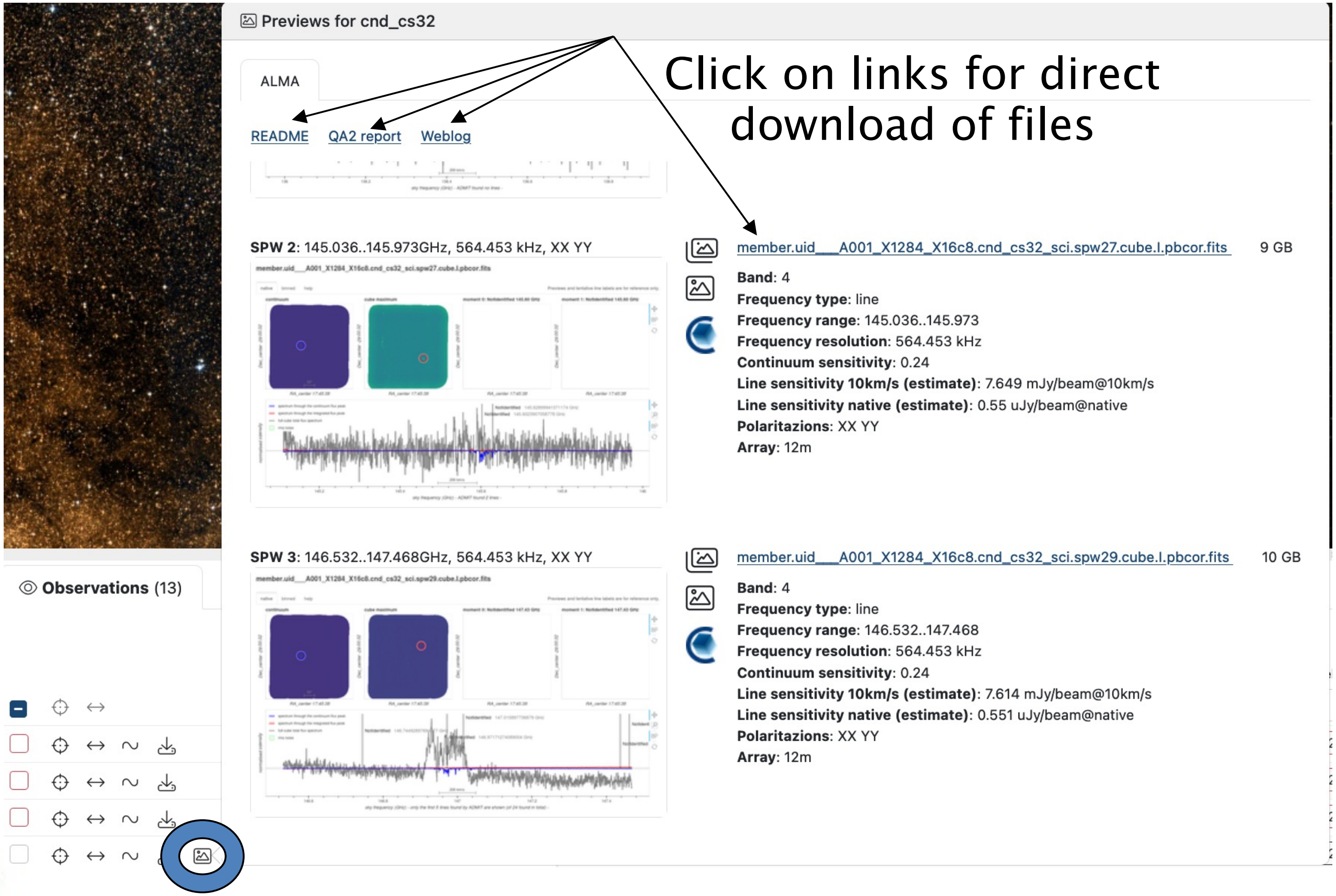
Apply Column Sub-Filters



Modify Searches



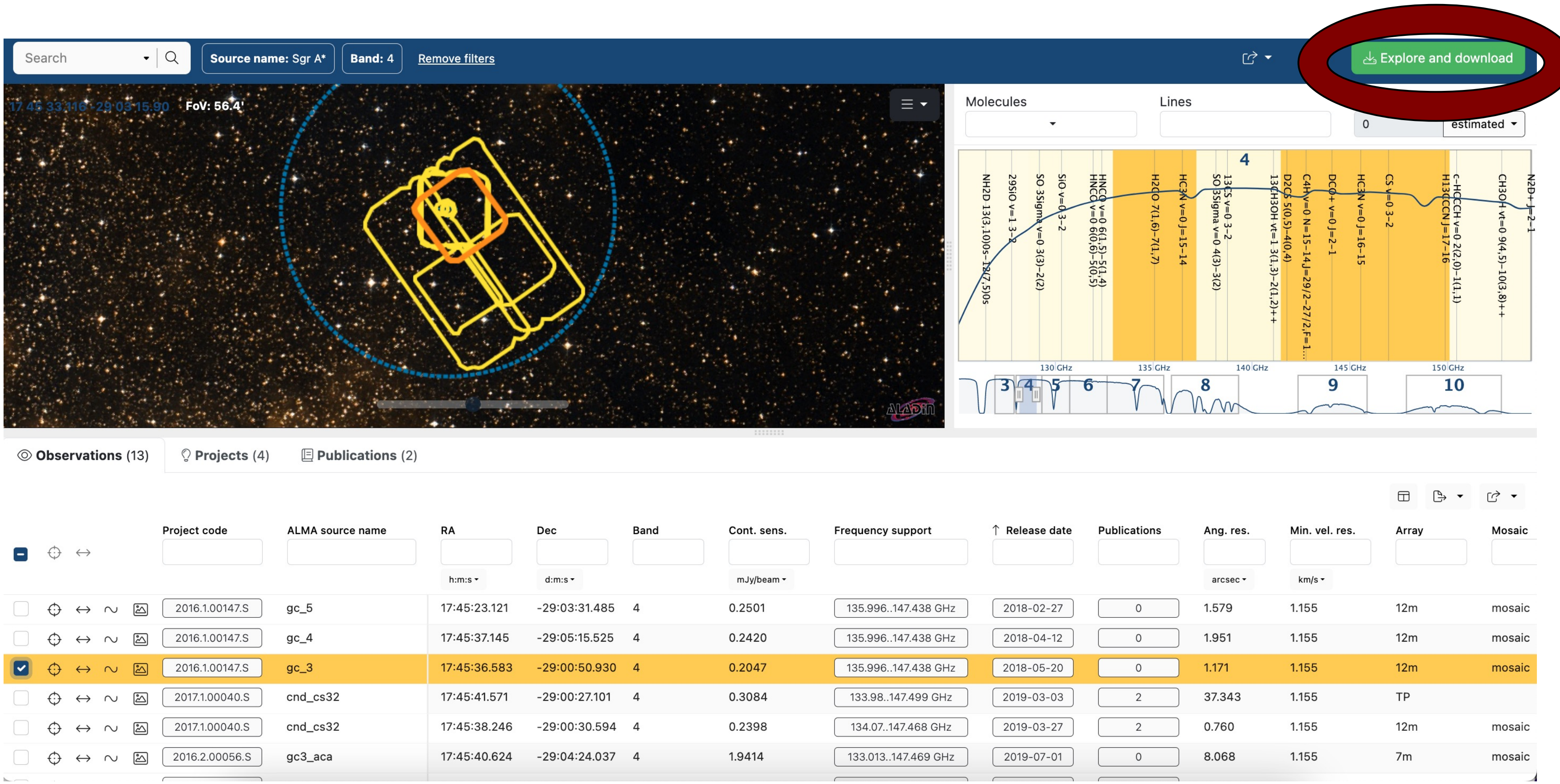
New: Quick Look Images and Spectra



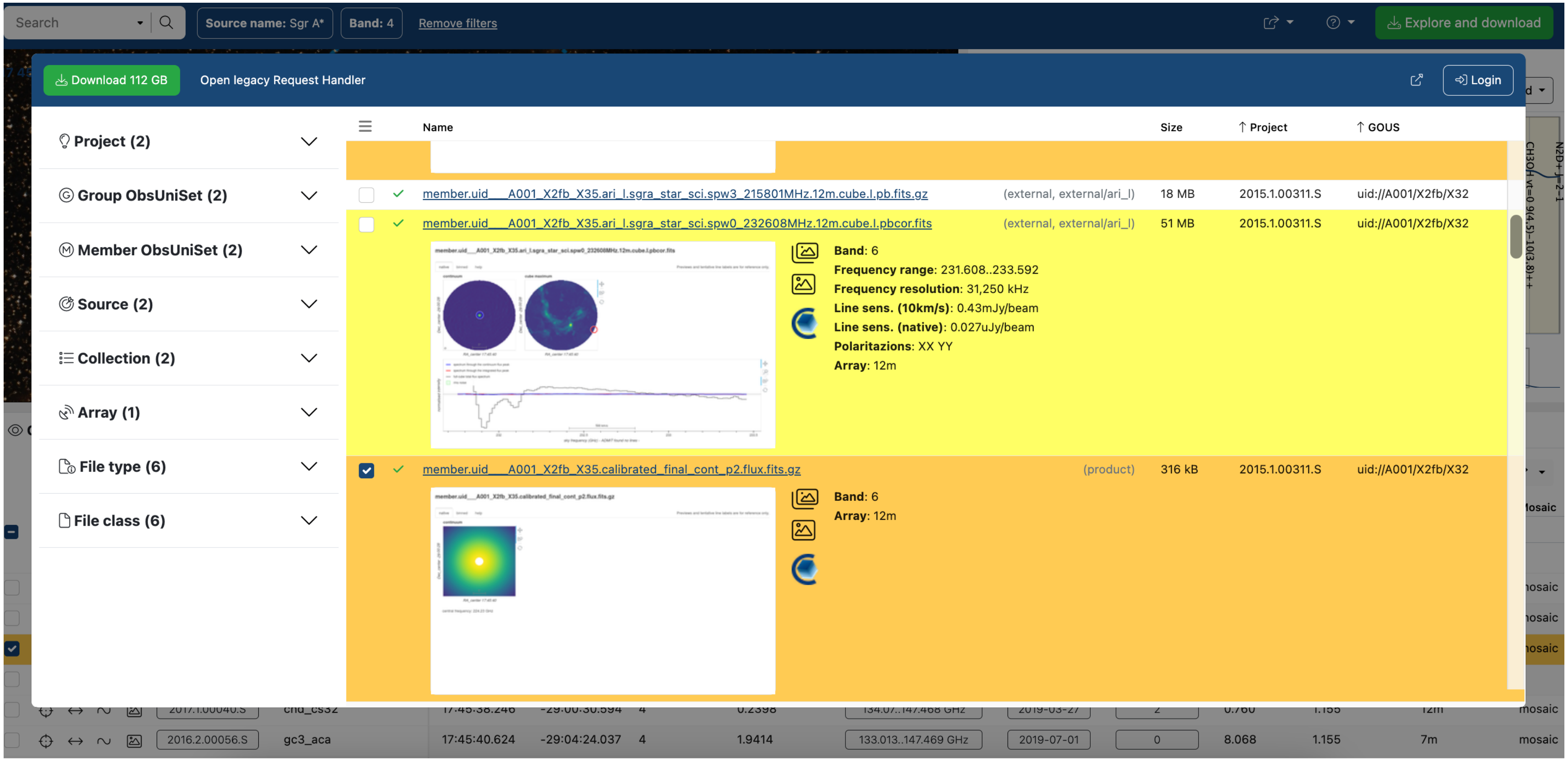
Click on links for direct download of files

Hover over for quick look

Find Data to Download



Find Data to Download



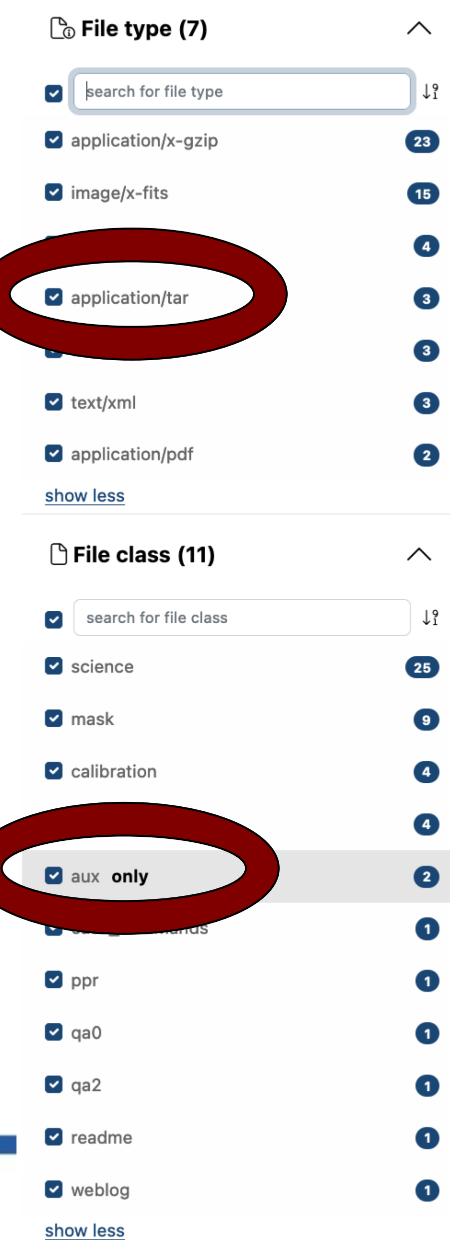
Find Data to Download

Login to download proprietary data

Select Files to Download

- Newer (Cycle 5+) individual file download available
  - Download auxiliary (contains calibration tables, scripts, etc.) and raw tar files to restore calibrated data and work with visibilities
  - Download the products for just Fits files

Select File class: aux or File Type: tar for full tar files of products and auxiliary files



QA2 Data Products Package:

Cycles 5-Present

	Name		Size	↑ Project	↑ GOUS	↑ MOUS
☐ ✓	member.uid___A001_X2d20_X1530.hifa_calimage.pldriver_report.xml	(auxiliary, script)	174 B	2022.1.01203.S	uid://A001/X2d20/X152f	uid://A001/X2d20/X1530
☑ ✓	2022.1.01203.S_uid___A001_X2d20_X1530_001_of_001.tar	(product)	159 GB	2022.1.01203.S	uid://A001/X2d20/X152f	uid://A001/X2d20/X1530
☑ ✓	2022.1.01203.S_uid___A001_X2d20_X1530_auxiliary.tar	(auxiliary)	599 MB	2022.1.01203.S	uid://A001/X2d20/X152f	uid://A001/X2d20/X1530
☐ ✓	member.uid___A001_X2d20_X1530.calimage.product_rename.txt	(auxiliary, script)	94 kB	2022.1.01203.S	uid://A001/X2d20/X152f	uid://A001/X2d20/X1530
☑ ✓	2022.1.01203.S_uid___A002_X101c3b2_Xd4e3.asdm.sdm.tar	(raw)	13 GB	2022.1.01203.S	uid://A001/X2d20/X152f	uid://A001/X2d20/X1530

Download Selected files

- Save and Run download-files.sh
  - Run with “sh download-files.sh” in a terminal
  - Re-run the script if you have connection failures
  - File a Helpdesk ticket if you encounter issues

Legacy Request Handler

- Newer (Cycle 5+) individual file download available
- Select the arrow to drop down and download individual files or download the whole tar file

Download Selected

☑ readme ☑ product ☑ auxiliary ☐ raw ☐ raw (semipass) ☐ external

Project / OUSet / Executionblock	File	Size	Accessible
Request 1652471453732			
Project 2016.1.00164.S			
Science Goal OUS uid://A001/X87a/X9fa			
Group OUS uid://A001/X87a/X9fb			
Member OUS uid://A001/X87a/X9fc			
SB M83_a_06_TM1			
☑ product	2016.1.00164.S_uid___A001_X87a_X9fc_001_of_001.tar	5.2GB	✔
☐ raw	2016.1.00164.S_uid___A002_Xbdcd3c_X13fb.asdm.sdm.tar	27.9GB	✔
Member OUS uid://A001/X87a/X9fe			
SB M83_a_06_7M			
☑ readme	member.uid___A001_X87a_X9fe.README.txt	3.4KB	✔
☑ product	2016.1.00164.S_uid___A001_X87a_X9fe_001_of_001.tar	309.7MB	✔
☑ auxiliary	2016.1.00164.S_uid___A001_X87a_X9fe_auxiliary.tar	223.6MB	✔
☐ raw	2016.1.00164.S_uid___A002_Xb8e961_X4eea.asdm.sdm.tar	1.2GB	✔
☐ raw	2016.1.00164.S_uid___A002_Xbb44e1_X192b.asdm.sdm.tar	1.3GB	✔
☐ raw	2016.1.00164.S_uid___A002_Xbc19b1_X35d9.asdm.sdm.tar	1.4GB	✔
☐ raw	2016.1.00164.S_uid___A002_Xbc4a22_X1f16.asdm.sdm.tar	1.2GB	✔
		Total: 33.6GB	

Click on "Open Legacy Request Handler for the older list view

QA2 Data Products Package:

Cycles 5-Present: Auxiliary Tarball

Tar ball

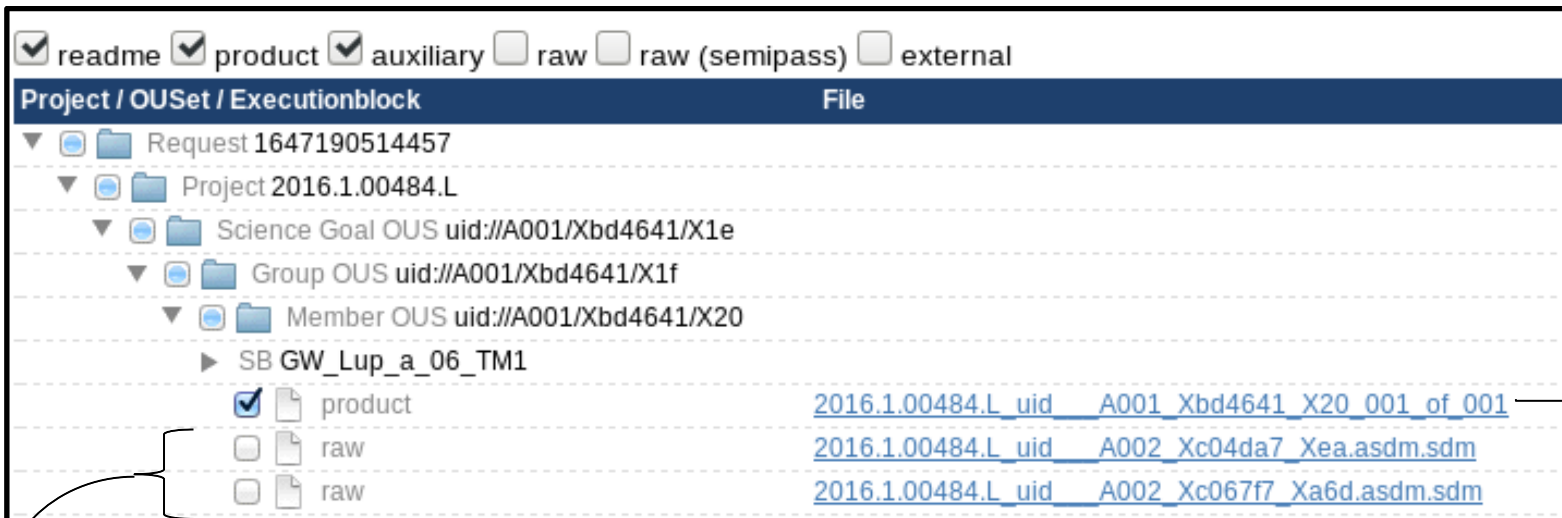
OR

Individual file download

Group OUS uid://A001/X1383/X221	
Member OUS uid://A001/X1383/X222	
SB HC672_b_06_TM1	
readme	member.uid___A001_X1383_X222.README.txt
product	2018.1.00306.S_uid___A001_X1383_X222_001_of_001.tar
auxiliary	2018.1.00306.S_uid___A001_X1383_X222_auxiliary.tar
calibration	member.uid___A001_X1383_X222.hifa_calimage.auxproducts.tgz
calibration	member.uid___A001_X1383_X222.session_1.auxcaltables.tgz
calibration	member.uid___A001_X1383_X222.session_1.caltables.tgz
calibration	uid___A002_Xd64dca_X11d3.ms.calapply.txt
calibration	uid___A002_Xd64dca_X11d3.ms.flagversions.tgz
calibration	uid___A002_Xd64dca_X11d3_target.ms.auxcalapply.txt
calibration	uid___A002_Xd64dca_X1991.ms.calapply.txt
calibration	uid___A002_Xd64dca_X1991.ms.flagversions.tgz
calibration	uid___A002_Xd64dca_X1991_target.ms.auxcalapply.txt
calibration	uid___A002_Xd64dca_X23b0.ms.calapply.txt
calibration	uid___A002_Xd64dca_X23b0.ms.flagversions.tgz
calibration	uid___A002_Xd64dca_X23b0_target.ms.auxcalapply.txt
calibration	uid___A002_Xd64dca_X2d22.ms.calapply.txt
calibration	uid___A002_Xd64dca_X2d22.ms.flagversions.tgz
calibration	uid___A002_Xd64dca_X2d22_target.ms.auxcalapply.txt
log	member.uid___A001_X1383_X222.hifa_calimage.casa_commands.log
qa	member.uid___A001_X1383_X222.hifa_calimage.weblog.tgz
qa	member.uid___A001_X1383_X222.qa2_report.html
qa	member.uid___A001_X1383_X222.qa2_report.pdf
qa	uid___A002_Xd64dca_X11d3.qa0_report.pdf
qa	uid___A002_Xd64dca_X1991.qa0_report.pdf
qa	uid___A002_Xd64dca_X23b0.qa0_report.pdf
qa	uid___A002_Xd64dca_X2d22.qa0_report.pdf
script	member.uid___A001_X1383_X222.calimage.product_rename.txt
script	member.uid___A001_X1383_X222.hifa_calimage.casa_piperestorescript.py
script	member.uid___A001_X1383_X222.hifa_calimage.casa_pipescript.py
script	member.uid___A001_X1383_X222.hifa_calimage.pipeline_manifest.xml
script	member.uid___A001_X1383_X222.hifa_calimage.pprequest.xml
script	member.uid___A001_X1383_X222.scriptForPI.py
raw	2018.1.00306.S_uid___A002_Xd64dca_X11d3.asdm.sdm
raw	2018.1.00306.S_uid___A002_Xd64dca_X1991.asdm.sdm
raw	2018.1.00306.S_uid___A002_Xd64dca_X23b0.asdm.sdm

QA2 Data Products Package:

Cycles 1-4 Packages

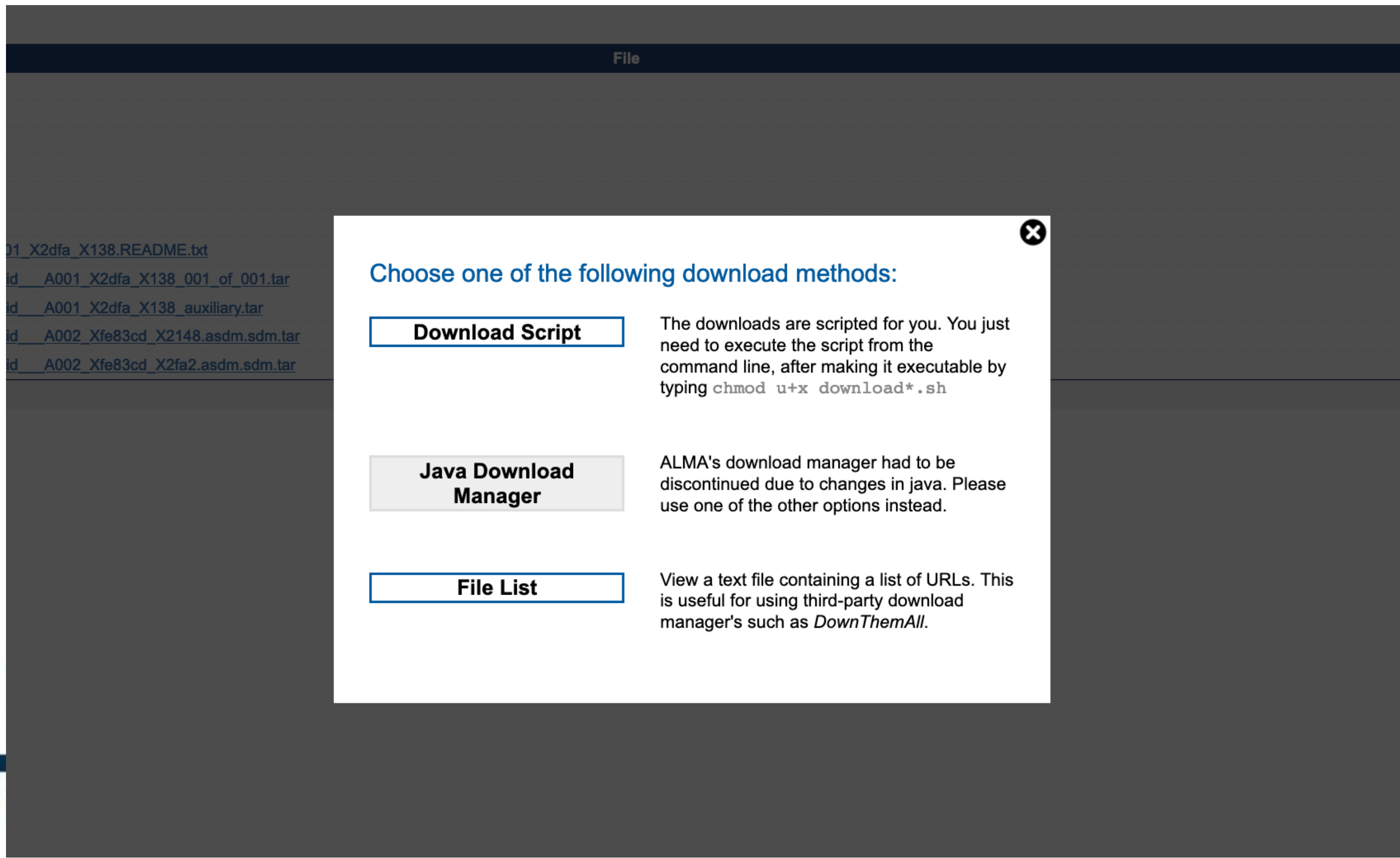


Raw data tar balls.

Tar ball with imaging products, logs, calibration tables and scripts.

Legacy Downloads

- You can either use the download script or get a file list
- The script is the same with both the legacy and new Request Handler



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QA2 Data Products Package: Directory Structure

After un-tarring the processed data we have a directory tree:

Science goal

Project code

```
2016.1.00164.S
└── science_goal.uid___A001_X87a_X9fa
    └── group.uid___A001_X87a_X9fb
        └── member.uid___A001_X87a_X9fe
            ├── calibration
            ├── product
            ├── qa
            ├── script
```

Group OUS: combination of member OUS's

Data delivery products…

Member OUS: may contain 12-m array, ALMA Compact Array (ACA), or Total Power observation

QA2 Data Products Package: Calibration directory

Pipeline Calibration Tables

```
uid___A002_Xe20b32_X84e7_target.ms.auxcalapply.txt
uid___A002_Xe20b32_X84e7.ms.flagversions.tgz
uid___A002_Xe20b32_X84e7.ms.calapply.txt
member.uid___A001_X146c_Xa2.session_1.caltables.tgz
member.uid___A001_X146c_Xa2.session_1.auxcaltables.tgz
member.uid___A001_X146c_Xa2.hifa_calimage.auxproducts.tgz
```

All flags will be restored during calibration

Contains PL helper files

```
flux.csv
antennapos.csv
cont.dat
uid___A002_Xe20b32_X84e7.flagtargetstemplate.txt
uid___A002_Xe20b32_X84e7.flagtsystemplate.txt
uid___A002_Xe20b32_X84e7.flagtemplate.txt
```

QA2 Data Products Package: Product directory

Products:

```
member.uid___A001_X87a_X9fe.M83_sci.spw16.cube.I.mask.fits.gz
member.uid___A001_X87a_X9fe.M83_sci.spw16.cube.I.pb.fits.gz
member.uid___A001_X87a_X9fe.M83_sci.spw16.cube.I.pbcor.fits
member.uid___A001_X87a_X9fe.M83_sci.spw16.mfs.I.mask.fits.gz
member.uid___A001_X87a_X9fe.M83_sci.spw16.mfs.I.pb.fits.gz
member.uid___A001_X87a_X9fe.M83_sci.spw16.mfs.I.pbcor.fits
member.uid___A001_X87a_X9fe.M83_sci.spw16_18_20_22.cont.I.mask.fits.gz
member.uid___A001_X87a_X9fe.M83_sci.spw16_18_20_22.cont.I.pb.fits.gz
member.uid___A001_X87a_X9fe.M83_sci.spw16_18_20_22.cont.I.pbcor.fits
member.uid___A001_X87a_X9fe.M83_sci.spw18.cube.I.mask.fits.gz
member.uid___A001_X87a_X9fe.M83_sci.spw18.cube.I.pb.fits.gz
member.uid___A001_X87a_X9fe.M83_sci.spw18.cube.I.pbcor.fits
member.uid___A001_X87a_X9fe.M83_sci.spw18.mfs.I.mask.fits.gz
member.uid___A001_X87a_X9fe.M83_sci.spw18.mfs.I.pb.fits.gz
member.uid___A001_X87a_X9fe.M83_sci.spw18.mfs.I.pbcor.fits
member.uid___A001_X87a_X9fe.M83_sci.spw20.cube.I.mask.fits.gz
member.uid___A001_X87a_X9fe.M83_sci.spw20.cube.I.pb.fits.gz
member.uid___A001_X87a_X9fe.M83_sci.spw20.cube.I.pbcor.fits
member.uid___A001_X87a_X9fe.M83_sci.spw20.mfs.I.mask.fits.gz
member.uid___A001_X87a_X9fe.M83_sci.spw20.mfs.I.pb.fits.gz
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member.uid___A001_X87a_X9fe.M83_sci.spw22.cube.I.mask.fits.gz
member.uid___A001_X87a_X9fe.M83_sci.spw22.cube.I.pb.fits.gz
member.uid___A001_X87a_X9fe.M83_sci.spw22.cube.I.pbcor.fits
member.uid___A001_X87a_X9fe.M83_sci.spw22.mfs.I.mask.fits.gz
member.uid___A001_X87a_X9fe.M83_sci.spw22.mfs.I.pb.fits.gz
member.uid___A001_X87a_X9fe.M83_sci.spw22.mfs.I.pbcor.fits
```

Calibration and Target images produced from QA2

QA2 Data Products Package: Cycle 4 - now

https://help.almascience.org/kb/articles/what-calibration-and-imaging-products-will-be-delivered-to-me /

Naming convention for pipeline products

Image products are named according to the following convention:

<MOUS UID>.<Source Name>_<intent>.<spectral window(s)>.<dimensionality>.<calibration type>.<stokes>.<comment>.<imagetype>.fits

MOUS UID is a string that uniquely identifies the dataset (e.g. uid___A001_X88f_X270)

<intent> is the observation intent of the source, e.g. *sci* for science target, *ph* for phase calibrator, *bp* for bandpass calibrator.

The spectral window list contains the spectral window numbers used in the product (e.g. spw17, spw17_19_21_23). The quickest way to identify which spectral window corresponds to which frequency/resolution combination is to click on the link to the measurement set on the Home page of the weblog, then to click on the "LISTOBS OUTPUT" button.

<dimensionality> is either *mfs* for multifrequency synthesis (resulting in an image with two spatial dimensions), *cont* for continuum aggregated over all spectral windows (two spatial dimensions), or *cube* for a cube with two spatial axes and a frequency/velocity axis. You may also see *tt0* and *tt1* for mfs images made using the the zeroth and first Taylor terms, respectively. The *tt0* image corresponds to the regular image, the *tt1* image is related to the spectral index image.

<calibration type> indicates if the data were self-calibrated with *.selfcal.* or not self-calibrated with . Only data imaged with the Cycle 10 pipeline and later will have this designation.

<stokes> indicates the Stokes parameter in the image (e.g., I).

<comment> can be explanatory text, usually added by a manual reducer.

<imagetype> is *pbcor* for a primary beam corrected image, *pb* for the primary beam image, *mask* for the mask image, or *sd* for single dish.

Image analysis

- ADMIT (ALMA data-mining toolkit)
  - Tools for analyzing image data cubes
  - http://admit.astro.umd.edu/
  - CASA guide: https://casaguides.nrao.edu/index.php?title=ADMIT_Products_and_Usage
- CARTA (Cube Analysis and Rendering Tool for Astronomy)
  - https://cartavis.github.io/

QA2 Data Products Package: Raw directory

If you also download and untar 2016.1.****.S_uid*.asdm.sdm.tar

```
raw
├── uid___A002_X87f18c_X116b.asdm.sdm/
├── uid___A002_X87f18c_Xed9.asdm.sdm/
├── uid___A002_X88063e_X694.asdm.sdm/
└── uid___A002_X88cee1_X4d0.asdm.sdm/
```

QA2 Data Products Package: Script directory

Pipeline Calibration Scripts:

Commands to re-run the pipeline from scratch

```
member.uid___A001_X87a_X9fe.calimage.product_rename.txt
member.uid___A001_X87a_X9fe.hifa_calimage.casa_commands.log
member.uid___A001_X87a_X9fe.hifa_calimage.casa_piperestorescript.py
member.uid___A001_X87a_X9fe.hifa_calimage.casa_pipescript.py
member.uid___A001_X87a_X9fe.hifa_calimage.pipeline_manifest.xml
member.uid___A001_X87a_X9fe.hifa_calimage.pprequest.xml
member.uid___A001_X87a_X9fe.scriptForPI.py
```

Run scriptForPI.py to restore calibration

QA2 Data Products Package: QA directory

QA reports (Cycle 6 – now) and weblog

QA0 report: Quality assurance during observations

```
uid___A002_Xe20b32_X84e7.qa0_report.pdf
member.uid___A001_X146c_Xa2.qa2_report.pdf
member.uid___A001_X146c_Xa2.qa2_report.html
member.uid___A001_X146c_Xa2.hifa_calimage.weblog.tgz
```

Calibration and/or imaging weblog

QA2 report: Quality assurance after calibration and imaging; details about calibration and imaging methods

QA2 Data Products Package: The QA2 Report (previously README)

Different format before Cycle 5

```
|-- member.uid___A001_X1299_X39.README.txt
```

Cycle 0–4

Project code: 2015.1.02572.S
PI name: Bob Hops
Project title: A first look at Space
Configuration: 0.241 km
Proposed rms:
Proposed beam size: 3.44"
CASA version: 4.7.2
Comments from Reducer:
This scheduling block was manually calibrated and imaged.
Several antennas were flagged for particularly high Tsys.
Continuum images were produced using scriptForImaging.py. They include the entire bandwidth.
Continuum:
Beam= 4.33" by 2.59"
RMS = 5.0 Jy/Beam over 7.5 GHz bandwidth

Cycle 5

You can download the AQUA quality report for these observations from SnooPI using the following URL...

https://asa.alma.cl/snoopi

If you are not on the project and need the QA2 report of the public data, submit HD ticket

Cycle 6–Now

Details about the quality of the data processing are in

qa/member.uid___A001_X135e_X8f.qa2_report.pdf (or html)

Details about the processing are in

qa/*weblog.tgz

Details about the quality of the raw data are in

qa/*qa0_report.pdf (or html)

https://help.almascience.org/kb/articles/how-are-alma-data-products-packaged

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    - What's in your downloaded dataset?
- **Tutorial example – Review & Restore Calibration**
    - ALMA Pipeline
        - The Pipeline Weblog-Calibration and Imaging Information
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    - How to re-run the pipeline, if needed
    - How to re-do imaging
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    - Automated Self-Calibration

Example dataset

- Project code: 2019.2.00028.S
- Project title: A Representative Interferometric Survey of Galaxies in the z=0 Universe with Full IFU Spectroscopic Coverage: EDGE
- PI: Alberto Bolatto
- 7m (ACA)
- Scheduling Block (SB) name: IC1528_a_06_7M
- 2 science targets
- 4 science spectral windows (spw)
- Originally processed with CASA 6.1.1.15

Exploring the dataset

- Untar the files: tar xvf *.tar (* – file name)
- Creates a directory called 2019.2.00028.S
- cd into this directory, and explore:

```
cd 2019.2.00028.S/science_goal.uid___A001_X14c3_X593/group.uid___A001_X14c3_X5e2/member.uid___A001_X14c3_X5e3/
```

- ls to list contents of directory

```
raw
product
log
qa
script
calibration
```

cd qa
ls

```
uid___A002_Xed9025_X8eb5.qa0_report.pdf
member.uid___A001_X14c3_X5e3.qa2_report.pdf
member.uid___A001_X14c3_X5e3.hifa_calimage.weblog.tgz
```

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  - **ALMA Pipeline**
    - **How to restore the calibrated measurement set**
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Restoring calibrated measurement set

- Recommend using same CASA version used in processing
- Two ways:
  - Method I: Using scriptForPI.py – for pipeline and manually reduced data – the recommended and fastest way
  - Method II: Using casa_piperestorescript.py – to restore pipeline calibrated data only, invoked by scriptForPI.py

Restoring calibrated measurement set: scriptForPI

- https://help.almascience.org/kb/articles/interferometric-calibration-and-imaging-regeneration
- Recommend using same CASA version used in processing
- But if you do want to use a newer version, inspect the measurement set carefully to make sure flags were applied correctly.
- A few known issues are posted here:
  - https://help.almascience.org/kb/articles/why-does-scriptforpi-py-crash-with-the-error-no-such-file-or-directory-rawdata-uid-a002-x12345
  - https://help.almascience.org/kb/articles/why-does-scriptforpi-py-crash-with-nameerror-name-hif-restoredata-is-not-defined
  - For new issues post a Helpdesk ticket – https://help.almascience.org/

```
cd 2019.2.00028.S/science_goal.uid___A001_X14c3_X593/group.uid___A001_X14c3_X5e2/member.uid___A001_X14c3_X5e3/
calibration/  log/          product/       qa/            raw/           script/
```

Restoring calibrated measurement set: scriptForPI

- cd into script directory
- Start the correct version of casa (casa --pipeline for PL tasks)
- Run scriptForPI.py (with spacesaving options, if needed) – execfile('member.uid___A001_X1465_X2ed7.scriptForPI.py')

```
cd script
casa -c "SPACESAVING=N; execfile('scriptForPI.py')" --pipeline
```

where N is an integer from 0 to 3 with the following meaning:

SPACESAVING	= 0	same as not set (all intermediate MSs are kept)
	= 1	do not keep intermediate MSs named *.ms.split
	= 2	do not keep intermediate MSs named *.ms and *.ms.split
	>= 3	do not keep intermediate MSs named *.ms, *.ms.split, and *.ms.split.cal (if possible)
	= -1	do not check disk space

```
cd 2019.2.00028.S/science_goal.uid___A001_X14c3_X593/group.uid___A001_X14c3_X5e2/member.uid___A001_X14c3_X5e3/
calibrated     calibration     product     qa     _     raw     script
```

Restoring calibrated measurement sets: scriptForPI - PL calibration + imaging

```
NOTICE: Exporting to images in screen resolution is currently not working.  Switching to high resolution (which is slower, but works
2024-05-02 13:26:18 INFO: Selecting representative target source IC1528 for data set uid___A002_Xed9025_X8eb5.ms
2024-05-02 13:26:20 INFO: Selecting representative target source IC1528 for data set uid___A002_Xed9025_X8eb5.ms
2024-05-02 13:26:20 INFO: Saving context: pipeline-20240502T130504.context
Imaging pipeline was used. Will not create uid___A002_Xed9025_X8eb5.ms.split.cal
Linking MS uid___A002_Xed9025_X8eb5.ms into directory "calibrated"
Done. Please find results in directory "calibrated".

CASA <2>:
```

- Results in calibrated directory, which contains:

```
products@ -> ../calibration
rawdata/
working/
uid___A002_Xed9025_X8eb5.ms@ -> working/uid___A002_Xed9025_X8eb5.ms
uid___A002_Xed9025_X8eb5.ms.flagversions@ -> working/uid___A002_Xed9025_X8eb5.ms.flagversions
```

Measurement set containing data (raw or uncalibrated) and corrected (calibrated) columns of all targets (calibrators and science targets)

```
cd 2019.2.00028.S/science_goal.uid___A001_X14c3_X593/group.uid___A001_X14c3_X5e2/member.uid___A001_X14c3_X5e3/
calibrated   calibration   log   product   qa   raw   script
products   uid___A002_Xed9025_X8eb5.ms                   working
rawdata    uid___A002_Xed9025_X8eb5.ms.flagversions
```

Restoring calibrated measurement sets: scriptForPI - PL calibration + imaging

Working directory:

```
byspw
flux.csv
pipeline-20240502T124600
pipeline-20240502T124600.context
pipeline-20240502T124600.timetracker.db
pipeline-20240502T124600.timetracker.json
pipeline-20240502T130504
pipeline-20240502T130504.context
pipeline-20240502T130504.timetracker.db
pipeline-20240502T130504.timetracker.json
uid___A002_Xed9025_X8eb5.flagonline.txt
uid___A002_Xed9025_X8eb5.flagtargetstemplate.txt
uid___A002_Xed9025_X8eb5.flagtemplate.txt
uid___A002_Xed9025_X8eb5.flagtsystemplate.txt
uid___A002_Xed9025_X8eb5.ms
uid___A002_Xed9025_X8eb5.ms.flagversions
uid___A002_Xed9025_X8eb5.ms.h_tsyscal.s6_1.tsyscal.tbl
uid___A002_Xed9025_X8eb5.ms.hifa_bandpass.s13_3.spw16_18_20_22.channel.solintinf.bcal.tbl
uid___A002_Xed9025_X8eb5.ms.hifa_spwphaseup.s14_3.spw16_18_20_22.solintinf.gpcal.tbl
uid___A002_Xed9025_X8eb5.ms.hifa_timegaincal.s17_2.spw16_18_20_22.solintinf.gpcal.tbl
uid___A002_Xed9025_X8eb5.ms.hifa_timegaincal.s17_3.spw16_18_20_22.solintint.gpcal.tbl
uid___A002_Xed9025_X8eb5.ms.hifa_timegaincal.s17_7.spw16_18_20_22.solintinf.gacal.tbl
uid___A002_Xed9025_X8eb5.ms.s1.3.callibrary
uid___A002_Xed9025_X8eb5.ms.s1.3.calstate
```

Applying Renormalization corrections

- If your dataset has not been checked for renormalization (indicated in the QA2 report or weblog)
- Run in /calibrated/working directory
- Available in CASA 6.2.1.7 and pipeline version 2021.2.0.128 and above only
- Corrections applied if renormalization factor > 2%
- Creates weblog with plots and calculated renormalization factors

```
__rethrow_casa_exceptions = True
h_init()
try:
    hifa_importdata(vis=['uid___A002_Xe3da01_X18fa.ms'], session=['session_1'], ocorr_mode='ca')
    hifa_renorm(apply=True, atm_auto_exclude=True)
    hif_mstransform(pipelinemode='automatic')
finally:
    h_save()
```

https://casaguides.nrao.edu/index.php?title=ALMA_Renormalization_Correction

Applying Renormalization corrections

- If your dataset has not been corrected for renormalization (indicated in the QA2 report or weblog)

Imaging issues: None

General info:
It is recommended that the PI carefully assess the results on the hif_findcont weblog page,
and the "line-free moment 0" images on the cube imaging weblog page.
Self-calibration was not performed.

This dataset has been checked for the so-called "renormalization issue".
A detailed description about this issue, and how the renormalization process is carried out,
can be found at the following link: https://help.almascience.org/kb/articles/what-are-the-amplitude-calibration-issues-caused-by-alma-s-normalization-strategy

The requirement of rescaling due to any astronomical lines detected in this dataset has been evaluated and the largest peak rescaling value has been estimated to be 1.360,
as displayed in the table in the hifa_renorm task of the delivered weblog. The effect of rescaling is a channel-dependent increase of the line flux, which is largest in the brightest channels.
This is not an increase in flux-scale uncertainty, but a flux offset correction. When comparing such an offset to the nominal absolute flux accuracy,
which is 5% in Bands 3, 4 & 5 and increasing to 20% in Bands 9 & 10, it is concluded that offsets up to 2% are considered negligible.
Since the rescaling factor is above this threshold, this dataset has been corrected for the above issue.

https://casaguides.nrao.edu/index.php?title=ALMA_Imaging_Pipeline_ReprocessingReprocessing

Outline

- ALMA Data Reduction Overview
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  - What's in your downloaded dataset?
- **Tutorial example – Review & Restore Calibration**
  - **ALMA Pipeline**
    - **How to restore the calibrated measurement set: Special cases**
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```
cd 2019.1.00195.L/science_goal.uid___A001_X146c_X95/group.uid___A001_X146c_X9d/member.uid___A001_X146c_Xa2/
calibrated     calibration     product     qa     _     raw     script
```

Restoring calibrated measurement sets: scriptForPI - PL calibration + Manual Imaging

calibrated directory if only calibration pipeline was run:

```
products -> ../calibration
rawdata
uid___A002_Xdd9a29_X17e0.ms.split.cal
working
```

Measurement set containing only science spectral windows (spw) of all sources

Look for scriptForImaging.py in the script directory

```
member.uid___A001_X131c_X167.scriptForPI.py
member.uid___A001_X131c_X167.scriptForImaging.py
member.uid___A001_X131c_X167.image.product_rename.txt
member.uid___A001_X131c_X167.hifa_cal.pprequest.xml
member.uid___A001_X131c_X167.hifa_cal.pipeline_manifest.xml
member.uid___A001_X131c_X167.hifa_cal.casa_pipescript.py
member.uid___A001_X131c_X167.hifa_cal.casa_piperestorescript.py
member.uid___A001_X131c_X167.hifa_cal.casa_commands.log
member.uid___A001_X131c_X167.cal.product_rename.txt
```

```
cd 2019.1.00195.L/science_goal.uid___A001_X146c_X95/group.uid___A001_X146c_X9d/member.uid___A001_X146c_Xa2/
calibrated    calibration    product    qa    raw    script
```

Restoring calibrated measurement sets: PL calibration + imaging + subset imaging

- Results of running scriptForPI.py same as that for PL calibration + imaging
- Subset imaging reasons: self-calibration, improved continuum selection, different robust parameter, etc.
- If subset imaging was done manually, look for scriptForImaging.py in script directory
- If additional subset PL imaging was done after the imaging pipeline was run, look for member.uid*.manual_imaging.tgz in the script directory

```
(base) agrellite:script dkunneri$ tar xvzf member.uid___A001_X133f_X276.manual_imaging.tgz
x products/uid___A001_X133f_X276.weblog.tgz
x scriptForImaging_PL.py
x casa-20181128-121059.log
x cont.dat
```

Additional weblog

PL imaging script

Manual continuum selection file

Restoring calibrated measurement sets: using PL script casa_piperestorescript.py

- Create **rawdata/**, **working/**, and **products/** subdirectories.
- Download the raw ASDMs from the archive and put them in **rawdata/**. Make sure the naming of the raw ALMA data is consistent with those provided in the script (e.g. if the data ends in **.asdm.sdm** then move to names which do not have this suffix).
- Copy or move ***manifest.xml, *caltables.tgz, *flagversions.tgz,** and ***calapply.txt** to **products/.**
- Copy **uid*casa_piperetorescript.py** to **casa_piperestorescript.py** to **working/.**
- In **working/,** start casa –pipeline, and execfile("casa_piperestorescript.py").

Resulting uid*.ms in working directory
For more information, refer to the user's guide:
https://almascience.nrao.edu/processing/science-pipeline

Outline

- ALMA Data Reduction Overview
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  - What's in your downloaded dataset?
- **Tutorial example – Review & Restore Calibration**
  - **ALMA Pipeline**
    - How to restore the calibrated measurement set
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After Observations – QA2

- Calibration by pipeline or DA/staff.
- Final QA checks include
  - RMS of complex antenna-based gains
  - Absolute flux calibration scale
  - T_{sys} within acceptable range
  - Proper phase transfer cadence
  - Proper bandpass corrections
- Assessment of Imaging Products
  - RMS noise and angular resolution
  - No strong artifacts
  - Performed on the reference source/spectra
- Information about QA review is aggregated for delivery in the QA2 Report

The QA2 Report (Cycle 5 to now):

QA2 Report

Project information	
Name	A Representative Interferometric Survey of Galaxies in the z=0 Universe with Full IFU Spectroscopic Coverage: EDGE
Code	2019.2.00028.S
PI	Alberto Bolatto
Organization	Department of Astronomy, Maryland, University of
Co-Is	J. Barrera-Ballesteros, L. Blitz, Y. Cao, D. Colombo, J. Cortes, H. Dannerbauer, B. Diemer, D. Fisher, G. Galaz, R. Herrera-Camus, K. Joachimi, V. Kalari, V. Kalinova, L. Lenkic, A. Leroy, Y. Leung, R. Levy, E. Ostriker, E. Rosolowsky, M. Rubio, S. Sanchez, K. Sandstrom, P. Teuben, D. Utomo, M. Valdivia Mena, G. van de Ven, B. Vila Vilaro, V. Villanueva, S. Vogel, F. Walter, T. Wong

ObsUnitSet information	
Name	Member OUS (IC1528)
QA2 Status	✔ Pass
Member OUS Status ID	uid://A001/X14c3/X5e3
SchedBlock name	IC1528_a_06_7M
SchedBlock UID	uid://A001/X14c3/X511
Array	7M
Mode	Standard
Band	ALMA_RB_06
Repr.Freq. (sky)	227.26 [GHz]
Spectral setup	ACA
Sources	IC1528, MCG-02-02-030
Other SBs in this Group OUS (Member OUS Status ID in brackets):	
Execution count	1.50 of 1 expected

Final QA2 comment

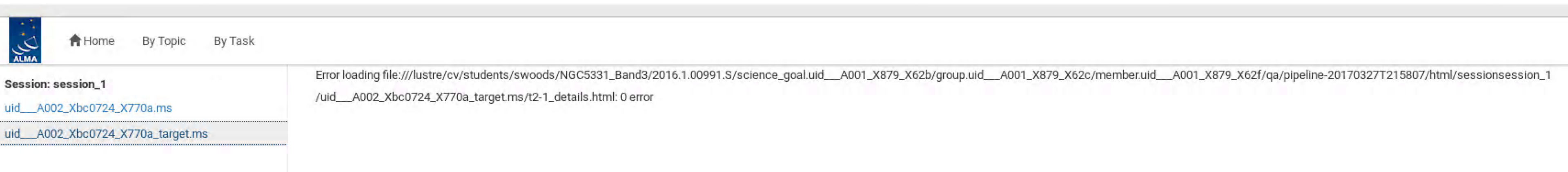
CASA version: 6.1.1.15

Reduction mode: PL calibration and imaging;

Calibration Issues: None

Open the Weblog

- We'll look at the CASA 6.5.4 PL run weblog today
- Run the command: tar -xvzf uid___A001_X1465_X2ed7.weblog.tgz
- Open pipeline-20230505T202834/html/index.html in a browser (recommend using Firefox)
- Note: If using Firefox version >= 68.0, open about:config and change "privacy.file_unique_origin" property to false or "security.fileuri.strict_origin_policy" to False if you get the following error message:



- Recommended to use h_weblog: https://help.almascience.org/kb/articles/what-is-the-best-way-to-view-the-weblog

QA directory: WebLog

Home By Topic By Task 2019.2.00028.S

Observation Overview

Project	uid://A001/X146c/X45
Principal Investigator	bolatto
OUS Status Entity id	uid://A001/X14c3/X5e3
Observation Start	2021-07-05 08:00:58 UTC
Observation End	2021-07-05 09:26:33 UTC
Number of Execution Blocks	1

Pipeline Summary

Pipeline Version	2023.1.0.125 (documentation)
CASA Version	6.5.4.9 (environment)
IERSeop2000 Version	0001.0179 (last date: 2024-02-08 00:00:00)
IERSpredict Version	0623.1511 (last date: 2024-07-06 00:00:00)
Pipeline Start	2024-04-26 18:02:56 UTC
Execution Duration	2:26:21

Observation Summary

			Time (UTC)			Baseline Length			
Measurement Set	**Receivers**	**Num Antennas**	**Start**	**End**	**On Target**	**Min**	**Max**	**RMS**	**Size**
Observing Unit Set Status: uid://A001/X14c3/X5e3 **Scheduling Block ID:** uid://A001/X14c3/X511 **Scheduling Block Name:** IC1528_a_06_7M									
Session: session_1 **ACS Version:** Unknown, **Build Version:** ONLINE-CYCLE7-B-515-2021-03-16-28-00-00									
uid___A002_Xed9025_X8eb5.ms	ALMA Band 6	9	2021-07-05 08:00:58	2021-07-05 09:26:33	0:48:13	8.9 m	45.0 m	24.6 m	2.3 GiB
uid___A002_Xed9025_X8eb5_targets.ms	ALMA Band 6	9	2021-07-05 08:24:30	2021-07-05 09:25:15	0:48:13	8.9 m	45.0 m	24.6 m	1018.6 MiB
uid___A002_Xed9025_X8eb5_targets_line.ms	ALMA Band 6	9	2021-07-05 08:24:30	2021-07-05 09:25:15	0:48:13	8.9 m	45.0 m	24.6 m	1018.6 MiB

Pipeline users guide:
https://almascience.nrao.edu/processing/science-pipeline

Outline

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Re-running the pipeline using casa_pipescript.py

```
__rethrow_casa_exceptions = True
context=h_init()
try:
  hifa_importdata(dbservice=False, vis=['uid___A002_X877e41_X452'], session=['session_1']) ## Uses flux.csv
  hifa_flagdata() ## Uses *flagtemplate.txt
  hifa_fluxcalflag()
  hif_rawflagchans()
  hif_refant()
  h_tsyscal()
  hifa_tsysflag()
  hifa_antpos() ## Uses antennapos.csv
  hifa_wvrgcalflag()
  hif_lowgainflag()
  hif_setmodels()
  hifa_bandpassflag()
  hifa_bandpass()
  hifa_spwphaseup()
  hifa_gfluxscaleflag()
  hifa_gfluxscale()
  hifa_timegaincal()
  hifa_targetflag()
  hif_applycal()
  hif_makeimlist(intent='PHASE,BANDPASS,AMPLITUDE')
  hif_makeimages()
  hif_makeimlist(per_eb=True, intent='CHECK')
  hif_makeimages()
  hifa_imageprecheck()
  hif_checkproductsize(maxproductsize=350.0, maxcubesize=40.0, maxcubelimit=60.0)
  hifa_renorm()
  hifa_exportdata()
# Start of pipeline imaging commands
  hif_mstransform()
  hifa_flagtargets() ## Uses *flagtargetstemplate.txt
  hif_makeimlist(specmode='mfs')      ## Uses cont.dat
  hif_findcont() ## Modifies cont.dat
  hif_uvcontsub()
  hif_makeimages() ## Uses cont.dat
  hif_makeimlist(specmode='cont') ## Uses cont.dat
  hif_makeimages() ## Uses cont.dat
  hif_makeimlist(specmode='cube') ## Uses cont.dat
  hif_makeimages() ## Uses cont.dat
  hif_makeimlist(specmode='refBW') ## Uses cont.dat
  hif_makeimages() ## Uses cont.dat
finally:
  h_save()
```

Calibration tasks;
indicates the use of pipeline helper files

Imaging tasks;
indicates the use of pipeline helper files

Re-running the calibration pipeline using casa_pipescript.py

- Create rawdata/, working/, and products/ subdirectories
- Copy uid*casa_pipescript.py to casa_pipescript.py in the working/ directory (edit to include PL steps you wish to repeat)
- Copy flux.csv, antennapos.csv (if present) and uid*flagtemplate.py (one flagtemplate.py per execution, modify as needed) to the working directory (found in uid*auxproducts.tgz from cycle 6-now)
- Copy raw ASDMs (rename without suffix .asdm.sdm) to rawdata/ directory
- Start CASA using casa --pipeline
- Run the script using execfile('casa_pipescript.py')

Outline

- ALMA Data Reduction Overview
- ALMA archive and data products
  - Download data from *Archive Query* and *Request Handler* tools on the ALMA Science Portal
  - What's in your downloaded dataset?
- Tutorial example – Review & Restore Calibration
  - ALMA Pipeline
    - The Pipeline Weblog–Calibration and Imaging Information
    - How to restore the calibrated measurement set
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  - **How to re-do imaging**
- Science Ready Data Products Initiative (SRDP)
  - Automated Self-Calibration

Manual Imaging following PL calibration

- Automasking Guide
  https://casaguides.nrao.edu/index.php/Automasking_Guide
- Manual imaging template available at:
  https://casaguides.nrao.edu/index.php?title=Guide_to_the_NA_Imaging_Template
- Combining multiple MOUS:
  https://casaguides.nrao.edu/index.php?title=M100_Band3_Combine_6.4
- casa_commands.log in the script directory
  - list of equivalent CASA task commands used by the PL
  - comments indicate which Pipeline stage the tasks were called from, and why
  - Imaging commands can be modified to produce new imaging products with more finely tuned inputs (e.g. interactive masks and deeper cleaning thresholds)

Pipeline Image Reprocessing

- To re-run imaging tasks also, copy uid*flagtargetstemplate.txt and cont.dat to the working/ directory
- Pipeline images are quality assessed but may not be science ready
  - All sources/spws may not be imaged (image mitigation to avoid long PL runs)
  - Change continuum selection
  - Change weighting, channel width, automasking, etc.
- For pipeline calibrated data, see https://casaguides.nrao.edu/index.php/ALMA_Imaging_Pipeline_Reprocessing
- For manually calibrated data, see https://casaguides.nrao.edu/index.php?title=ALMA_Imaging_Pipeline_Reprocessing_for_Manually_Calibrated_Data

Imaging pipeline reprocessing

- https://casaguides.nrao.edu/index.php?title=ALMA_Cycle_10_Imaging_Pipeline_Reprocessing – for examples of imaging recipes
- Common re-imaging examples:
  - Make pipeline aggregate continuum image with all channels
  - Revise continuum selection before PL continuum subtraction
  - Restore PL continuum subtraction and use channel binning for subset of spws and fields for PL imaging of cubes
  - Remake images with uvtaper

Example imaging recipe

Make Pipeline Aggregate Continuum Image With All Channels

This example moves the cont.dat file to a backup name so it is not picked up by pipeline, in which case all unflagged channels are used to make an aggregate continuum image
continuum bandwidth is possible than it identified (i.e. due to noise spikes etc).

```
## Edit the USER SET INPUTS section below and then execute
## this script (note it must be in the 'calibrated/working' directory.

import glob as glob
__rethrow_casa_exceptions = True
pipelinemode='automatic'
context = h_init()

###########################################################
## USER SET INPUTS

## Select a title for the weblog
context.project_summary.proposal_code='NEW AGGREGATE CONT'

## Delete uid*_targets.ms and flagversions if it exists
os.system('rm -rf uid*_targets.ms')
os.system('rm -rf uid*_targets.ms.flagversions')
os.system('rm -rf uid*_targets_line.ms')
os.system('rm -rf uid*_targets_line.ms.flagversions')

############################################################


## Move cont.dat to another name if it exists
os.system('mv cont.dat original.cont.dat')

## Make a list of all uv-datasets appended with *.ms
MyVis=glob.glob('*.ms')

try:
    ## Load the *.ms files into the pipeline
    hifa_importdata(vis=MyVis,dbservice=False,pipelinemode=pipelinemode)

    ## Split off the science target data into its own ms (called
    ## *targets.ms) and apply science target specific flags
    hif_mstransform(pipelinemode=pipelinemode)
    hifa_flagtargets(pipelinemode=pipelinemode)


    ## calculate the synthesized beam and estimate the sensitivity
    ## for the aggregate bandwidth and representative bandwidth
    ## for three values of the robust parameter.
    hifa_imageprecheck(pipelinemode="automatic")

    ## check the imaging product size and adjust the relevent
    ## imaging parameters (channel binning, cell size and image size)
    ## User can comment this out if they don't want size mitigation.
    hif_checkproductsize(maxproductsize=350.0, maxcubesize=40.0, maxcubelimit=60.0)

    ## Skip the continuum subtraction steps and make an aggregate
    ## continuum image with all unflagged channels (file named
    ## cont.dat should NOT be present in directory).
    hif_makeimlist(specmode='cont',pipelinemode=pipelinemode)
    hif_makeimages(pipelinemode=pipelinemode)

    ## Export new images to fits format if desired.
    hifa_exportdata(pipelinemode=pipelinemode)

finally:
    h_save()
```

Select different imaging modes

Example imaging recipe

Revise the Continuum Ranges (cont.dat) Before Pipeline Continuum Subtraction and Remake Pipeline Images

This example uses the pipeline imaging tasks to remake the pipeline imaging products for one spw (17 in the example) after manually editing the cont.dat file.

```
## Edit the cont.dat file(s) for the spw(s) you want
## to change the continuum subtraction for. In this example
## spw 17 was changed.

## Edit the USER SET INPUTS section below and then execute
## this script (note it must be in the 'calibrated/working' directory.

import glob as glob
__rethrow_casa_exceptions = True
pipelinemode='automatic'
context = h_init()

###############################################################
## USER SET INPUTS

## Select a title for the weblog
context.project_summary.proposal_code = 'NEW CONTSUB'

## Delete uid*_targets.ms and flagversions if it exists
os.system('rm -rf uid*_targets.ms')
os.system('rm -rf uid*_targets.ms.flagversions')
os.system('rm -rf uid*_targets_line.ms')
os.system('rm -rf uid*_targets_line.ms.flagversions')

## Select spw(s) that have new cont.dat parameters
## If all spws have changed use MySpw=''
MySpw='17'
###############################################################


## Make a list of all uv-datasets appended with *.ms
MyVis=glob.glob('*.ms')

try:
    ## Load the *.ms files into the pipeline
    hifa_importdata(vis=MyVis,dbservice=False,pipelinemode=pipelinemode)

    ## Split off the science target data into its own ms (called
    ## *targets.ms) and apply science target specific flags
    hif_mstransform(pipelinemode=pipelinemode)
    hifa_flagtargets(pipelinemode=pipelinemode)

    ## Fit and subtract the continuum using revised cont.dat for all spws
    hif_makeimlist(specmode='mfs',spw=MySpw)
    hif_uvcontsub(pipelinemode=pipelinemode)
    hif_makeimages(pipelinemode=pipelinemode)

    ## calculate the synthesized beam and estimate the sensitivity
    ## for the aggregate bandwidth and representative bandwidth
    ## for three values of the robust parameter
    hifa_imageprecheck(pipelinemode=pipelinemode)

    ## check the imaging product size and adjust the relevent
    ## imaging parameters (channel binning, cell size and image size)
    ## User can comment this out if they don't want size mitigation.
    hif_checkproductsize(maxproductsize=350.0, maxcubesize=40.0, maxcubelimit=60.0)

    ## Make new aggregate cont

    hif_makeimlist(specmode='cont',pipelinemode=pipelinemode)
    hif_makeimages(pipelinemode=pipelinemode)

    ## Make new continuum subtracted cube for revised spw(s)
    hif_makeimlist(specmode='cube',spw=MySpw,pipelinemode=pipelinemode)
    hif_makeimages(pipelinemode=pipelinemode)

    ## Export new images to fits format if desired.
    hifa_exportdata(pipelinemode=pipelinemode)

finally:
    h_save()
```

Select different spws

Continuum subtraction using revised selection

Example imaging recipe

Revise the Continuum Ranges (cont.dat) Before Pipeline Continuum Subtraction and Remake Pipeline Images [edit]

This example uses the pipeline imaging tasks to remake the pipeline imaging products for one spw (17 in the example) after manually editing the cont.dat file.

```
## Edit the cont.dat file(s) for the spw(s) you want
```

Home   By Topic   By Task

cont.dat

```
Field: Serpens_Main_850_00

SpectralWindow: 12
335.6109403008~335.6158234543GHz LSRK
335.6539120516~335.7418088146GHz LSRK
335.7672012128~335.7984533952GHz LSRK
335.8111495943~335.8492381916GHz LSRK
335.8638876521~335.8834202661GHz LSRK
335.9195556020~335.9508077844GHz LSRK
335.9947561659~335.9996393194GHz LSRK
336.0230784562~336.0670268377GHz LSRK
336.1070686964~336.2057083971GHz LSRK
336.2262176418~336.2633296084GHz LSRK
336.2818855917~336.3014182057GHz LSRK
336.4371698730~336.4410763958GHz LSRK
336.4723285782~336.4967443457GHz LSRK
336.5192068518~336.5416693579GHz LSRK
336.5621786026~336.6110101376GHz LSRK
336.6657014568~336.6910938550GHz LSRK
336.7028134234~336.7116030997GHz LSRK
336.7379721286~336.8141493232GHz LSRK
336.8287987837~336.8483313977GHz LSRK
336.8834901029~336.9254852230GHz LSRK
336.9743167581~337.0163118782GHz LSRK
337.0641667825~337.0836993965GHz LSRK
337.1549934376~337.1588999604GHz LSRK
```

```
    ## Export new images to fits format if desired.
    hifa_exportdata(pipelinemode=pipelinemode)

finally:
    h_save()
```

Example imaging recipe

Restore Pipeline Continuum Subtraction for Subset of SPWs and Fields and Use Channel Binning for Pipeline Imaging of Cubes

Using Pipeline Tasks

This example uses the pipeline imaging tasks to remake the cubes for a subset of spws and fields with channel binning and a more naturally-weighted Briggs robust parameter.

```
## Edit the USER SET INPUTS section below and then execute
## this script (note it must be in the 'calibrated/working' directory.

import glob as glob
__rethrow_casa_exceptions = True
pipelinemode='automatic'
context = h_init()

###############################################################
## USER SET INPUTS

## Select a title for the weblog
context.project_summary.proposal_code = 'SUBSET CUBE IMAGING'

## Delete uid*_targets.ms and flagversions if it exists
os.system('rm -rf uid*_targets.ms')
os.system('rm -rf uid*_targets.ms.flagversions')
os.system('rm -rf uid*_targets_line.ms')
os.system('rm -rf uid*_targets_line.ms.flagversions')

## Select spw(s) to image and channel binning for each spcified
## MySpw. All spws listed in MySpw must have a corresponding MyNbins
## entry, even if it is 1 for no binning.
MySpw='17,23'
MyNbins='17:8,23:2'

## Select subset of sources to image by field name.
## To select all fields, set MyFields=''
MyFields='CoolSource1,CoolSource2'

## Select Briggs Robust factor for data weighting (affects angular
## resolution of images)
MyRobust=1.5

###############################################################

## Make a list of all uv datasets appended with *.ms
MyVis=glob.glob('*.ms')

try:
    ## Load the *.ms files into the pipeline
    hifa_importdata(vis=MyVis, dbservice=False, pipelinemode=pipelinemode)

    ## Split off the science target data into its own ms (called
    ## *targets.ms) and apply science target specific flags
    ## In this example we split off all science targets and science
    ## spws, however hif_mstransform could also contain the spw and field
    ## selections
    hif_mstransform(pipelinemode=pipelinemode)
    hifa_flagtargets(pipelinemode=pipelinemode)

    ## Fit and subtract the continuum using existing cont.dat
    ## for selected spws and fields only.
    hif_makeimlist(specmode='mfs')
    hif_uvcontsub(spw=MySpw,field=MyFields,pipelinemode=pipelinemode)
    hif_makeimages(pipelinemode=pipelinemode)

    ## calculate the synthesized beam and estimate the sensitivity
    ## for the aggregate bandwidth and representative bandwidth
    ## for three values of the robust parameter.
    ## Don't need to run this task if you will use a different robust value anyway.
    ## hifa_imageprecheck(pipelinemode=pipelinemode)

    ## check the imaging product size and adjust the relevent
    ## imaging parameters (channel binning, cell size and image size)
    ## User can comment this out if they don't want size mitigation.
    hif_checkproductsize(maxproductsize=350.0, maxcubesize=40.0, maxcubelimit=60.0)

    ## Make new continuum subtracted cube for selected spw(s) and fields
    hif_makeimlist(specmode='cube',spw=MySpw,nbins=MyNbins,field=MyFields,robust=MyRobust, pipelinemode=pipelinemode)
    hif_makeimages(pipelinemode=pipelinemode)

    ## Export new images to fits format if desired.
    hifa_exportdata(pipelinemode=pipelinemode)

finally:
    h_save()
```

Select channel binning for spws, subset of sources, different weighting

Imaging pipeline reprocessing

- https://casaguides.nrao.edu/index.php?title=ALMA_Cycle_10_Imaging_Pipeline_Reprocessing – for examples of imaging recipes and instructions
- cd into calibrated/working
- Copy PL helper files cont.dat and uid*flagtargetstemplate.py from calibration/ directory to working
- Select imaging pipeline recipe, edit and save into a file, e.g. scriptForImaging.py (aggregate continuum image using all channels for a science target)
- Start casa --pipeline
- execfile('scriptForImaging.py')
- Example scriptForImaging.py available at: https://bulk.cv.nrao.edu/almadata/public/SIS2024/ALMA_Pipeline_Tutorial/

Example imaging script

```
## Edit the USER SET INPUTS section below and then execute
## this script (note it must be in the 'calibrated/working' directory.

import glob as glob
__rethrow_casa_exceptions = True
pipelinemode='automatic'
context = h_init()

###########################################################
## USER SET INPUTS

## Select a title for the weblog
context.project_summary.proposal_code = 'SUBSET CUBE IMAGING'

## Delete uid*_targets.ms and flagversions if it exists
os.system('rm -rf uid*_targets.ms')
os.system('rm -rf uid*_targets.ms.flagversions')
os.system('rm -rf uid*_targets_line.ms')
os.system('rm -rf uid*_targets_line.ms.flagversions')

## Select spw(s) to image and channel binning for each spcified
## MySpw. All spws listed in MySpw must have a corresponding MyNbins
## entry, even if it is 1 for no binning.
MySpw='16'
MyNbins='16:4'

## Select subset of sources to image by field name.
## To select all fields, set MyFields=''
MyFields='IC1528'

## Select Briggs Robust factor for data weighting (affects angular
## resolution of images)
MyRobust=1.5
```

Select spw and specify binning

Select a subset of sources

Example imaging script

```
##################################################################

## Make a list of all uv-datasets appended with *.ms
MyVis=glob.glob('*.ms')

try:
    ## Load the *.ms files into the pipeline
    hifa_importdata(vis=MyVis, dbservice=False, pipelinemode=pipelinemode)

    ## Split off the science target data into its own ms (called
    ## *targets.ms) and apply science target specific flags
    ## In this example we split off all science targets and science
    ## spws, however hif_mstransform could also contain the spw and field
    ## selections
    hif_mstransform(pipelinemode=pipelinemode)
    hifa_flagtargets(pipelinemode=pipelinemode)

    ## Fit and subtract the continuum using existing cont.dat
    ## for selected spws and fields only.
    #hif_makeimlist(specmode='mfs')
    hif_uvcontsub(spw=MySpw,field=MyFields,pipelinemode=pipelinemode)
    #hif_makeimages(pipelinemode=pipelinemode)

    ## calculate the synthesized beam and estimate the sensitivity
    ## for the aggregate bandwidth and representative bandwidth
    ## for three values of the robust parameter.
    ## Don't need to run this task if you will use a different robust value anyway.
    ## hifa_imageprecheck(pipelinemode=pipelinemode)

    ## check the imaging product size and adjust the relevent
    ## imaging parameters (channel binning, cell size and image size)
    ## User can comment this out if they don't want size mitigation.
    #hif_checkproductsize(maxproductsize=350.0, maxcubesize=40.0, maxcubelimit=60.0)

    ## Make new continuum subtracted cube for selected spw(s) and fields
    hif_makeimlist(specmode='cube',spw=MySpw,nbins=MyNbins,field=MyFields,robust=MyRobust, pipelinemode=pipelinemode)
    hif_makeimages(pipelinemode=pipelinemode)

    ## Export new images to fits format if desired.
    hifa_exportdata(pipelinemode=pipelinemode)

finally:
    h_save()
```

Make cont. subtracted cube for spw with specified robust and binning

Imaging pipeline reprocessing

- Will create:
  - new pipeline-*/html directory with weblog and casa_commands.log file
  - Images (PL imaging products are always named the same, exported to calibrated/products)
  - Calibrated MS files for each ASDM containing only science targets and spectral windows (uid*_targets.ms and uid*_targets_line.ms)
    - After hif_mstransform, the DATA column in uid*_targets.ms has calibrated continuum+line data
    - After hif_uvcontsub, the DATA column in uid*_targets_line.ms has calibrated continuum-subtracted line data

Imaging pipeline reprocessing

Home By Topic By Task SUBSET CUBE IMAGING

Tasks in execution order

1. hifa_importdata
2. hif_mstransform
3. hifa_flagtargets
4. hif_uvcontsub
5. hif_makeimlist (cube)
6. hif_makeimages (cube)
7. hifa_exportdata

5. Make image list

Set-up parameters for target cube imaging

BACK

QA Score: 1.00 All clean targets defined *All QA Scores (2 green)*

Most Severe Notification: **Warning!** Could not determine aggregate bandwidth frequency range for spw 18. Exception: Vis list ['uid___A002_Xed9025_X8eb5_targets_line.ms'] does not contain any MS with data for spw 18 *All Notifications (3)*

List of Clean Targets

field	intent	spw	data type	phasecenter	cell	imsize	imagename	specmode	nbin	robust
IC1528	TARGET	16	REGCAL_LINE_SCIENCE	ICRS 00:05:05.7090 -007.05.33.147	['0.97arcsec']	[144, 144]	oussid.sSTAGENUMBER.IC1528_sci.spw16.cube.regcal	cube	4	1.5

Clean Targets Summary

Input Parameters

Tasks Execution Statistics

Imaging pipeline reprocessing

Home | By Topic | By Task | SUBSET CUBE IMAGING

Tasks in execution order

1. hifa_importdata
2. hif_mstransform
3. hifa_flagtargets
4. hif_uvcontsub
5. hif_makeimlist (cube)
6. hif_makeimages (cube)
7. hifa_exportdata

6. Tclean/MakeImages

Make target cubes

BACK

QA Score: 0.96 MOM8 FC image for field IC1528 virtspw 16 has a peak SNR of 2.8052 and no significant flux histogram asymmetry. ***All QA Scores (2 green)***

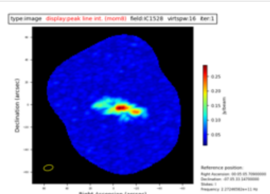
Most Severe Notification: **Warning!** Could not determine aggregate bandwidth frequency range for spw 18. Exception: Vis list ['uid___A002_Xed9025_X8eb5_targets_line.ms'] does not contain any MS with data for spw 18 ***All Notifications (3)***

In this stage, images with significant emission are cleaned to a threshold of 2 x (predicted rms noise) x (dynamic range correction factor) using automasking. If a clean mask is not found automatically, then this threshold is doubled and the bulk of the whole image is used (PB>0.3). The dynamic range correction factor (abbreviated as "DR correction") accounts for the fact that sources with a high dynamic range will typically exhibit larger imaging artifacts, resulting in a noise level greater than an equivalent blank field. The artifacts are worse for poorer UV coverage, so different dynamic range (DR) correction factors are adopted for different antenna configurations (12m Array vs. 7m Array multi-EB vs. 7m Array single-EB), and for different targets (science targets vs. calibrators). See the Pipeline User's Guide for details.

The DR correction adopted is a function of the dirty dynamic range (abbreviated as "Dirty DR"), which is defined as the peak intensity divided by the theoretical rms sensitivity delivered by the visibilities.

Image Details

Field	Spw
IC1528 (TARGET)	16 / X185299731#ALMA_RB_06#BB_1#SW-01



View other QA images...

More Pipeline Imaging Resources

- Cycle compatibility and new tool: https://casaguides.nrao.edu/index.php?title=ALMA_Imaging_Pipeline_Reprocessing_Tool

About the Imaging Pipeline Reprocessing Tool - scriptForReprocessing.py

scriptForReprocessing.py is intended to be a convenient wrapper for many of the ALMA imaging pipeline functions (including continuum subtraction) that users may wish to use on their NA delivered value-added products. See the Pipeline Users Guide and Reference Manual for a full description of the ALMA pipeline.

The script can be launched via CASA with any version of CASA that includes the ALMA pipeline from Cycle 9 or later. See the above link for a mapping of ALMA Cycle, CASA version, and Pipeline version. Thus it should be launched as:

```
$ casa --pipeline -c scriptForReprocessing.py [options]
```

- I-TRAIN #1: imaging with the ALMA Pipeline:
  - https://almascience.eso.org/tools/eu-arc-network/i-train
  - https://www.youtube.com/watch?v=Tqql8lhvyPE

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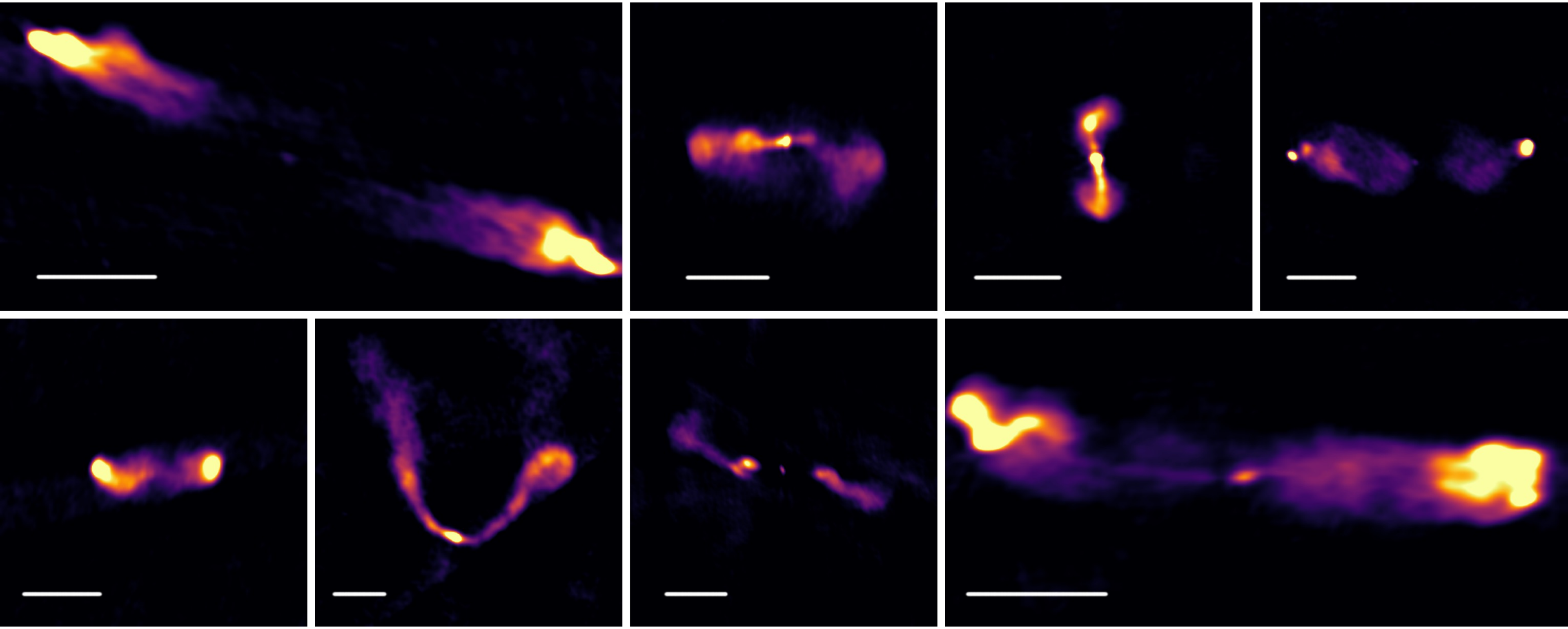
    - ALMA Pipeline
        - The Pipeline Weblog-Calibration and Imaging Information
        - How to restore the calibrated measurement set
    - How to re-run the pipeline, if needed
    - How to re-do imaging
- **Science Ready Data Products Initiative (SRDP)**
    - Automated Self-Calibration



B. Kent+NINE program

NRAO Science Ready Data Products

https://science.nrao.edu/srdp

https://data.nrao.edu/portal/#/

ALMA User-Defined Imaging (AUDI) - calibrated Measurement Set + Imaging

- Cycle 5 and beyond
- Only pipeline-calibrated data
- Users can select their own imaging parameters via a web interface
- Pipeline software will apply the calibration to the raw data, then make the image per the users' request.
- Allows the user to image the part of the cube they want, at the resolution they need.
- NEW! Automated self-calibration: https://science.nrao.edu/srdp/self-calibration-preview

https://data.nrao.edu/portal/#/

View Projects | View Observations | View

Project	Instrument	Title	Last Obs
2017.1.00236.S	ALMA	Feedi… Unive…	2018-11-28 11:09

1 execution blocks

Title: Feeding and feedback in an unbiased an…

Abstract: We will map CO(2-1)in the central 3 … om the 12?m all-sky sample. This is crucial to quantify the global AGN feeding and feedback … xy evolution. We will detect molecular outflows down to 10^5 Mo, derive outflow rates, gas res… he gravitational torques driving infall, and measure inflow rates. With the continuum map… 2 bright AGN in 27 hours which, when added to ALMA archival observations, will provide a sam… of a similarly selected sample of LINERs. The legacy value comes from combining uniform C… itable bright nearby AGN for ALMA high-resolution follow-up to dynamically constrain t…

PI: Matthew Malkan

Co-Authors: Francoise Combes, Miguel Perei… dio Ricci, Jason Glenn, Paola Michela Andreani, Masatoshi Imanishi, Matthew Malkan, Kotaro K…

MOUSes | Images

MOUS	Ob…		
ngc_2992_a_06_TM1	2017-…	Download Restored MS	Optimized Imaging

Launch Optimized Imaging on: 2017.1.00236.S

×

User Email (required):

Request Description: Request Description

Destination Directory: Specify directory *(must be logged in & staff)*

/lustre/

CASA Version: 5.4.2-8 (recommended)

SPW: spw:19 (225.392 GHz-227.330 GHz) dnu = 124995k...

Field: ngc_2992

Frequency Space | Velocity Space

Rest Frequency: GHz

Start: km/s

Width: km/s

N Channels: 8

End: km/s

Cancel | Submit Request

…National Science Foundation operated …ed Universities, Inc.

NRAO

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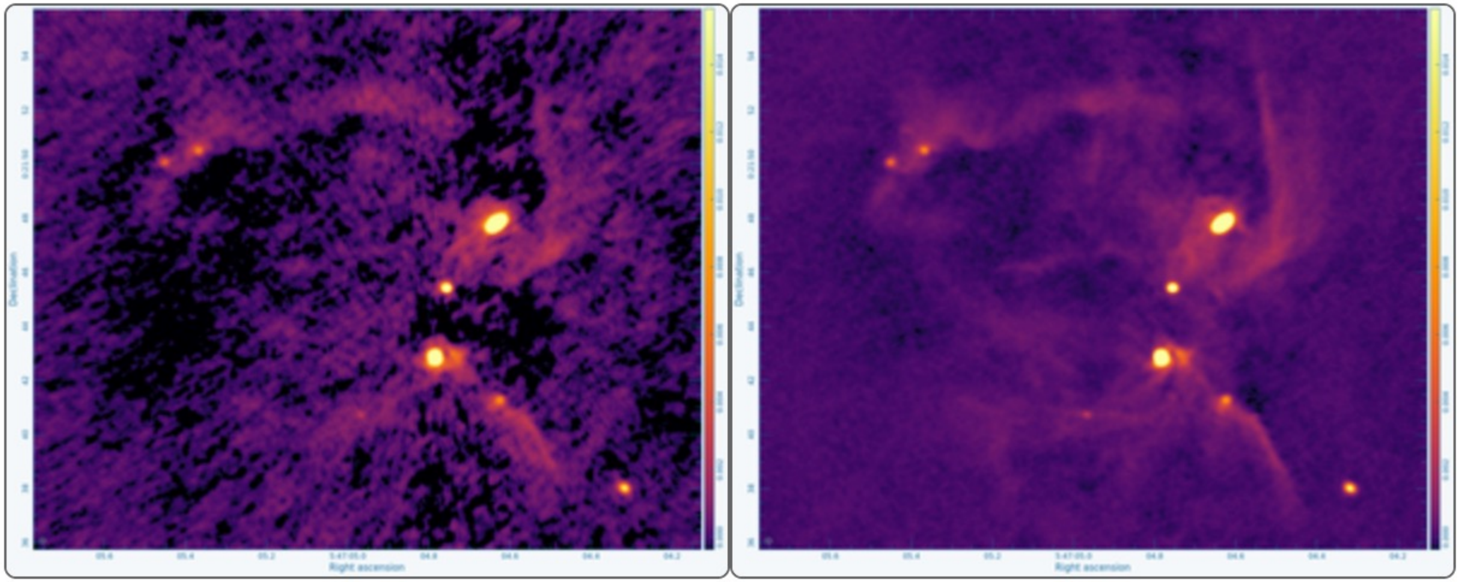
  - How to re-do imaging
- **Science Ready Data Products Initiative (SRDP)**
  - **Automated Self-Calibration**

SRDP – Self-calibration

- Currently only supports single pointing observations (non-ephemeris)
- Possible to use self-calibration with ALMA and VLA pipelines
- Used in ALMA pipeline starting Cycle 9

Example Results from Automated Self-calibration



ALMA Band 6 images of the NGC 2071 IR star forming region from ALMA project 2018.1.01038.S (Cheng et al. 2022). The *left* image is without self-calibration, while the *right* image is from the automated self-calibration within the pipeline.

Selfcal stage in ALMA Pipeline

Home | By Topic | By Task | E2E6.1.00007.S

13. hifa_bandpass
14. hifa_spwphaseup
15. hifa_gfluxscaleflag
16. hifa_gfluxscale
17. hifa_timegaincal
18. hifa_targetflag
19. hif_applycal
20. hif_makeimlist (cals)
21. hif_makeimages (cals)
22. hif_makeimlist (checksrc)
23. hif_makeimages (checksrc)
24. hifa_imageprecheck
25. hif_checkproductsize
26. hifa_renorm
27. hifa_exportdata
28. hif_mstransform
29. hifa_flagtargets
30. hif_makeimlist (mfs)
31. hif_findcont
32. hif_uvcontsub
33. hif_makeimages (mfs)
34. hif_makeimlist (cont)
35. hif_makeimages (cont)
36. hif_makeimlist (cube)
37. hif_makeimages (cube)
38. hif_makeimlist (cube_repBW)
39. hif_makeimages (cube_repBW)
40. hif_selfcal
41. hif_makeimlist (mfs)
42. hif_makeimages (mfs)
43. hif_makeimlist (cont)
44. hif_makeimages (cont)
45. hif_makeimlist (cube)
46. hif_makeimages (cube)
47. hif_makeimlist (cube_repBW)
48. hif_makeimages (cube_repBW)
49. hifa_exportdata

40. Self-Calibration

Self-calibration using the science target visibilities

BACK

QA Score: N/A

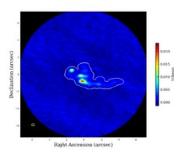
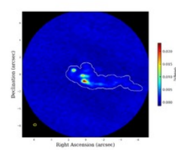
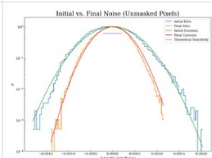
List of Self-cal Targets

Field	Band	spw	phasecenter	cell	imsize	Solints to Attempt	Success	Contline applied	Line applied
VV114-1 (rep.source)	Band 9	17,19,21,23,25,27,29,31	ICRS 01:07:47.5000 -017.30.25.000	['0.051arcsec']	[288, 288]	inf_EB, inf, 81.92s, 30.72s, 10.24s, int	✔	✔	✔

Self-calibration Target(s) Summary

Self-cal Target Details

VV114-1 Band 9 back to top | SUMMARY | PER-SOLINT DETAILS

Data Type	Initial	Final	Brightness Dist. / Ratio
Image			
Integrated Flux	210.525 ± 5.100 mJy	194.003 ± 20.567 mJy	0.922
SNR	42.715	69.203	1.620
SNR (N.F.)	42.764	69.322	1.621
RMS	0.479 mJy/bm	0.336 mJy/bm	0.700
RMS (N.F.)		0.335 mJy/bm	
Beam	0.341"x0.247" -85.906 deg	0.341"x0.247" -85.905 deg	0.999
Success / Final Solint		Yes / inf	

Selfcal stage in ALMA Pipeline

Home | By Topic | By Task

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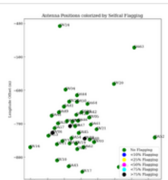
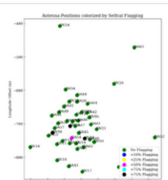
44. hif_makeimages (cont)
45. hif_makeimlist (cube)
46. hif_makeimages (cube)
47. hif_makeimlist (cube_repBW)
48. hif_makeimages (cube_repBW)
49. hifa_exportdata

Success / Final Solint	Yes / inf
Stop Reason	Estimated_SNR_too_low_for_solint 81.92s

Initial/Final Image Comparisons

Solint	inf_EB	inf	81.92s	30.72s	10.24s	int
Result	Pass QA Plots	Pass QA Plots	-			
Integrated Flux	153.578 ± 17.995 mJy	167.076 ± 16.661 mJy				
Integrated Flux Change	1.063	1.012				
Dynamic Range	53.559	59.582				
DR Improvement	1.288	1.048				
Dynamic Range (N.F.)	53.676	59.954				
DR Improvement (N.F.)	1.287	1.050				
RMS	0.420 mJy/bm	0.388 mJy/bm				
RMS Improvement	1.176	1.016				
RMS (N.F.)	0.419 mJy/bm	0.386 mJy/bm				
RMS Improvement (N.F.)	1.175	1.017				
Beam Pre	0.341"x0.247" -85.906 deg	0.341"x0.247" -85.905 deg				
Beam post						
Ratio of Beam Area	1.000	0.999				
Clean Threshold	2.401 mJy/bm	1.894 mJy/bm				
Measurement Set	uid___A002_Xd0a588_X1b32_targets.ms					
Flagged Frac. by antenna			-			

Selfcal stage in ALMA Pipeline

Home | By Topic | By Task

E2E6.1.00007.S

46. MakeImages

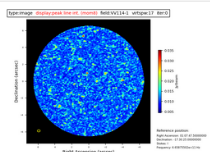
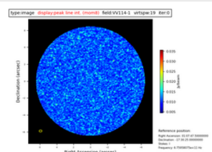
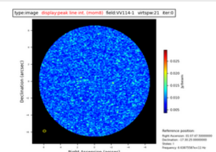
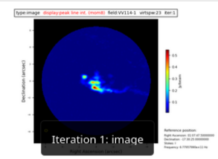
Make target cubes

BACK

QA Score: 0.99 MOM8 FC image for field VV114-1 virtspw 17 has a peak SNR of 5.8891 and no significant flux histogram asymmetry. *All QA Scores (16 green)*

In this stage, images with significant emission are cleaned to a threshold of 2 x (predicted rms noise) x (dynamic range correction factor) using automasking. If a clean mask is not found automatically, then this threshold is doubled and the bulk of the whole image is used (PB>0.3). The dynamic range correction factor (abbreviated as "DR correction") accounts for the fact that sources with a high dynamic range will typically exhibit larger imaging artifacts, resulting in a noise level greater than an equivalent blank field. The artifacts are worse for poorer UV coverage, so different dynamic range (DR) correction factors are adopted for different antenna configurations (12m Array vs. 7m Array multi-EB vs. 7m Array single-EB), and for different targets (science targets vs. calibrators). See the Pipeline User's Guide for details.
The DR correction adopted is a function of the dirty dynamic range (abbreviated as "Dirty DR"), which is defined as the peak intensity divided by the theoretical rms sensitivity delivered by the visibilities.

Image Details

Field	Spw			
VV114-1 (TARGET)	17 / X2132808557#ALMA_RB_09#BB_1#SW-01	19 / X2132808557#ALMA_RB_09#BB_1#SW-02	21 / X2132808557#ALMA_RB_09#BB_2#SW-01	23 / X2132808557#ALMA_RB_09#BB_2#SW-02
	 View other QA images...	 View other QA images...	 View other QA images...	 View other QA images...
stokes	I	I	I	I
centre / rest frequency of cube	665.8755GHz / 665.9116GHz (LSRK)	675.9581GHz / 676.0000GHz (LSRK)	663.8756GHz / 663.9116GHz (LSRK)	677.9580GHz / 678.0000GHz (LSRK)
beam	0.351 x 0.258 arcsec	0.348 x 0.254 arcsec	0.358 x 0.262 arcsec	0.351 x 0.259 arcsec
beam p.a.	-85.2deg	-84.1deg	-85.7deg	-85.5deg
final theoretical sensitivity	3.8 mJy/beam	4 mJy/beam	3.3 mJy/beam	3.9 mJy/beam
cleaning threshold	**findCont=AllCont, no cleaning** 0 Jy/beam Dirty DR: 9.1 DR correction: 1	**findCont=AllCont, no cleaning** 0 Jy/beam Dirty DR: 5.8 DR correction: 1	**findCont=AllCont, no cleaning** 0 Jy/beam Dirty DR: 6.1 DR correction: 1	19 mJy/beam Dirty DR: 1.5e+02 DR correction: 2.5

NRAO

SRDP – Self-calibration demo

- Stand-alone scripts available for use with older data
- Development version (mosaics, spectral scan, and long-baseline support): https://github.com/psheehan/auto_selfcal
- Stable version (heuristics used by current pipeline): https://github.com/jjtobin/auto_selfcal/
- Demo dataset from ALMA observatory filler project, we will use one EB from this project:

2018.A.00050.T	Sgr A* Coordinated observations with Spitzer, Chandra, NuSTAR	This project will observe the galactic center in the Band 6 or Band 7 continuum in coordination with Spitzer, Chandra, and NuStar. The ACA observations will be obtained on 3 days in July for approximately 7 hours each day. The description of the campaign is available at https://www.cfa.harvard.edu/irac/gc/.

SRDP – Self-calibration demo

- Stable version (heuristics used by current pipeline): https://github.com/jjtobin/auto_selfcal/
- Script runs on ALMA or VLA *_targets.ms file
- If cont.dat is available, performs self-cal on the continuum only
- Instructions to run from calibrated_final.ms (delivered by NA ARC) on website:

To run this code with a concatenated calibrated_final.ms that one might receive from the NA ARC, one must split out the groups of SPWs associated with the individual observations, selecting on SPW, such that one has a set of MSes with SPWs that are all the same. For example, if an MS has SPWs 0,1,2,3,10,11,12,13, and 0,1,2,3 are from the first observation and 10,11,12,13 are from the second observation, they should be split out as follows:
split(vis='my_concat.ms',spw'0,1,2,3',outputvis='my_ms_0_target.ms')
split(vis='my_concat.ms',spw'10,11,12,13',outputvis='my_ms_1_target.ms') We provide a script split_calibrated_final.py to do this automatically.

- We will start from uid*.ms file created after restore

SRDP – Self-calibration demo

- prep_data.py contains PL tasks necessary to create uid*_targets.ms from uid*.ms, creates a PL weblog

```
h_init()
hifa_importdata('uid___A002_Xdf0444_Xc22.ms')
hif_mstransform()
h_save()
```

Home By Topic By Task Project Code N/A

Task Summaries

Task		QA Score		Duration
1. **hifa_importdata**: Register measurement sets with the pipeline	Flux catalog service not used. Source.xml is the origin.		0.30	0:11:55
2. **hif_mstransform**: Create science target MS			1.00	0:02:13

CASA logs and scripts

- View, view in new tab or download casa-20240430-154713.log (87.8 KiB)
- View, view in new tab or download casa_commands.log (1.1 KiB)
- View, view in new tab or download casa_pipescript.py (123 bytes)
- View, view in new tab or download (672 bytes)

SRDP – Self-calibration demo

- Script performs phase self-calibration first and then amplitude self-calibration
- Amplitude self-cal turned off by setting the variable 'do_amp_selfcal'=False in auto_selfcal.py

Brief instructions:

1. Create an empty directory
2. Copy into this directory the *_target.ms files that have identical setups (targets and spectral windows) to be self-calibrated (must contain only the targets desired for self-calibration and only TARGET observation intents)
3. Copy cont.dat file for all targets into directory (will be used to flag out spectral lines).
4. Copy all .py files in the cloned auto_selfcal repo into your working directory
5. Run script with mpicasa -n X casa -c auto_selfcal.py; X is the number of mpi threads to use

If serial operation is desired (without mpicasa), run with casa -c auto_selfcal.py

SRDP – Self-calibration demo

- Script finds uid*_targets.ms, determines all parameters necessary for self-cal and imaging of science targets
- Outputs uid*_targets.selfcal.ms
- Outputs script 'applycal_to_orig_MSes.py', which applies self-cal solutions to original MS file so line data is also self-calibrated
- Outputs script 'uvcontsub_orig_MSes.py', if cont.dat exists, to exclude same regions for continuum fitting as were flagged for continuum self-calibration
- Summaries generated in weblog/index.html for all targets

SRDP – Self-calibration demo

SelfCal Weblog

Date Executed:2024-04-30

Targets:

SgrAstar

Bands:

Band_7

Solints to Attempt:

Band_7: inf_EB, inf, 141.12s, 40.32s, int

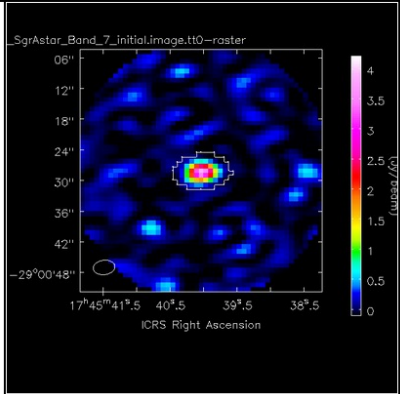
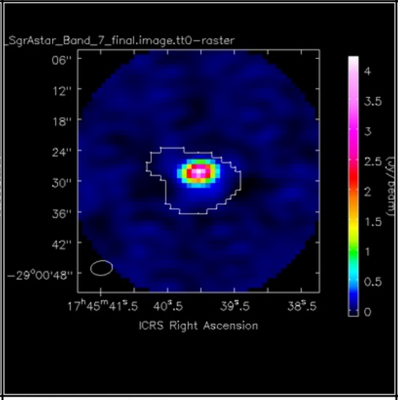
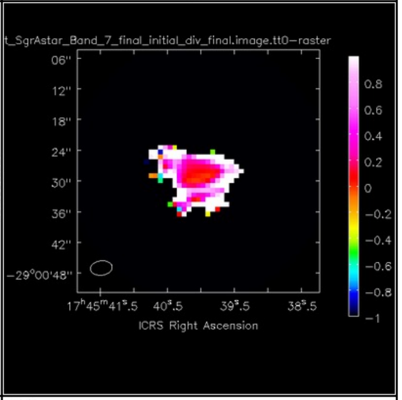
SgrAstar Summary

Back to Top

Band_7

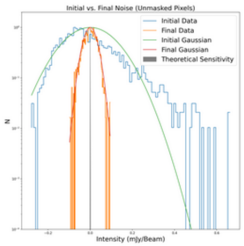
Selfcal Success?: True
Stop Reason: S/N decrease; NF S/N decrease; All sub-fields failed

Final Successful solint: 141.12s

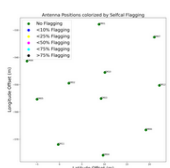
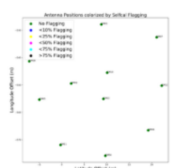
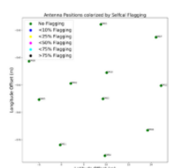
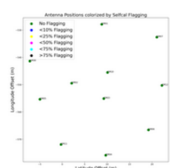
Data:	Initial	Final	Comparison
Image:			
Integrated Flux:	3303.375 +/- 434.213 mJy	4788.996 +/- 115.268 mJy	1.450
SNR:	34.450	140.123	4.067
SNR (near-field):	34.450	140.123	4.067
RMS:	113.413 mJy/beam	30.107 mJy/beam	3.767
RMS (near-field):	113.413 mJy/beam	30.107 mJy/beam	3.767
Beam:	4.276"x2.807" -82.969 deg	4.276"x2.807" -82.969 deg	1.000

SRDP – Self-calibration demo

Initial vs. Final Noise Characterization



Per solint stats:

Solint:	inf_EB	inf	141.12s	40.32s	int
Result:	Pass	Pass	Pass	Fail S/N decrease; NF S/N decrease; All sub-fields failed	-
Integrated Flux:	4190.429 +/- 167.827 mJy	4501.707 +/- 109.553 mJy	4612.355 +/- 94.540 mJy	4683.586 +/- 88.312 mJy	-
Integrated Flux Change:	1.025	1.034	0.999	0.998	-
Dynamic Range:	62.972	99.582	117.118	128.670	-
DR Improvement:	1.637	1.409	1.009	0.995	-
Dynamic Range (near-field):	62.972	99.582	117.118	128.670	-
DR Improvement (near-field):	1.637	1.409	1.009	0.995	-
RMS:	6.441e+01 mJy/bm	4.204e+01 mJy/bm	3.595e+01 mJy/bm	3.298e+01 mJy/bm	-
RMS Improvement:	1.575e+00	1.364e+00	1.004e+00	9.881e-01	-
RMS (near-field):	6.441e+01 mJy/bm	4.204e+01 mJy/bm	3.595e+01 mJy/bm	3.298e+01 mJy/bm	-
RMS Improvement (near-field):	1.575e+00	1.364e+00	1.004e+00	9.881e-01	-
Ratio of Beam Area:	1.000e+00	1.000e+00	1.000e+00	1.000e+00	-
Clean Threshold:	5.585e+02 mJy/bm	2.834e+02 mJy/bm	1.628e+02 mJy/bm	1.225e+02 mJy/bm	-
Plots:	QA Plots	QA Plots	QA Plots	QA Plots	-
Flagged solutions by antenna:					
uid___A002_Xdf0444_Xc22_targets.selfcal.ms:					-
Nsols	88	88	242	858	-
Flagged_Sols	0	0	0	0	-
Frac_Flagged	0.000	0.000	0.000	0.000	-

Per SPW stats:

Virtual SPW ID:	0	1	2	3
Virtual SPW to real SPW mapping				
uid___A002_Xdf0444_Xc22_targets.selfcal.ms:	16	18	20	22
Metadata and Statistics				
bandwidth:	2.0000 GHz	2.0000 GHz	2.0000 GHz	2.0000 GHz
effective_bandwidth:	1.0958 GHz	1.5392 GHz	0.8790 GHz	1.7599 GHz
SNR_orig:	[redacted]			
SNR_final:				
RMS_orig:				
RMS_final:				

Thank you!

Questions?