

The ALMA Archive and Data Reduction

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The ALMA Science Archive was updated within the past year. The website is <https://almascience.eso.org/asax/>. The default view shows the entire contents of the archive.

The screenshot displays the ALMA Science Archive interface. On the left, a mosaic image of a galaxy is shown with coordinates 17:45 40.041 -29 00 28.12 and a field of view (FoV) of 176.61". On the right, a spectral plot shows intensity versus frequency from 100 GHz to 900 GHz. The plot is divided into sections labeled 3 through 10, with various molecular lines identified, such as HCO+, CS, SiO, and HCN. Below the plot, a table lists observations with columns for Project code, ALMA source name, Ra, Dec, Band, Cont. sens., Frequency support, Release date, Publications, Ang. res., Min. vel. res., Array, Mosaic, Max. reco. scale, FOV, Scientific category, Science keyword, Int. Time, Gal. lon., Gal. lat., and Min. fre.

Project code	ALMA source name	Ra	Dec	Band	Cont. sens.	Frequency support	Release date	Publications	Ang. res.	Min. vel. res.	Array	Mosaic	Max. reco. scale	FOV	Scientific category	Science keyword	Int. Time	Gal. lon.	Gal. lat.	Min. fre.
2011.0.00191.S	Fomalhaut b	22:57:38.685	-29:37:12.616	7	0.118	343.08..358.84GHz	2012-12-06	2	1.015	0.816	12m		8.816	16.592	Disks and planet format...	Debris disks, Exoplanets	8709.120	20.493	-64.908	976.6
2011.0.00131.S	R Scl	01:26:58.079	-32:32:36.424	7	0.912	330.25..346.11GHz	2012-12-06	5	1.025	0.846	12m	mosaic	8.838	62.007	Stars and stellar evolut...	Asymptotic Giant Branc...	661.617	250.183	-80.589	976.6
2011.0.00101.S	GRB021004	00:26:54.680	+18:55:41.600	7	0.114	337.01..353.00GHz	2012-12-06	2	0.981	26.541	12m		7.876	16.878	Active galaxies	Starburst galaxies, Ga...	3749.760	114.917	-43.561	3125
2011.0.00397.S	J063027.81-212205...	06:30:27.810	-21:20:58.600	7	0.535	337.01..352.99GHz	2012-12-20	3	1.114	26.541	12m		7.804	16.878	Active galaxies	Active Galactic Nuclei (...)	90.720	230.024	-13.990	3125
2011.0.00397.S	J035448.24-33082...	03:54:48.240	-33:08:27.200	7	0.485	337.03..353.01GHz	2012-12-20	3	1.114	26.541	12m		7.803	16.877	Active galaxies	Active Galactic Nuclei (...)	90.720	233.094	-50.214	3125
2011.0.00397.S	J061200.23-06220...	06:12:00.230	-06:22:09.600	7	0.535	337.00..352.99GHz	2012-12-20	3	1.114	26.541	12m		7.804	16.878	Active galaxies	Active Galactic Nuclei (...)	90.720	214.169	-11.655	3125
2011.0.00397.S	J041754.10-28165...	04:17:54.100	-28:16:55.900	7	0.485	337.02..353.01GHz	2012-12-20	3	1.114	26.541	12m		7.804	16.877	Active galaxies	Active Galactic Nuclei (...)	90.720	226.951	-44.644	3125
2011.0.00397.S	J054930.06-37394...	05:49:30.060	-37:39:40.100	7	0.485	337.02..353.00GHz	2012-12-20	3	1.114	26.541	12m		7.804	16.878	Active galaxies	Active Galactic Nuclei (...)	90.720	243.321	-27.820	3125
2011.0.00397.S	J070257.20-28084...	07:02:57.200	-28:08:42.300	7	0.535	337.01..352.99GHz	2012-12-20	3	1.114	26.541	12m		7.804	16.878	Active galaxies	Active Galactic Nuclei (...)	90.720	239.481	-10.118	3125
2011.0.00397.S	J030427.53-31083...	03:04:27.530	-31:08:38.300	7	0.485	337.03..353.01GHz	2012-12-20	3	1.114	26.541	12m		7.803	16.877	Active galaxies	Active Galactic Nuclei (...)	90.720	228.860	-60.786	3125

The results table actually has three tabs:

- Observation
- Project
- Publication

ALMA Science Archive - Mozilla Firefox

File Edit View History Bookmarks Tools Help

ALMA Science Archive x +

https://almascience.eso.org/asax/

17:45 40.041 -29 00 28.12
FoV: 176.61"

The interface displays a spectral plot on the right with 10 tabs labeled 1 through 10. The plot shows intensity versus frequency from 100 GHz to 900 GHz. The left side shows a mosaic of ALMA observations of a galaxy.

Observations (44036) | **Projects (3348)** | Publications (1957)

Project Code	Project Title	Type	PI Name	↑Max. Release Date	Publications	Observations	SB names
2011.0.00236.S	The Dynamics of Massive Starless Cores	S	Tan, Jonathan	2013-01-23	4	4	Project236_ES_V2_ks
2011.0.00268.S	Metallicity of a Submillimeter Galaxy at z=5	S	Nagao, Tohru	2013-02-09	3	1	LESS J0332-2756
2011.0.00454.S	(Why) Is CenA a source of Ultra High Energy Cosmic Rays: Shock acceleration, jet and UHECR composition	S	Nagar, Neil	2013-02-14	1	6	Band 6 CenA - CO knot S1
2011.0.00851.S	The Origin of the Destroyed Minor Planet at G29-38: a Main Belt or Kuiper Belt Analog?	S	Farihi, Jay	2013-02-14	1	2	G29-38 Band 6 RA=23: Run x2, G29-38 Band 7 RA=23: Run x5
2011.0.00294.S	More than LESS: The first fully-identified submillimetre survey	S	Smail, Ian	2013-02-15	19	122	Targets1-16, Targets112-126, Targets17-32, Targets33-48, Targets49-...
2011.0.00510.S	Probing the Molecular Outflows of the Coldest Known Object in the Universe: The Boomerang Nebula	S	Sahai, Raghvendra	2013-03-13	2	2	B3 1 SB of 1 - Boomerang Nebula CO 1-0, B6 1 SB of 1 Boomerang N...
2011.0.00131.S	Piecing the shell together: ALMA and the detached shell around R Scl	S	Maercker, Matthias	2013-03-29	5	3	R Scl B3 Spec 1: Run x2, R Scl B6: Run x3, R Scl B7: Run x4
2011.0.00367.S	Outflow Entrainment in HH 46/47 v0.6	S	Mardones, Diego	2013-03-30	1	1	HH46/47 12CO HH46/47 C17O
2011.0.00808.S	Probing the vertical structure of Saturn's storm with ALMA	S	Cavalle, Thibault	2013-04-23	0	1	GROUP_1_SB: Run directly after GROUP_2_SB GROUP_2_SB: Run...
2011.0.00101.S	Shedding Light on Distant Starburst Galaxies Hosting Gamma-ray Bursts v9	S	Wang, Wei-Hao	2013-05-01	2	2	GRB021004, GRB080607

The results table actually has three tabs:

- Observation
- Project
- Publication

The screenshot displays the ALMA Science Archive interface. On the left, a spectral plot shows intensity versus frequency (100-800 GHz) with labeled peaks for various molecules and lines. On the right, a table lists publications related to the observations.

Observations (44036) | Projects (3348) | Publications (1957)

BibCode	First Author	Journal	Year	Publication Title	Max. Release Date	Projects	Observations	Authors
2013ApJ...779...96T	Tan, Jonathan C.	ApJ	2013	The Dynamics of Massive Starless Cores with ALMA	2013-01-23	1	4	Tan, Jonathan C.; Kong, Shuo; Butler, Michael J.; Caselli, Paola; Font...
2016ApJ...828..100F	Feng, Siyi	ApJ	2016	Outflow Detection in a 70 μ m Dark High-Mass Core	2013-01-23	1	4	Feng, Siyi; Beuther, Henrik; Zhang, Qizhou; Liu, Haoyu Baobab; Zh...
2016ApJ...821..94K	Kong, Shuo	ApJ	2016	The Deuterium Fraction in Massive Starless Cores and Dynamical Implications	2013-01-23	1	4	Kong, Shuo; Tan, Jonathan C.; Caselli, Paola; Fontani, Francesco; Pill...
2012A&A...542L..34N	Nagao, T.	A&A	2012	ALMA reveals a chemically evolved submillimeter galaxy at $z = 4.76$	2013-02-09	1	1	Nagao, T.; Maiolino, R.; De Breuck, C.; Caselli, P.; Hatsukade, B.; Saig...
2014MNRAS.444.1821F	Farihi, J.	MNRAS	2014	ALMA and Herschel observations of the prototype dusty and polluted white dwarf G29-38	2013-02-14	1	2	Farihi, J.; Wyatt, M. C.; Greaves, J. S.; Bonsor, A.; Sibthorpe, B.; Panić, O.
2016A&A...586A..45S	Salomé, Q.	A&A	2016	Star formation efficiency along the radio jet in Centaurus A	2013-02-14	1	6	Salomé, Q.; Salomé, P.; Combes, F.; Hamer, S.; Heywood, I.
2017ApJ...840..78D	Danielson, A. L. R.	ApJ	2017	An ALMA Survey of Submillimeter Galaxies in the Extended Chandra Deep Field South: Spectroscopic Redshifts	2013-02-15	1	122	Danielson, A. L. R.; Swinbank, A. M.; Small, Ian; Simpson, J. M.; Case...
2016MNRAS.463..10M	Mackenzie, Todd P.	MNRAS	2016	SEDEBLEND: a new method for deblending spectral energy distributions in confused imaging	2013-02-15	1	122	Mackenzie, Todd P.; Scott, Douglas; Swinbank, Mark
2014ApJ...788..125S	Simpson, J. M.	ApJ	2014	An ALMA Survey of Submillimeter Galaxies in the Extended Chandra Deep Field South: The Redshift Distribution and Evolu...	2013-02-15	1	122	Simpson, J. M.; Swinbank, A. M.; Small, Ian; Alexander, D. M.; Brandt, ...
2016MNRAS.462.1192L	Lindroos, L.	MNRAS	2016	Estimating sizes of faint, distant galaxies in the submillimetre regime	2013-02-15	1	122	Lindroos, L.; Knudsen, K. K.; Fan, L.; Conway, J.; Coppin, K.; Decarli, ...
2014MNRAS.442..577T	Thomson, A. P.	MNRAS	2014	An ALMA survey of submillimetre galaxies in the Extended Chandra Deep Field South: radio properties and the far-infrared/r...	2013-02-15	1	122	Thomson, A. P.; Ivison, R. J.; Simpson, J. M.; Swinbank, A. M.; Small, I...

Searches can be done in one of two ways. The best way to start a search, especially for a single object, is to use the search menu that is displayed when hovering over the rectangle with the magnifying glass.

The screenshot displays the ALMA Science Archive interface in a Mozilla Firefox browser. A yellow arrow points to a search icon in the top navigation bar. The main content area is divided into several sections:

- Search Filters:** A grid of input fields for Position, Energy, Project, Publication, and Observation. Fields include Source name, Frequency, Project code, Publication Title, Observation Date, ALMA source name, Band, Project Title, Abstract, Polarisation Type, RA Dec, Spectral resolution, Project abstract, First Author, Member oid id, Galactic, Continuum sensitivity, PI Full Name, Authors, Target List, Line sensitivity (10 km/s), Proposal authors, Angular Resolution, Science keyword, and Maximum Recoverable Scale. An 'Options' section includes checkboxes for 'Public data only' and 'Calibration observations'.
- Spectral Plot:** A plot showing intensity versus frequency (100 GHz to 900 GHz). It features several labeled peaks corresponding to different molecules and lines, such as HCO+, CS, SiO, and HCN. The plot is divided into sections numbered 3 through 10.
- Observations Table:** A table listing search results with columns for Project code, ALMA source name, Ra, Dec, Band, Cont. sens., Frequency support, Release date, Publications, Ang. res., Min. vel. res., Array, Mosaic, Max. reco. scale, FOV, Scientific category, Science keyword, Int. Time, Gal. lon., Gal. lat., and Min. fre.

Project code	ALMA source name	Ra	Dec	Band	Cont. sens.	Frequency support	Release date	Publications	Ang. res.	Min. vel. res.	Array	Mosaic	Max. reco. scale	FOV	Scientific category	Science keyword	Int. Time	Gal. lon.	Gal. lat.	Min. fre
2011.0.00191.S	Fomalhaut b	22:57:38.685	-29:37:12.616	7	0.118	343.08..358.84GHz	2012-12-06	2	1.015	0.816	12m		8.816	16.592	Disks and planet format...	Debris disks, Exoplanets	8709.120	20.493	-64.908	976.6
2011.0.00131.S	R Scl	01:26:58.079	-32:32:36.424	7	0.912	330.25..346.11GHz	2012-12-06	5	1.025	0.846	12m	mosaic	8.838	62.007	Stars and stellar evolut...	Asymptotic Giant Branc...	661.617	250.183	-80.589	976.6
2011.0.00101.S	GRB021004	00:26:54.680	+18:55:41.600	7	0.114	337.01..353.00GHz	2012-12-06	2	0.981	26.541	12m		7.876	16.878	Active galaxies	Starburst galaxies, Ga...	3749.760	114.917	-43.561	3125
2011.0.00397.S	J063027.81-212205...	06:30:27.810	-21:20:58.600	7	0.535	337.01..352.99GHz	2012-12-20	3	1.114	26.541	12m		7.804	16.878	Active galaxies	Active Galactic Nuclei (...)	90.720	230.024	-13.990	3125
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2011.0.00397.S	J030427.53-31083...	03:04:27.530	-31:08:38.300	7	0.485	337.03..353.01GHz	2012-12-20	3	1.114	26.541	12m		7.803	16.877	Active galaxies	Active Galactic Nuclei (...)	90.720	228.860	-60.786	3125

The other method is to type in search criteria in the entry fields above each column in the results table. This can also be done after initially setting up a search using the search menu.

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Project code	ALMA source name	Ra	Dec	Band	Cont. sens.	Frequency support	Release date	Publications	Ang. res.	Min. vel. res.	Array	Mosaic	Max. reco. scale	FOV	Scientific category	Science keyword	Int. Time	Gal. lon.	Gal. lat.	Min. fre.
2011.0.00191.S	Fomalhaut b	22:57:38.685	-29:37:12.616	7	0.118	343.08..358.84GHz	2012-12-06	2	1.015	0.816	12m		8.816	16.592	Disks and planet format...	Debris disks, Exoplanets	8709.120	20.493	-64.908	976.6
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When the number of results in the results table changes, the map and spectrum panels will automatically adjust to show the observed fields and spectra in more detail.

ALMA Science Archive - Mozilla Firefox

ALMA Science Archive x +

Source name: Z CMa

07 03 43.158 -11 33 6.19
FoV: 2.87'

Molecules Lines Redshift

220 GHz 225 GHz 230 GHz 235 GHz 240 GHz 245 GHz 250 GHz 255 GHz 260 GHz 265 GHz

Observations (9) Projects (4) Publications (0)

Project code	ALMA source name	Ra	Dec	Band	Cont. sens.	Frequency support	Release date	Publications	Ang. res.	Min. vel. res.	Array	Mosaic	Max. reco. scale	FOV	Scientific category	Science keyword	Int. Time	Gal. lon.	Gal. lat.	Min. freq.
2016.1.00110.S	Z_CMa	07:03:43.159	-11:33:06.188	6	0.036	215.87_232.63GHz	2018-02-04	0	0.177	0.159	12m		1.752	25.966	Disks and planet format...	Exo-planets	635.040	224.606	-2.557	122.067
2016.2.00168.S	z_cma	07:03:43.159	-11:33:06.185	6	0.234	215.81_232.69GHz	2018-10-09	0	4.725	0.159	7m		28.085	44.514	Disks and planet format...	Disks around low-mass...	1572.480	224.606	-2.557	122.078
2016.1.00110.S	Z_CMa	07:03:43.159	-11:33:06.185	6	0.020	215.87_232.62GHz	2018-11-10	0	0.050	0.159	12m		1.130	25.967	Disks and planet format...	Exo-planets	2068.416	224.606	-2.557	122.066
2018.1.01131.S	Z_CMa	07:03:43.159	-11:33:06.184	6	0.833	217.11_233.54GHz	2020-01-04	1	5.065	0.183	7m		29.811	44.302	ISM and star formation	Outflows, jets and ioniz...	393.120	224.606	-2.557	141.110
2018.1.01131.S	Z_CMa	07:03:43.159	-11:33:06.183	6	0.915	250.91_268.10GHz	2020-02-21	1	4.346	0.634	7m		25.668	38.467	ISM and star formation	Outflows, jets and ioniz...	302.400	224.606	-2.557	564.495
2018.1.01131.S	Z_CMa	07:03:43.158	-11:33:06.183	6	0.073	217.11_233.47GHz	2020-08-24	1	0.968	0.183	12m		9.345	25.846	ISM and star formation	Outflows, jets and ioniz...	302.400	224.606	-2.557	141.132
2018.1.01131.S	Z_CMa	07:03:43.158	-11:33:06.183	6	0.377	250.91_268.10GHz	2020-08-24	1	20.255	0.634	TP		359.023	22.439	ISM and star formation	Outflows, jets and ioniz...	4380.672	224.606	-2.557	564.527
2018.1.01131.S	Z_CMa	07:03:43.158	-11:33:06.182	6	0.074	250.97_268.07GHz	2020-08-26	1	0.394	0.634	12m		5.227	22.438	ISM and star formation	Outflows, jets and ioniz...	302.400	224.606	-2.557	564.533
2018.1.00814.S	ZCMA	07:03:43.200	-11:33:06.700	6	0.037	216.58_234.44GHz	2020-12-27	1	0.114	0.159	12m		1.840	25.822	Disks and planet format...	Disks around low-mass...	604.800	224.607	-2.557	122.066

The map display can be adjusted to display different wavebands. The spectrum can be adjusted to show broader or narrower frequency ranges, to show different spectral lines, and to show those lines at different redshifts.

ALMA Science Archive - Mozilla Firefox

Source name: Z CMa

07 03 43.158 -11 33 6.19
FoV: 2.87'

Molecules: Lines: Redshift: -0.00009 (estimated)

Observations (9) Projects (4) Publications (0)

Project code	ALMA source name	Ra	Dec	Band	Cont. sens.	Frequency support	Release date	Publications	Ang. res.	Min. vel. res.	Array	Mosaic	Max. reco. scale	FOV	Scientific category	Science keyword	Int. Time	Gal. lon.	Gal. lat.	Min. freq.
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2018.1.01131.S	Z_CMa	07:03:43.159	-11:33:06.183	6	0.915	250.91_268.10GHz	2020-02-21	1	4.346	0.634	7m	25.668	38.467	ISM and star formation	Outflows, jets and ioniz...	302.400	224.606	-2.557	564.495	
2018.1.01131.S	Z_CMa	07:03:43.158	-11:33:06.183	6	0.073	217.11_233.47GHz	2020-08-24	1	0.968	0.183	12m	9.345	25.846	ISM and star formation	Outflows, jets and ioniz...	302.400	224.606	-2.557	141.132	
2018.1.01131.S	Z_CMa	07:03:43.158	-11:33:06.183	6	0.377	250.91_268.10GHz	2020-08-24	1	20.255	0.634	TP	359.023	22.439	ISM and star formation	Outflows, jets and ioniz...	4380.672	224.606	-2.557	564.527	
2018.1.01131.S	Z_CMa	07:03:43.158	-11:33:06.182	6	0.074	250.97_268.07GHz	2020-08-26	1	0.394	0.634	12m	5.227	22.438	ISM and star formation	Outflows, jets and ioniz...	302.400	224.606	-2.557	564.533	
2018.1.00814.S	ZCMA	07:03:43.200	-11:33:06.700	6	0.037	216.58_234.44GHz	2020-12-27	1	0.114	0.159	12m	1.840	25.822	Disks and planet format...	Disks around low-mass...	604.800	224.607	-2.557	122.066	

The map display can be adjusted to display different wavebands. The spectrum can be adjusted to show broader or narrower frequency ranges, to show different spectral lines, and to show those lines at different redshifts.

ALMA Science Archive - Mozilla Firefox

Source name: Z CMa

07 03 43.158 -11 33 6.19
FoV: 2.87'

Observations (9) Projects (4) Publications (0)

Project code	ALMA source name	Ra	Dec	Band	Cont. sens.	Frequency support	Release date	Publications	Ang. res.	Min. vel. res.	Array	Mosaic	Max. reco. scale	FOV	Scientific category	Science keyword	Int. Time	Gal. lon.	Gal. lat.	Min. fre.
		h:m:s	d:m:s		mJy/beam				arcsec	km/s			arcsec	arcsec			s			kHz
2016.1.00110.S	Z_CMa	07:03:43.159	-11:33:06.188	6	0.036	215.87_232.63GHz	2018-02-04	0	0.177	0.159	12m		1.752	25.966	Disks and planet format...	Exo-planets	635.040	224.606	-2.557	122.067
2016.2.00168.S	z_cma	07:03:43.159	-11:33:06.185	6	0.234	215.81_232.69GHz	2018-10-09	0	4.725	0.159	7m		28.085	44.514	Disks and planet format...	Disks around low-mass...	1572.480	224.606	-2.557	122.078
2016.1.00110.S	Z_CMa	07:03:43.159	-11:33:06.185	6	0.020	215.87_232.62GHz	2018-11-10	0	0.050	0.159	12m		1.130	25.967	Disks and planet format...	Exo-planets	2068.416	224.606	-2.557	122.066
2018.1.01131.S	Z_CMa	07:03:43.159	-11:33:06.184	6	0.833	217.11_233.54GHz	2020-01-04	1	5.065	0.183	7m		29.811	44.302	ISM and star formation	Outflows, jets and ioniz...	393.120	224.606	-2.557	141.110
2018.1.01131.S	Z_CMa	07:03:43.159	-11:33:06.183	6	0.915	250.91_268.10GHz	2020-02-21	1	4.346	0.634	7m		25.668	38.467	ISM and star formation	Outflows, jets and ioniz...	302.400	224.606	-2.557	564.495
2018.1.01131.S	Z_CMa	07:03:43.158	-11:33:06.183	6	0.073	217.11_233.47GHz	2020-08-24	1	0.968	0.183	12m		9.345	25.846	ISM and star formation	Outflows, jets and ioniz...	302.400	224.606	-2.557	141.132
2018.1.01131.S	Z_CMa	07:03:43.158	-11:33:06.183	6	0.377	250.91_268.10GHz	2020-08-24	1	20.255	0.634	TP		359.023	22.439	ISM and star formation	Outflows, jets and ioniz...	4380.672	224.606	-2.557	564.527
2018.1.01131.S	Z_CMa	07:03:43.158	-11:33:06.182	6	0.074	250.97_268.07GHz	2020-08-26	1	0.394	0.634	12m		5.227	22.438	ISM and star formation	Outflows, jets and ioniz...	302.400	224.606	-2.557	564.533
2018.1.00814.S	ZCMA	07:03:43.200	-11:33:06.700	6	0.037	216.58_234.44GHz	2020-12-27	1	0.114	0.159	12m		1.840	25.822	Disks and planet format...	Disks around low-mass...	604.800	224.607	-2.557	122.066

Hovering over an entry in the results table will highlight the row, the field in the map panel, and the frequency ranges in the spectrum panel.

ALMA Science Archive - Mozilla Firefox

Source name: Z CMa

07 03 43.158 -11 33 6.19
FoV: 2.87'

Molecules Lines Redshift

220 GHz 225 GHz 230 GHz 235 GHz 240 GHz 245 GHz 250 GHz 255 GHz 260 GHz 265 GHz

Observations (9) Projects (4) Publications (0)

Project code	ALMA source name	Ra	Dec	Band	Cont. sens.	Frequency support	Release date	Publications	Ang. res.	Min. vel. res.	Array	Mosaic	Max. reco. scale	FOV	Scientific category	Science keyword	Int. Time	Gal. lon.	Gal. lat.	Min. freq.
2016.1.00110.S	Z_CMa	07:03:43.159	-11:33:06.188	6	0.036	215.87_232.63GHz	2018-02-04	0	0.177	0.159	12m	1.752	25.966	Disks and planet format...	Exo-planets	635.040	224.606	-2.557	122.067	
2016.2.00168.S	z_cma	07:03:43.159	-11:33:06.185	6	0.234	215.81_232.69GHz	2018-10-09	0	4.725	0.159	7m	28.085	44.514	Disks and planet format...	Disks around low-mass...	1572.480	224.606	-2.557	122.078	
2016.1.00110.S	Z_CMa	07:03:43.159	-11:33:06.185	6	0.020	215.87_232.62GHz	2018-11-10	0	0.050	0.159	12m	1.130	25.967	Disks and planet format...	Exo-planets	2068.416	224.606	-2.557	122.066	
2018.1.01131.S	Z_CMa	07:03:43.158	-11:33:06.184	6	0.833	217.11_233.54GHz	2020-01-04	1	5.065	0.183	7m	29.811	44.302	ISM and star formation	Outflows, jets and ioniz...	393.120	224.606	-2.557	141.110	
2018.1.01131.S	Z_CMa	07:03:43.159	-11:33:06.183	6	0.915	250.91_268.10GHz	2020-02-21	1	4.346	0.634	7m	25.668	38.467	ISM and star formation	Outflows, jets and ioniz...	302.400	224.606	-2.557	564.495	
2018.1.01131.S	Z_CMa	07:03:43.158	-11:33:06.183	6	0.377	250.91_268.10GHz	2020-08-24	1	20.255	0.634	TP	359.023	22.439	ISM and star formation	Outflows, jets and ioniz...	4380.672	224.606	-2.557	564.527	
2018.1.01131.S	Z_CMa	07:03:43.158	-11:33:06.182	6	0.074	250.97_268.07GHz	2020-08-26	1	0.394	0.634	12m	5.227	22.438	ISM and star formation	Outflows, jets and ioniz...	302.400	224.606	-2.557	564.533	
2018.1.00814.S	ZCMA	07:03:43.200	-11:33:06.700	6	0.037	216.58_234.44GHz	2020-12-27	1	0.114	0.159	12m	1.840	25.822	Disks and planet format...	Disks around low-mass...	604.800	224.607	-2.557	122.066	

Clicking on the checkbox next to an observation will select the data for download. The row will change to orange as will the field in the map panel and the frequency range in the spectral plot.

ALMA Science Archive - Mozilla Firefox

Source name: Z CMa

07 03 43.158 -11 33 6.19
FoV: 2.87'

Molecules Lines Redshift

Observations (9) Projects (4) Publications (0)

	Project code	ALMA source name	Ra	Dec	Band	Cont. sens.	Frequency support	↑Release date	Publications	Ang. res.	Min. vel. res.	Array	Mosaic	Max. reco. scale	FOV	Scientific category	Science keyword	Int. Time	Gal. lon.	Gal. lat.	Min. freq.
			h:m:s	d:m:s		mJy/beam				arcsec	km/s			arcsec	arcsec			s			kHz
<input type="checkbox"/>	2016.1.00110.S	Z_CMa	07:03:43.159	-11:33:06.188	6	0.036	215.87_232.63GHz	2018-02-04	0	0.177	0.159	12m	1.752	25.966	25.966	Disks and planet format...	Exo-planets	635.040	224.606	-2.557	122.067
<input type="checkbox"/>	2016.2.00168.S	z_cma	07:03:43.159	-11:33:06.185	6	0.234	215.81_232.69GHz	2018-10-09	0	4.725	0.159	7m	28.085	44.514	44.514	Disks and planet format...	Disks around low-mass...	1572.480	224.606	-2.557	122.078
<input type="checkbox"/>	2016.1.00110.S	Z_CMa	07:03:43.159	-11:33:06.185	6	0.020	215.87_232.62GHz	2018-11-10	0	0.050	0.159	12m	1.130	25.967	25.967	Disks and planet format...	Exo-planets	2068.416	224.606	-2.557	122.066
<input type="checkbox"/>	2018.1.01131.S	Z_CMa	07:03:43.159	-11:33:06.184	6	0.833	217.11_233.54GHz	2020-01-04	1	5.065	0.183	7m	29.811	44.302	44.302	ISM and star formation	Outflows, jets and ioniz...	393.120	224.606	-2.557	141.110
<input type="checkbox"/>	2018.1.01131.S	Z_CMa	07:03:43.159	-11:33:06.183	6	0.915	250.91_268.10GHz	2020-02-21	1	4.346	0.634	7m	25.668	38.467	38.467	ISM and star formation	Outflows, jets and ioniz...	302.400	224.606	-2.557	564.495
<input checked="" type="checkbox"/>	2018.1.01131.S	Z_CMa	07:03:43.158	-11:33:06.183	6	0.073	217.11_233.47GHz	2020-08-24	1	0.968	0.183	12m	9.345	25.846	25.846	ISM and star formation	Outflows, jets and ioniz...	302.400	224.606	-2.557	141.132
<input type="checkbox"/>	2018.1.01131.S	Z_CMa	07:03:43.158	-11:33:06.183	6	0.377	250.91_268.10GHz	2020-08-24	1	20.255	0.634	TP	359.023	22.439	22.439	ISM and star formation	Outflows, jets and ioniz...	4380.672	224.606	-2.557	564.527
<input type="checkbox"/>	2018.1.01131.S	Z_CMa	07:03:43.158	-11:33:06.182	6	0.074	250.97_268.07GHz	2020-08-26	1	0.394	0.634	12m	5.227	22.438	22.438	ISM and star formation	Outflows, jets and ioniz...	302.400	224.606	-2.557	564.533
<input type="checkbox"/>	2018.1.00814.S	ZCMA	07:03:43.200	-11:33:06.700	6	0.037	216.58_234.44GHz	2020-12-27	1	0.114	0.159	12m	1.840	25.822	25.822	Disks and planet format...	Disks around low-mass...	604.800	224.607	-2.557	122.066

Proprietary data can be selected but cannot be downloaded. The checkbox will appear red when these data are selected. Other data (such as for programs where the observations are not yet complete or where the data are in QA3) cannot be selected.

ALMA Science Archive - Mozilla Firefox

Source name: Z CMa

07 03 43.158 -11 33 6.19
FoV: 2.87'

Molecules Lines Redshift

Observations (9) Projects (4) Publications (0)

Project code	ALMA source name	Ra	Dec	Band	Cont. sens.	Frequency support	Release date	Publications	Ang. res.	Min. vel. res.	Array	Mosaic	Max. reco. scale	FOV	Scientific category	Science keyword	Int. Time	Gal. lon.	Gal. lat.	Min. freq.
<input type="checkbox"/>	2016.1.00110.S	Z_CMa	07:03:43.159	-11:33:06.188	6	0.036	215.87_232.63GHz	2018-02-04	0	0.177	0.159	12m	1.752	25.966	Disks and planet format...	Exo-planets	635.040	224.606	-2.557	122.067
<input type="checkbox"/>	2016.2.00168.S	z_cma	07:03:43.159	-11:33:06.185	6	0.234	215.81_232.69GHz	2018-10-09	0	4.725	0.159	7m	28.085	44.514	Disks and planet format...	Disks around low-mass...	1572.480	224.606	-2.557	122.078
<input type="checkbox"/>	2016.1.00110.S	Z_CMa	07:03:43.159	-11:33:06.185	6	0.020	215.87_232.62GHz	2018-11-10	0	0.050	0.159	12m	1.130	25.967	Disks and planet format...	Exo-planets	2068.416	224.606	-2.557	122.066
<input type="checkbox"/>	2018.1.01131.S	Z_CMa	07:03:43.159	-11:33:06.184	6	0.833	217.11_233.54GHz	2020-01-04	1	5.065	0.183	7m	29.811	44.302	ISM and star formation	Outflows, jets and ioniz...	393.120	224.606	-2.557	141.110
<input type="checkbox"/>	2018.1.01131.S	Z_CMa	07:03:43.159	-11:33:06.183	6	0.915	250.91_268.10GHz	2020-02-21	1	4.346	0.634	7m	25.668	38.467	ISM and star formation	Outflows, jets and ioniz...	302.400	224.606	-2.557	564.495
<input checked="" type="checkbox"/>	2018.1.01131.S	Z_CMa	07:03:43.158	-11:33:06.183	6	0.073	217.11_233.47GHz	2020-08-24	1	0.968	0.183	12m	9.345	25.846	ISM and star formation	Outflows, jets and ioniz...	302.400	224.606	-2.557	141.132
<input type="checkbox"/>	2018.1.01131.S	Z_CMa	07:03:43.158	-11:33:06.183	6	0.377	250.91_268.10GHz	2020-08-24	1	20.255	0.634	TP	359.023	22.439	ISM and star formation	Outflows, jets and ioniz...	4380.672	224.606	-2.557	564.527
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<input checked="" type="checkbox"/>	2018.1.00814.S	ZCMA	07:03:43.200	-11:33:06.700	6	0.037	216.58_234.44GHz	2020-12-27	1	0.114	0.159	12m	1.840	25.822	Disks and planet format...	Disks around low-mass...	604.800	224.607	-2.557	122.068

The interface has several other options as well. These include saving the search results (or a link to those results), accessing documentation, and adjusting the display.

ALMA Science Archive - Mozilla Firefox

ALMA Science Archive x +

https://almascience.eso.org/asax/

Source name: Z CMa

07 03 43.158 -11 33 6.19
FoV: 2.87'

Molecules Lines Redshift (estimated)

220 GHz 225 GHz 230 GHz 235 GHz 240 GHz 245 GHz 250 GHz 255 GHz 260 GHz

3 4 5 6 7 8 9 10

Observations (9) Projects (4) Publications (0)

	Project code	ALMA source name	Ra	Dec	Band	Cont. sens.	Frequency support	↑Release date	Publications	Ang. res.	Min. vel. res.	Array	Mosaic	Max. reco. scale	FOV	Scientific category	Science keyword	Int. Time	Gal. lon.	Gal. lat.	Min. fre.
			h:m:s	d:m:s		mJy/beam				arcsec	km/s			arcsec	arcsec			s			kHz
<input type="checkbox"/>	2016.1.00110.S	Z_CMa	07:03:43.159	-11:33:06.188	6	0.036	215.87_232.63GHz	2018-02-04	0	0.177	0.159	12m	1.752	25.966	Disks and planet format...	Exo-planets	635.040	224.606	-2.557	122.067	
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Selected data can be downloaded by clicking on the download icon at the top right. When request download is selected, this will open a new browser window or tab. If proprietary data were selected, a login screen will appear first.

The screenshot shows the ALMA Science Archive interface in Mozilla Firefox. The browser address bar shows <https://almascience.eso.org/asax/>. The search bar contains "Source name: Z CMa". The main view displays a spectral plot with a central image of the source and a spectrum showing various molecular lines. A yellow arrow points to the download icon in the top right corner of the plot area.

Below the plot, there is a table of observations. The table has the following columns: Project code, ALMA source name, Ra, Dec, Band, Cont. sens., Frequency support, Release date, Publications, Ang. res., Min. vel. res., Array, Mosaic, Max. reco. scale, FOV, Scientific category, Science keyword, Int. Time, Gal. lon., Gal. lat., and Min. freq.

Project code	ALMA source name	Ra	Dec	Band	Cont. sens.	Frequency support	Release date	Publications	Ang. res.	Min. vel. res.	Array	Mosaic	Max. reco. scale	FOV	Scientific category	Science keyword	Int. Time	Gal. lon.	Gal. lat.	Min. freq.
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2016.1.00110.S	Z_CMα	07:03:43.159	-11:33:06.185	6	0.020	215.87_232.62GHz	2018-11-10	0	0.050	0.159	12m		1.130	25.967	Disks and planet format...	Exo-planets	2068.416	224.606	-2.557	122.066
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2018.1.01131.S	Z_CMα	07:03:43.159	-11:33:06.183	6	0.915	250.91_268.10GHz	2020-02-21	1	4.346	0.634	7m		25.668	38.467	ISM and star formation	Outflows, jets and ioniz...	302.400	224.606	-2.557	564.495
2018.1.01131.S	Z_CMα	07:03:43.158	-11:33:06.183	6	0.073	217.11_233.47GHz	2020-08-24	1	0.968	0.183	12m		9.345	25.846	ISM and star formation	Outflows, jets and ioniz...	302.400	224.606	-2.557	141.132
2018.1.01131.S	Z_CMα	07:03:43.158	-11:33:06.183	6	0.377	250.91_268.10GHz	2020-08-24	1	20.255	0.634	TP		359.023	22.439	ISM and star formation	Outflows, jets and ioniz...	4380.672	224.606	-2.557	564.527
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2018.1.00814.S	ZCMA	07:03:43.200	-11:33:06.700	6	0.037	216.58_234.44GHz	2020-12-27	1	0.114	0.159	12m		1.840	25.822	Disks and planet format...	Disks around low-mass...	604.800	224.607	-2.557	122.066

The new page displays the data associated with the entries selected in the search interface. Data are sorted by Science Goal, Group OUS, and Member OUS. (A Member OUS is a unit of data containing one SB.)

ALMA Request Handler - Request Details - Mozilla Firefox

ALMA Science Archive x ALMA Request Handler - ... x +

https://almascience.eso.org/rh/submission

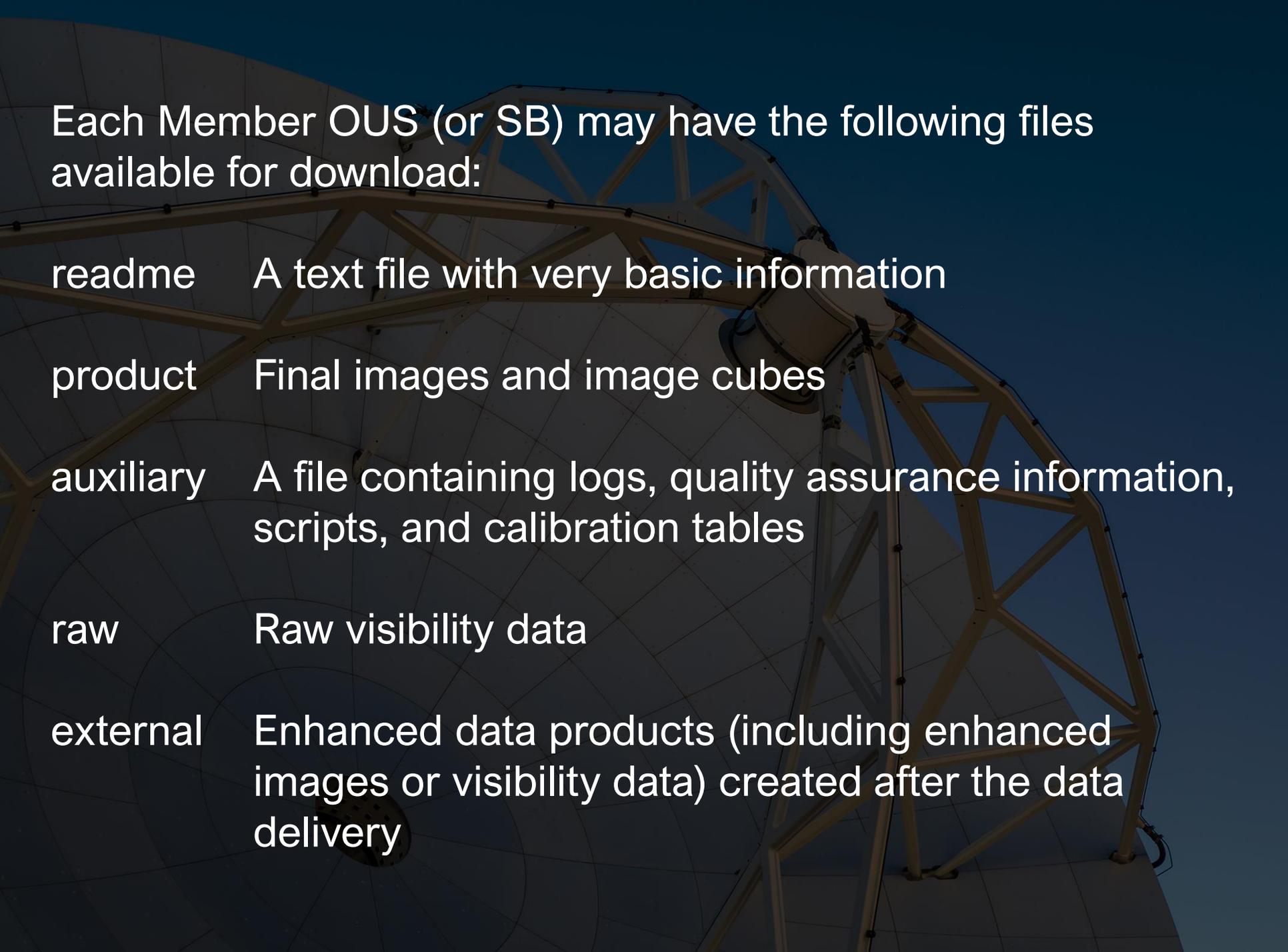
ALMA Request Handler

Anonymous User: Request #215489553204 ✓
Request Title: [click to edit](#)

Download Selected

readme product auxiliary raw raw (semipass) external

Project / OUSet / Executionblock	File	Size	Accessible
Request 215489553204		5 GiB	
Project 2018.1.01131.S			
Science Goal OUS uid://A001/X135b/X60			
Group OUS uid://A001/X135b/X61			
Member OUS uid://A001/X135b/X64			
SB V1647_Or_a_06_TM2			
<input checked="" type="checkbox"/> readme	member_uid_A001_X135b_X64_README.txt	258 B	✓
<input checked="" type="checkbox"/> product	2018.1.01131.S_uid_A001_X135b_X64_001_of_001.tar	2 GiB	✓
<input checked="" type="checkbox"/> auxiliary	2018.1.01131.S_uid_A001_X135b_X64_auxiliary.tar	338 MiB	✓
<input type="checkbox"/> raw	2018.1.01131.S_uid_A002_Xd9668b_Xa8e1.asdm.sdm.tar	6 GiB	✓
Member OUS uid://A001/X135b/X66			
SB V1647_Or_a_06_7M			
<input checked="" type="checkbox"/> readme	member_uid_A001_X135b_X66_README.txt	3 KiB	✓
<input checked="" type="checkbox"/> product	2018.1.01131.S_uid_A001_X135b_X66_001_of_001.tar	222 MiB	✓
<input checked="" type="checkbox"/> auxiliary	2018.1.01131.S_uid_A001_X135b_X66_auxiliary.tar	177 MiB	✓
<input type="checkbox"/> raw	2018.1.01131.S_uid_A002_Xd8fc22_X5da.asdm.sdm.tar	777 MiB	✓
Group OUS uid://A001/X135b/X68			
Member OUS uid://A001/X135b/X6b			
SB Z_CMa_a_06_TM2			
<input checked="" type="checkbox"/> readme	member_uid_A001_X135b_X6b_README.txt	258 B	✓
<input checked="" type="checkbox"/> product	2018.1.01131.S_uid_A001_X135b_X6b_001_of_001.tar	2 GiB	✓
<input checked="" type="checkbox"/> auxiliary	2018.1.01131.S_uid_A001_X135b_X6b_auxiliary.tar	347 MiB	✓
<input type="checkbox"/> raw	2018.1.01131.S_uid_A002_Xd98580_X354.asdm.sdm.tar	7 GiB	✓
Member OUS uid://A001/X135b/X6d			
SB Z_CMa_b_06_7M			
<input checked="" type="checkbox"/> readme	member_uid_A001_X135b_X6d_README.txt	258 B	✓
<input checked="" type="checkbox"/> product	2018.1.01131.S_uid_A001_X135b_X6d_001_of_001.tar	209 MiB	✓
<input checked="" type="checkbox"/> auxiliary	2018.1.01131.S_uid_A001_X135b_X6d_auxiliary.tar	147 MiB	✓
<input type="checkbox"/> raw	2018.1.01131.S_uid_A002_Xd3c7c2_X5388.asdm.sdm.tar	677 MiB	✓



Each Member OUS (or SB) may have the following files available for download:

readme A text file with very basic information

product Final images and image cubes

auxiliary A file containing logs, quality assurance information, scripts, and calibration tables

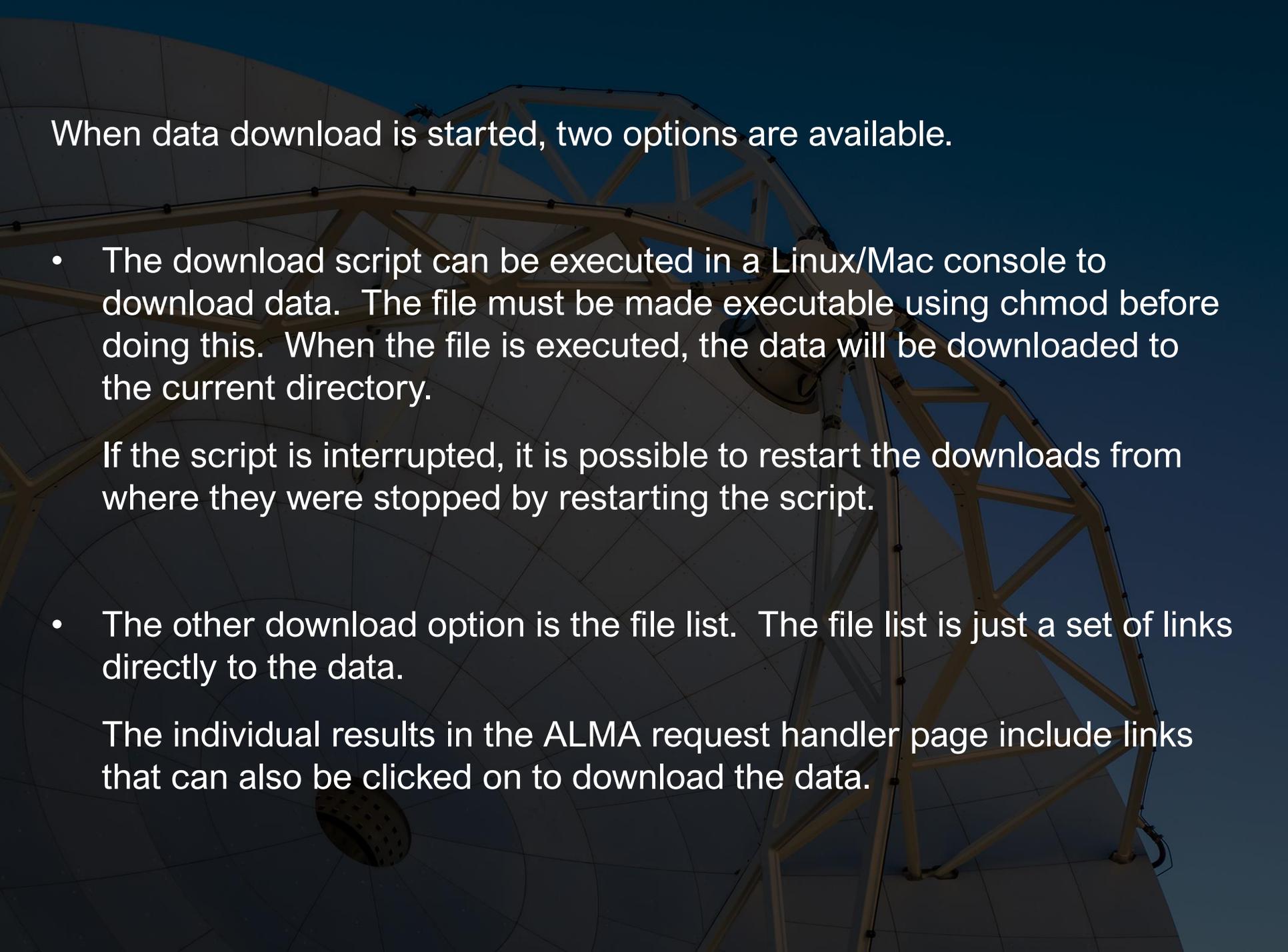
raw Raw visibility data

external Enhanced data products (including enhanced images or visibility data) created after the data delivery

Each file can be individually selected for download, or subsets of data can be selected for download. Proprietary data cannot be downloaded without logging in and without being delegate access to the data.

The screenshot shows the ALMA Request Handler interface in a Mozilla Firefox browser. The page title is "ALMA Request Handler" and the URL is "https://almascience.eso.org/rh/submission". The user is identified as "Anonymous User: Request #215489553204". A "Download Selected" button is visible. Below this, there are checkboxes for file types: readme, product, auxiliary, raw, raw (semipass), and external. The main content is a table with columns for "Project / OUSet / Executionblock", "File", "Size", and "Accessible". The table lists various files under different project and group identifiers, including "Science Goal OUS uid://A001/X135b/X60" and "Group OUS uid://A001/X135b/X68". Each file entry includes a file name, its size, and a green checkmark in the "Accessible" column.

Project / OUSet / Executionblock	File	Size	Accessible
Request 215489553204		9 GiB	
Project 2018.1.01131.S			
Science Goal OUS uid://A001/X135b/X60			
Group OUS uid://A001/X135b/X61			
Member OUS uid://A001/X135b/X64			
SB V1647_Or_a_06_TM2			
readme	member.uid_A001_X135b_X64_README.txt	258 B	✓
product	2018.1.01131.S_uid_A001_X135b_X64_001_of_001.tar	2 GiB	✓
auxiliary	2018.1.01131.S_uid_A001_X135b_X64_auxiliary.tar	338 MiB	✓
raw	2018.1.01131.S_uid_A002_Xd9668b_Xa8e1.asdm.sdm.tar	6 GiB	✓
Member OUS uid://A001/X135b/X66			
SB V1647_Or_a_06_7M			
readme	member.uid_A001_X135b_X66_README.txt	3 KiB	✓
product	2018.1.01131.S_uid_A001_X135b_X66_001_of_001.tar	222 MiB	✓
auxiliary	2018.1.01131.S_uid_A001_X135b_X66_auxiliary.tar	177 MiB	✓
raw	2018.1.01131.S_uid_A002_Xd8fc22_X5da.asdm.sdm.tar	777 MiB	✓
Group OUS uid://A001/X135b/X68			
Member OUS uid://A001/X135b/X6b			
SB Z_CMa_a_06_TM2			
readme	member.uid_A001_X135b_X6b_README.txt	258 B	✓
product	2018.1.01131.S_uid_A001_X135b_X6b_001_of_001.tar	2 GiB	✓
auxiliary	2018.1.01131.S_uid_A001_X135b_X6b_auxiliary.tar	347 MiB	✓
raw	2018.1.01131.S_uid_A002_Xd98580_X354.asdm.sdm.tar	7 GiB	✓
Member OUS uid://A001/X135b/X6d			
SB Z_CMa_b_06_7M			
readme	member.uid_A001_X135b_X6d_README.txt	258 B	✓
product	2018.1.01131.S_uid_A001_X135b_X6d_001_of_001.tar	209 MiB	✓
auxiliary	2018.1.01131.S_uid_A001_X135b_X6d_auxiliary.tar	147 MiB	✓
raw	2018.1.01131.S_uid_A002_Xd3c7c2_X5388.asdm.sdm.tar	677 MiB	✓



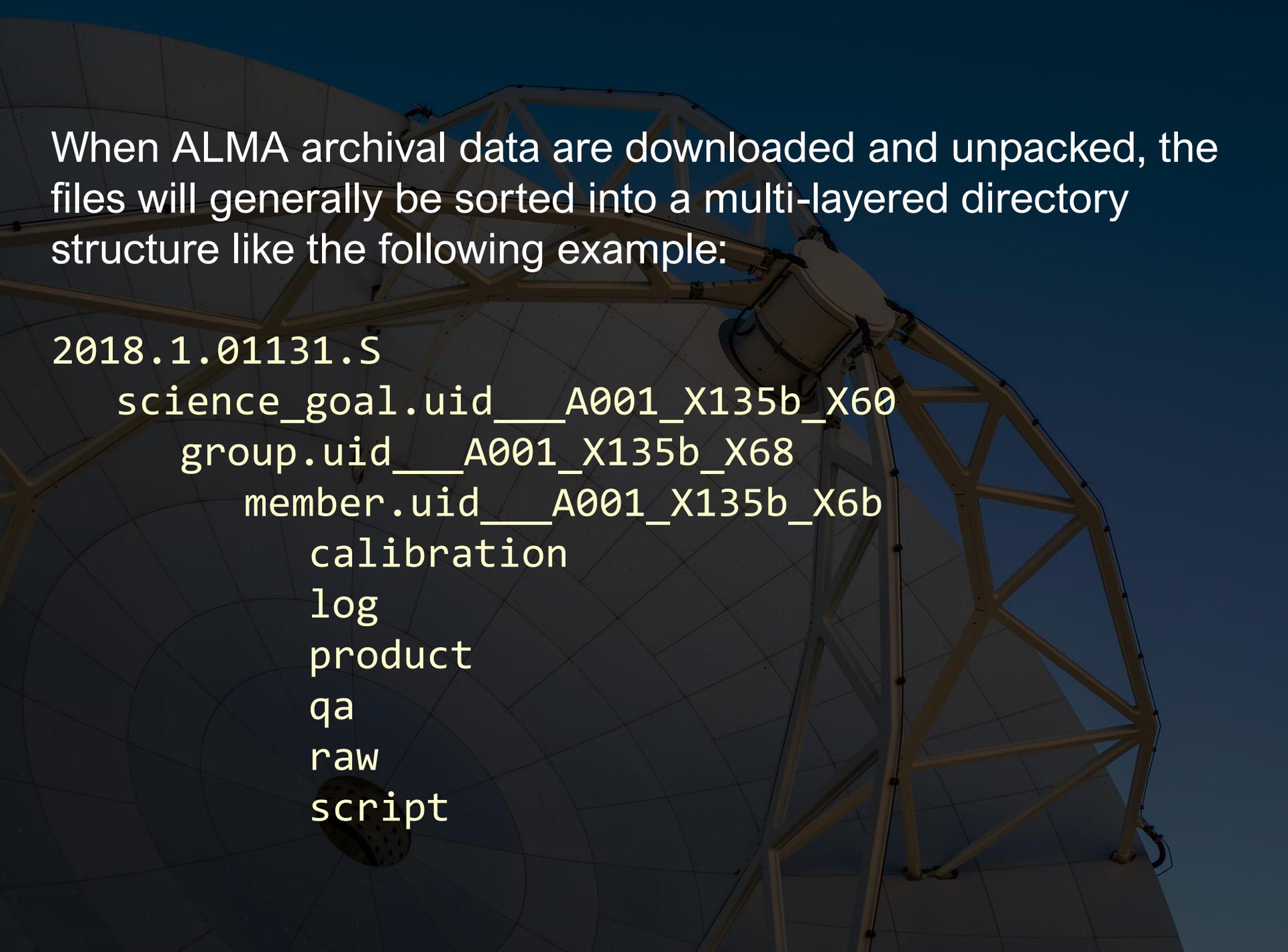
When data download is started, two options are available.

- The download script can be executed in a Linux/Mac console to download data. The file must be made executable using `chmod` before doing this. When the file is executed, the data will be downloaded to the current directory.

If the script is interrupted, it is possible to restart the downloads from where they were stopped by restarting the script.

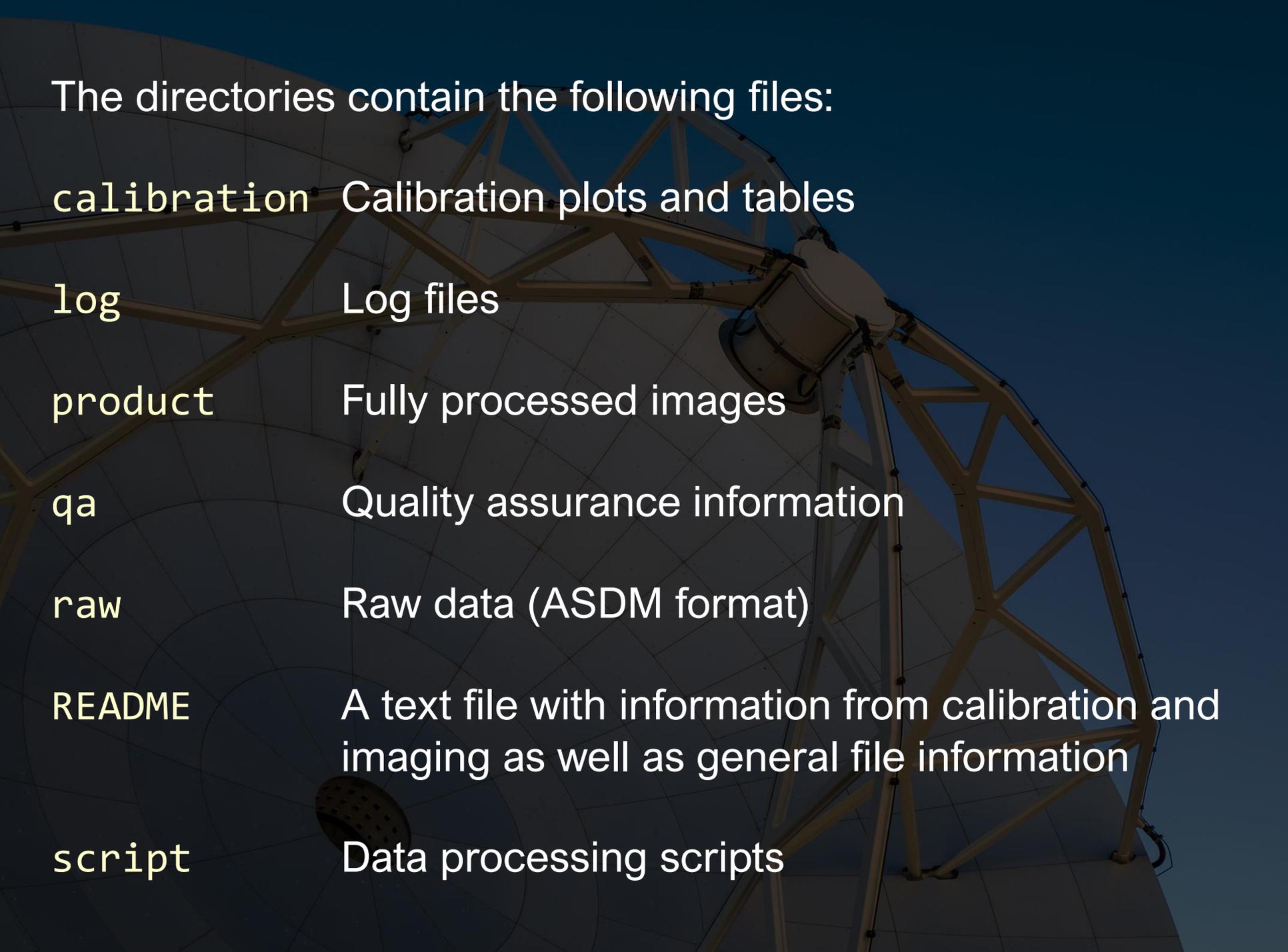
- The other download option is the file list. The file list is just a set of links directly to the data.

The individual results in the ALMA request handler page include links that can also be clicked on to download the data.

A large, white, segmented radio telescope dish is shown against a dark blue sky. The dish is supported by a complex metal truss structure. The text is overlaid on the left side of the image.

When ALMA archival data are downloaded and unpacked, the files will generally be sorted into a multi-layered directory structure like the following example:

```
2018.1.01131.S
  science_goal.uid___A001_X135b_X60
    group.uid___A001_X135b_X68
      member.uid___A001_X135b_X6b
        calibration
        log
        product
        qa
        raw
        script
```



The directories contain the following files:

`calibration` Calibration plots and tables

`log` Log files

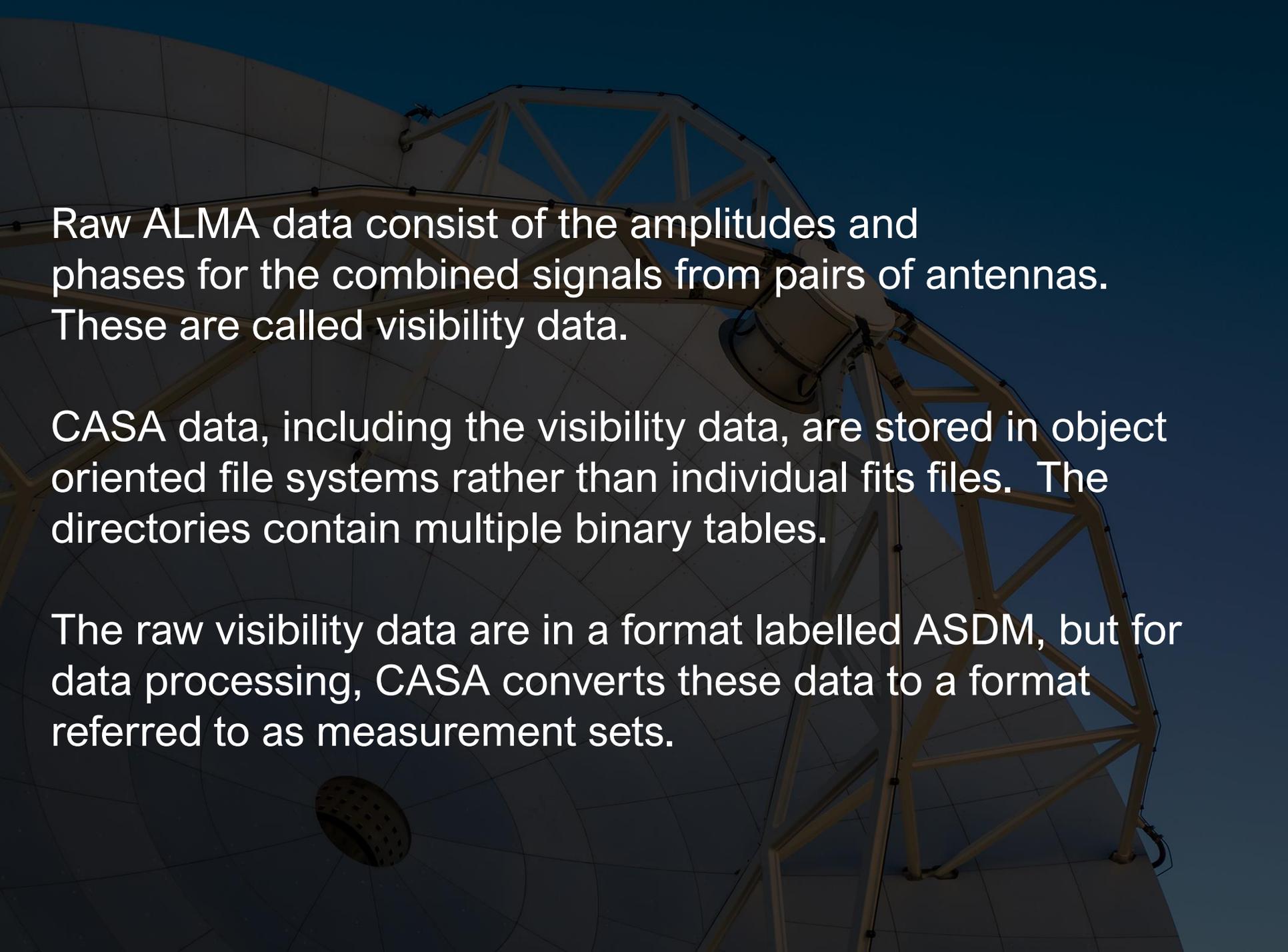
`product` Fully processed images

`qa` Quality assurance information

`raw` Raw data (ASDM format)

`README` A text file with information from calibration and imaging as well as general file information

`script` Data processing scripts



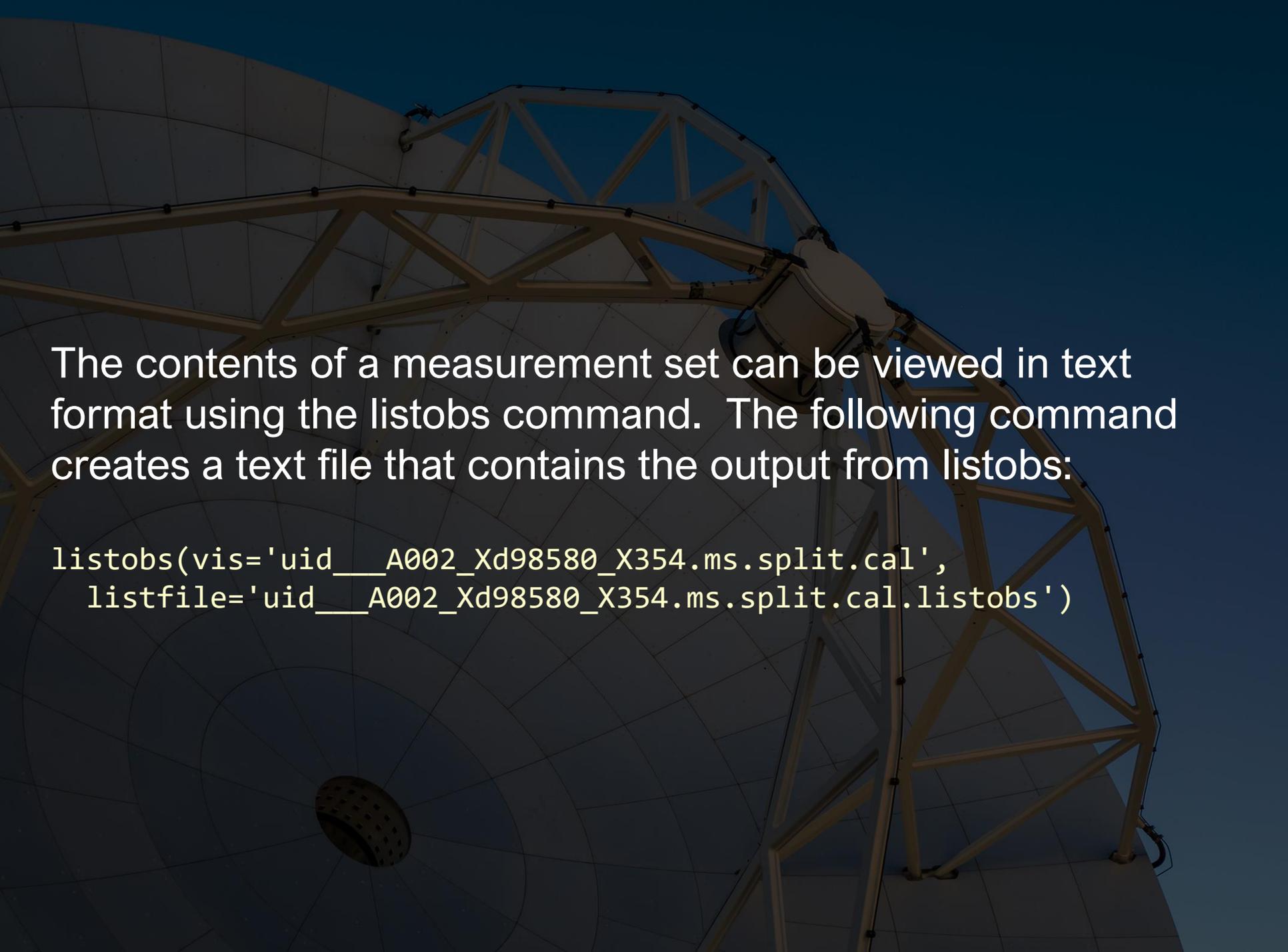
Raw ALMA data consist of the amplitudes and phases for the combined signals from pairs of antennas. These are called visibility data.

CASA data, including the visibility data, are stored in object oriented file systems rather than individual fits files. The directories contain multiple binary tables.

The raw visibility data are in a format labelled ASDM, but for data processing, CASA converts these data to a format referred to as measurement sets.

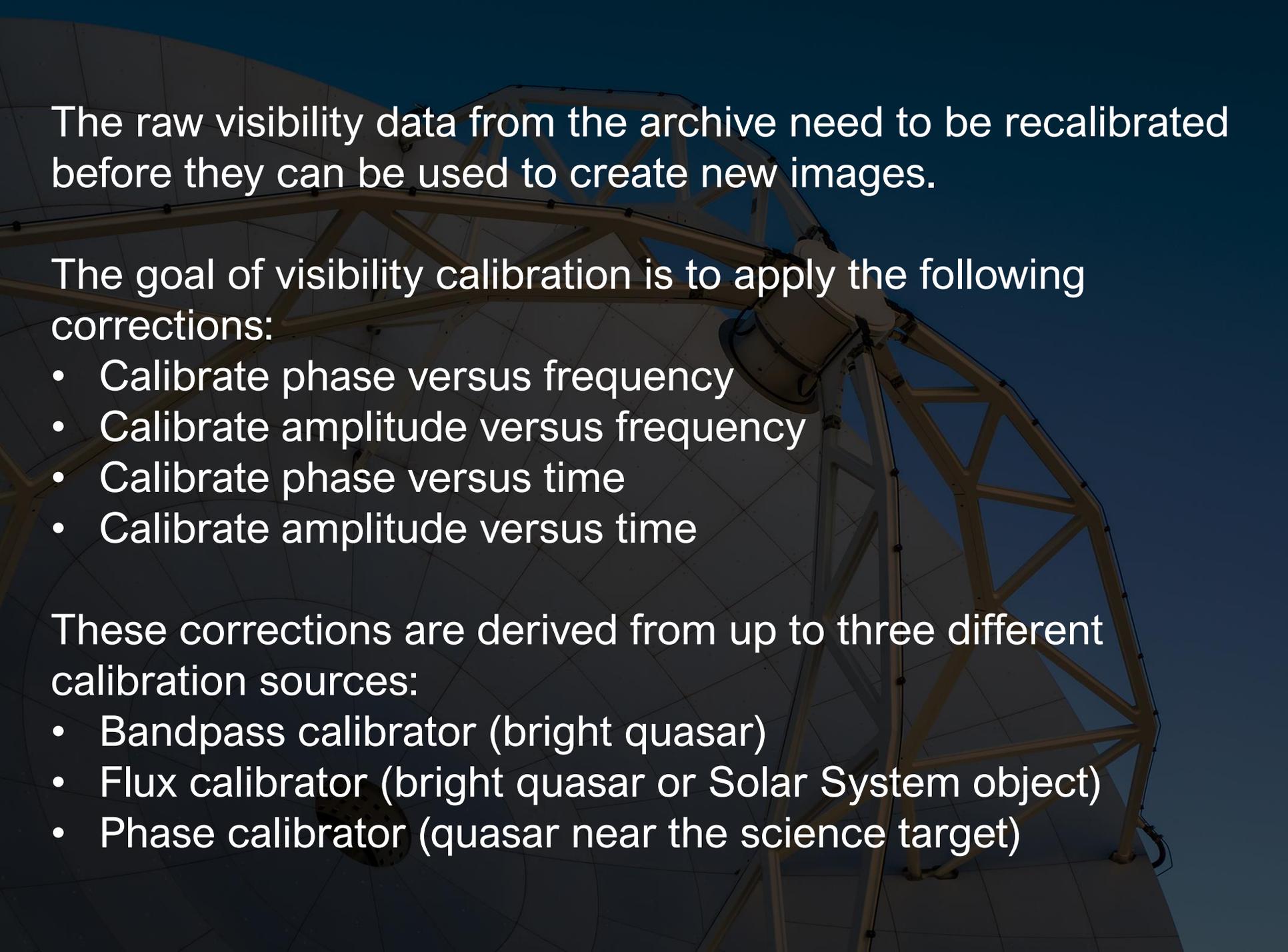
Contents of an example measurement set:

ANTENNA/	PROCESSOR/	table.f17_TSM3	table.f24
ASDM_ANTENNA/	SOURCE/	table.f17_TSM4	table.f24_TSM1
ASDM_CALATMOSPHERE/	SPECTRAL_WINDOW/	table.f18	table.f24_TSM2
ASDM_CALWVR/	STATE/	table.f19	table.f24_TSM3
ASDM_CORRELATORMODE/	SYSCAL/	table.f2	table.f24_TSM4
ASDM_RECEIVER/	SYSPower/	table.f20	table.f3
ASDM_SBSUMMARY/	table.dat	table.f20_TSM0	table.f4
ASDM_SOURCE/	table.f1	table.f21	table.f5
ASDM_STATION/	table.f10	table.f21_TSM1	table.f6
CALDEVICE/	table.f11	table.f21_TSM2	table.f7
DATA_DESCRIPTION/	table.f12	table.f21_TSM3	table.f8
FEED/	table.f13	table.f21_TSM4	table.f9
FIELD/	table.f14	table.f22	table.info
FLAG_CMD/	table.f15	table.f22_TSM1	table.lock
HISTORY/	table.f16	table.f22_TSM2	WEATHER/
OBSERVATION/	table.f17	table.f23	
POINTING/	table.f17_TSM1	table.f23_TSM1	
POLARIZATION/	table.f17_TSM2	table.f23_TSM2	

A large satellite dish antenna structure is shown against a dark blue sky. The dish is composed of a complex metal truss structure and a large, curved, perforated metal surface. The structure is illuminated from the side, creating strong highlights and deep shadows. The background is a clear, dark blue sky.

The contents of a measurement set can be viewed in text format using the listobs command. The following command creates a text file that contains the output from listobs:

```
listobs(vis='uid__A002_Xd98580_X354.ms.split.cal',  
        listfile='uid__A002_Xd98580_X354.ms.split.cal.listobs')
```



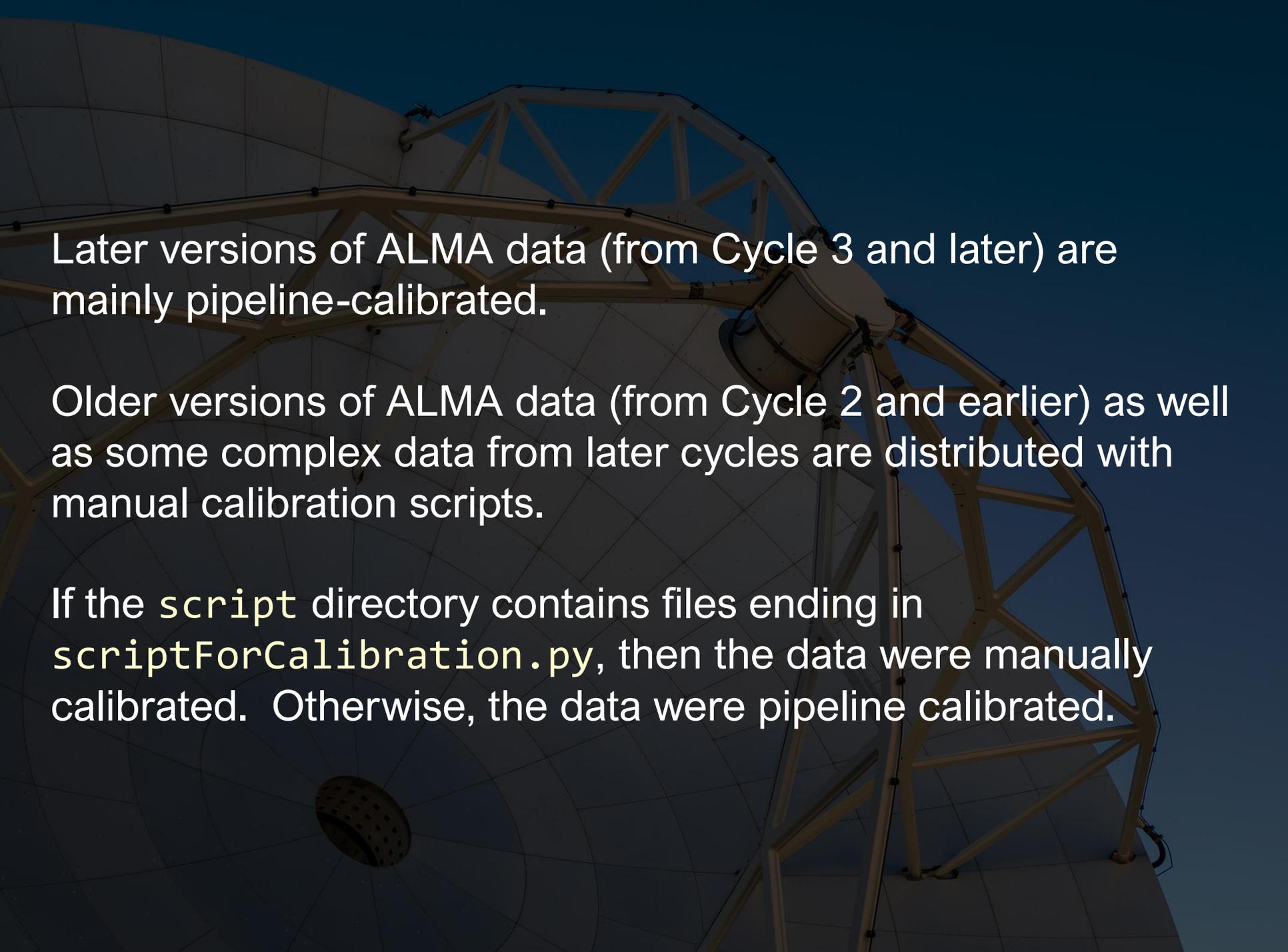
The raw visibility data from the archive need to be recalibrated before they can be used to create new images.

The goal of visibility calibration is to apply the following corrections:

- Calibrate phase versus frequency
- Calibrate amplitude versus frequency
- Calibrate phase versus time
- Calibrate amplitude versus time

These corrections are derived from up to three different calibration sources:

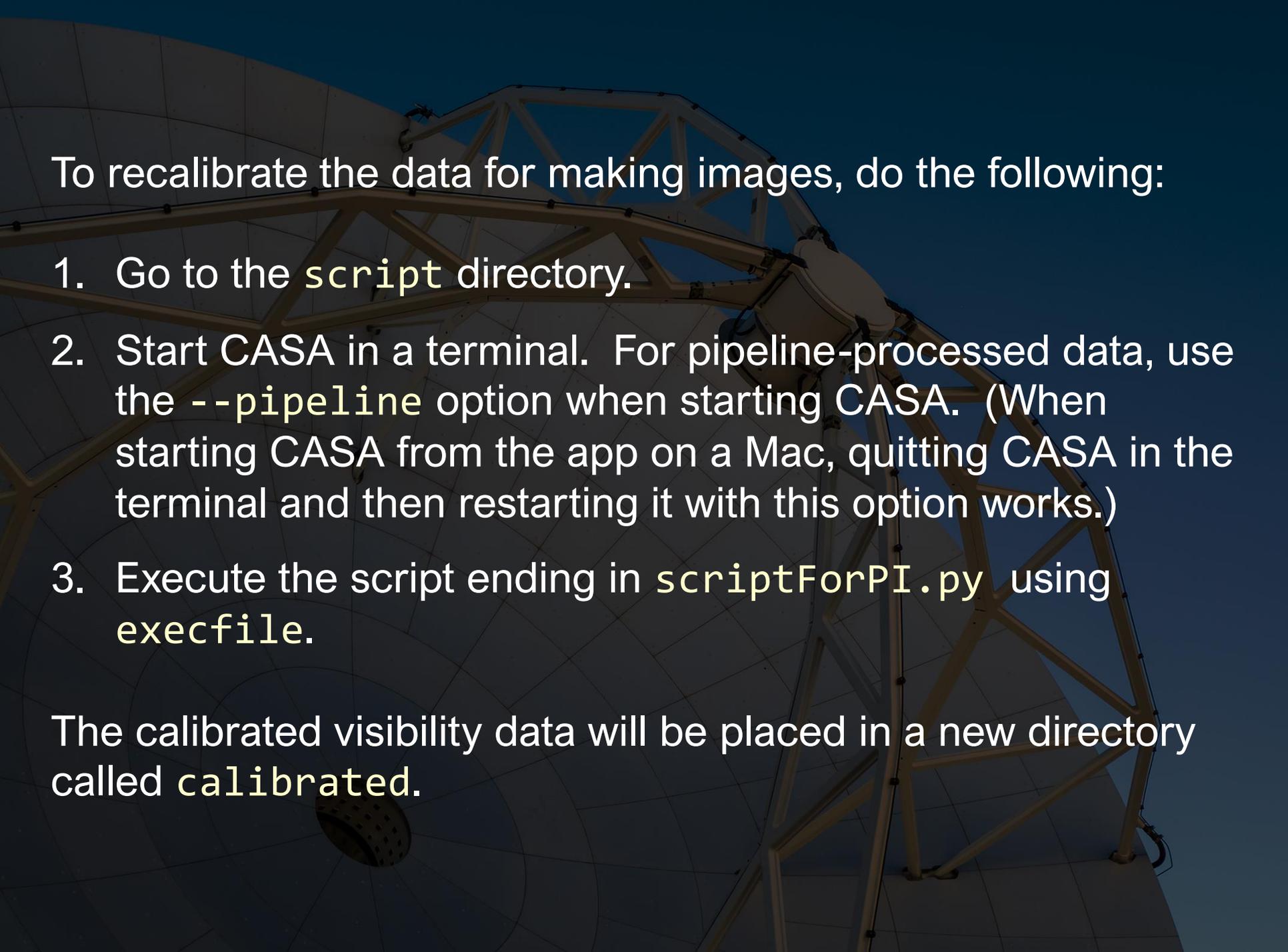
- Bandpass calibrator (bright quasar)
- Flux calibrator (bright quasar or Solar System object)
- Phase calibrator (quasar near the science target)



Later versions of ALMA data (from Cycle 3 and later) are mainly pipeline-calibrated.

Older versions of ALMA data (from Cycle 2 and earlier) as well as some complex data from later cycles are distributed with manual calibration scripts.

If the `script` directory contains files ending in `scriptForCalibration.py`, then the data were manually calibrated. Otherwise, the data were pipeline calibrated.

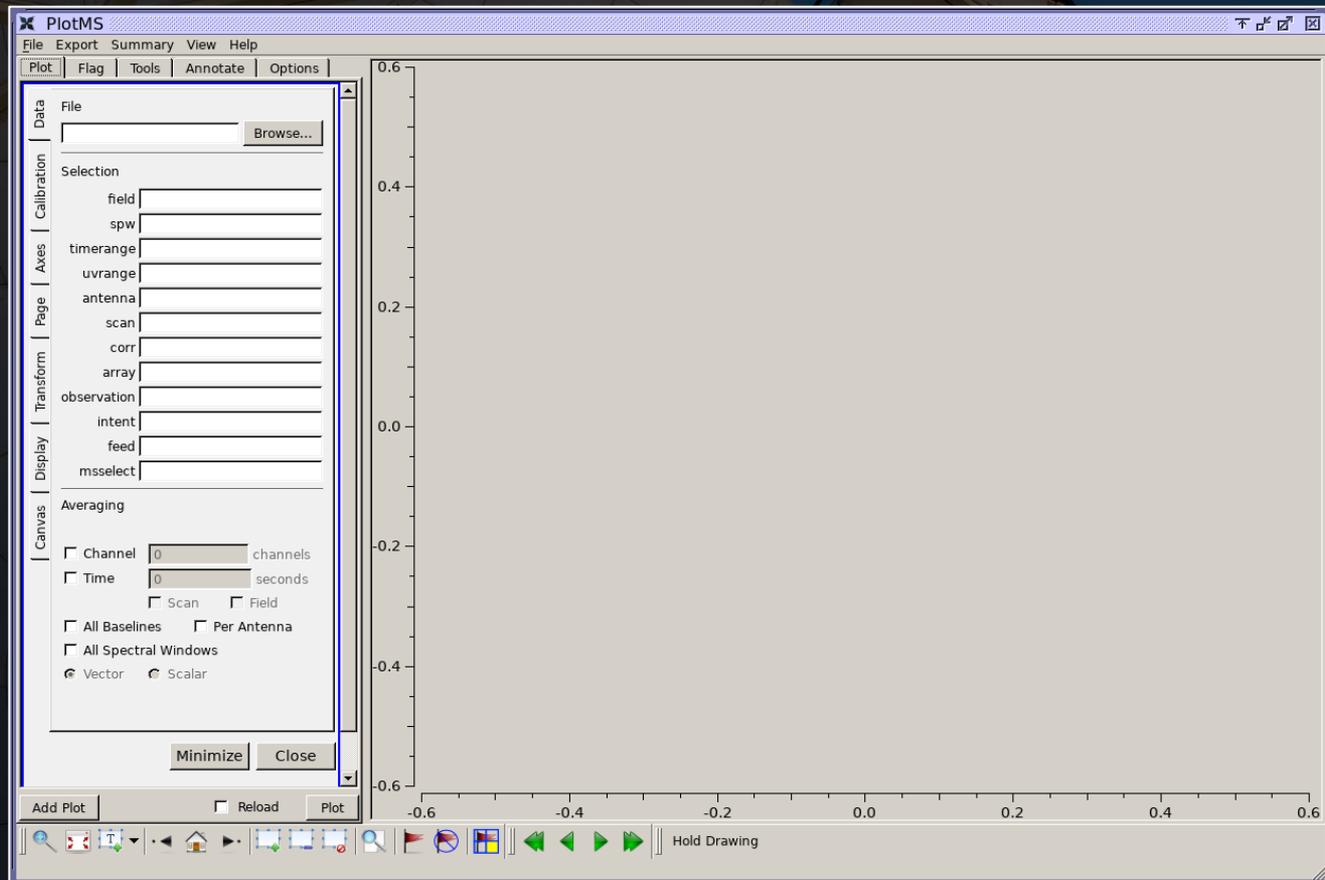


To recalibrate the data for making images, do the following:

1. Go to the `script` directory.
2. Start CASA in a terminal. For pipeline-processed data, use the `--pipeline` option when starting CASA. (When starting CASA from the app on a Mac, quitting CASA in the terminal and then restarting it with this option works.)
3. Execute the script ending in `scriptForPI.py` using `execfile`.

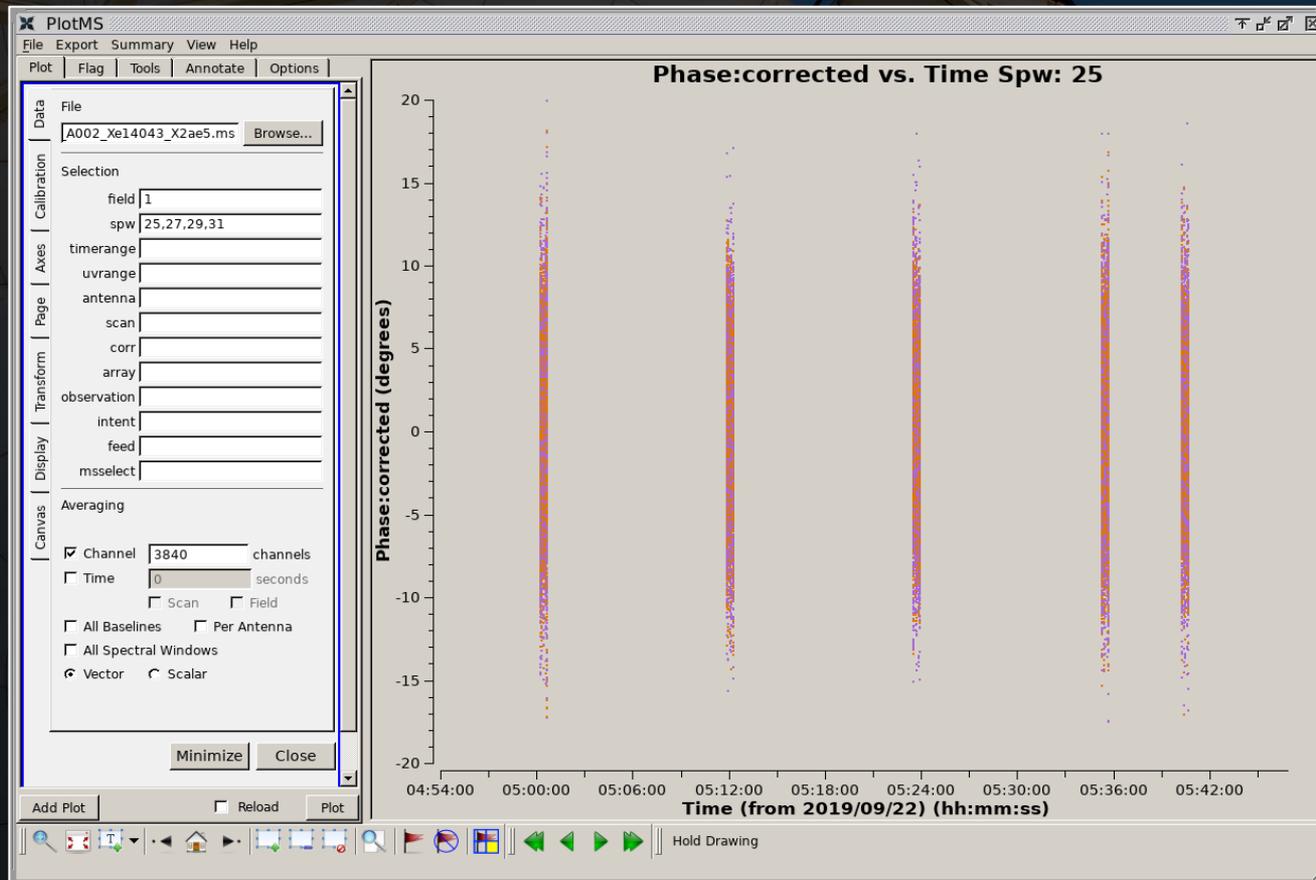
The calibrated visibility data will be placed in a new directory called `calibrated`.

The CASA tool plotms can be used to visually inspect the visibility data. This is useful for checking the quality of the data after it has been calibrated.



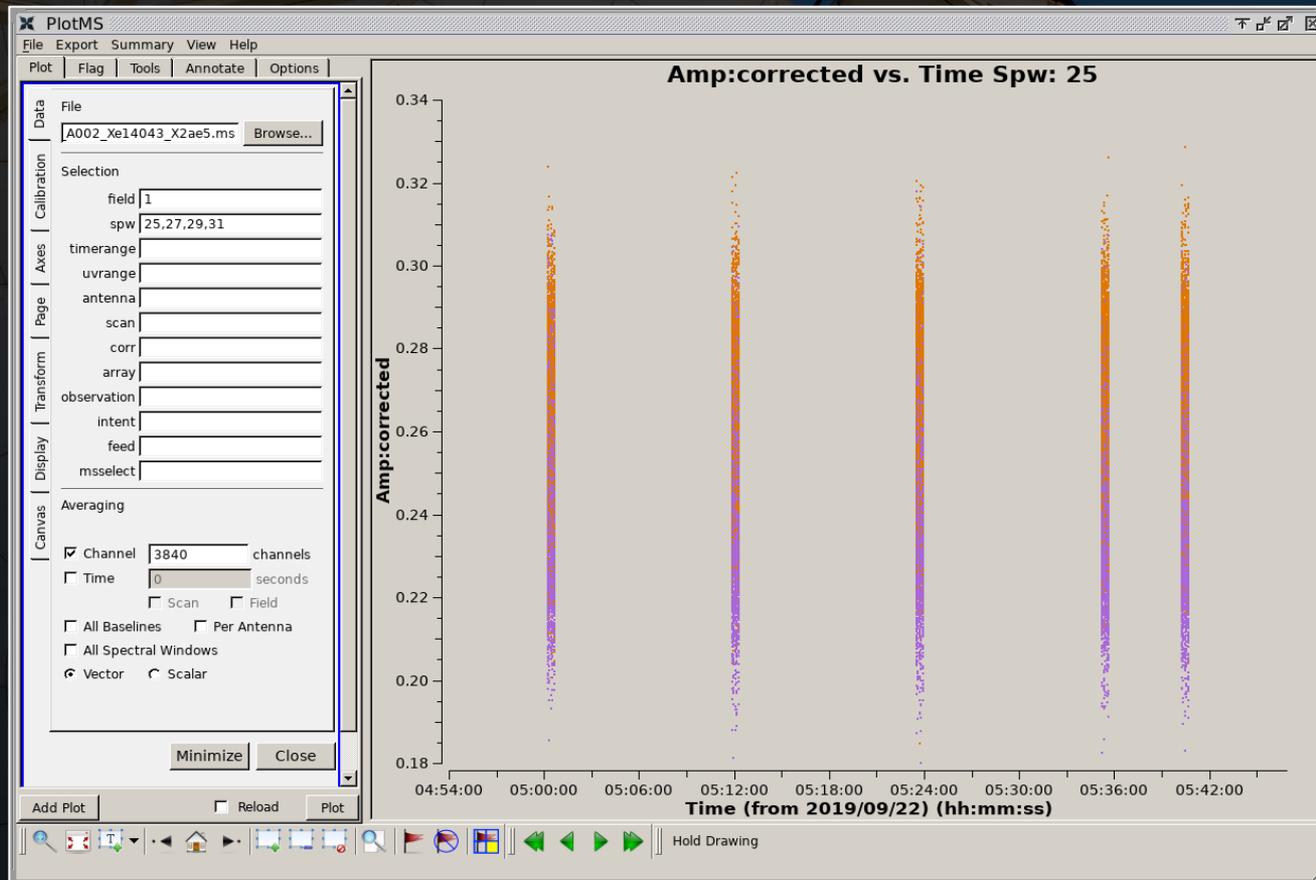
The following checks are recommended:

- Plot phase versus time for the phase calibrator
- Plot amplitude versus time for the phase calibrator
- Plot amplitude versus channel for the bandpass calibrator
- Plot amplitude versus uv distance for the flux calibrator



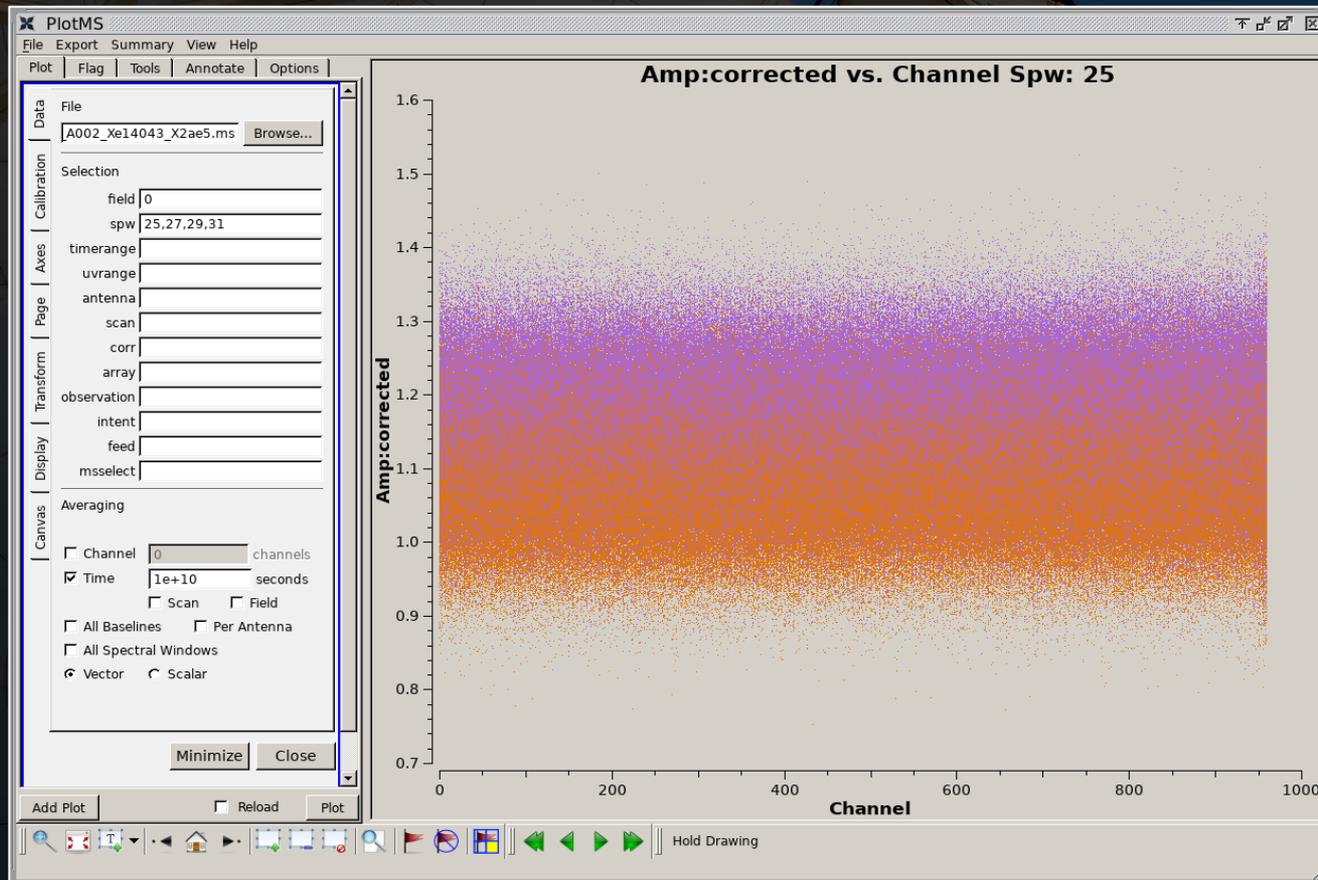
The following checks are recommended:

- Plot phase versus time for the phase calibrator
- Plot amplitude versus time for the phase calibrator
- Plot amplitude versus channel for the bandpass calibrator
- Plot amplitude versus uv distance for the flux calibrator



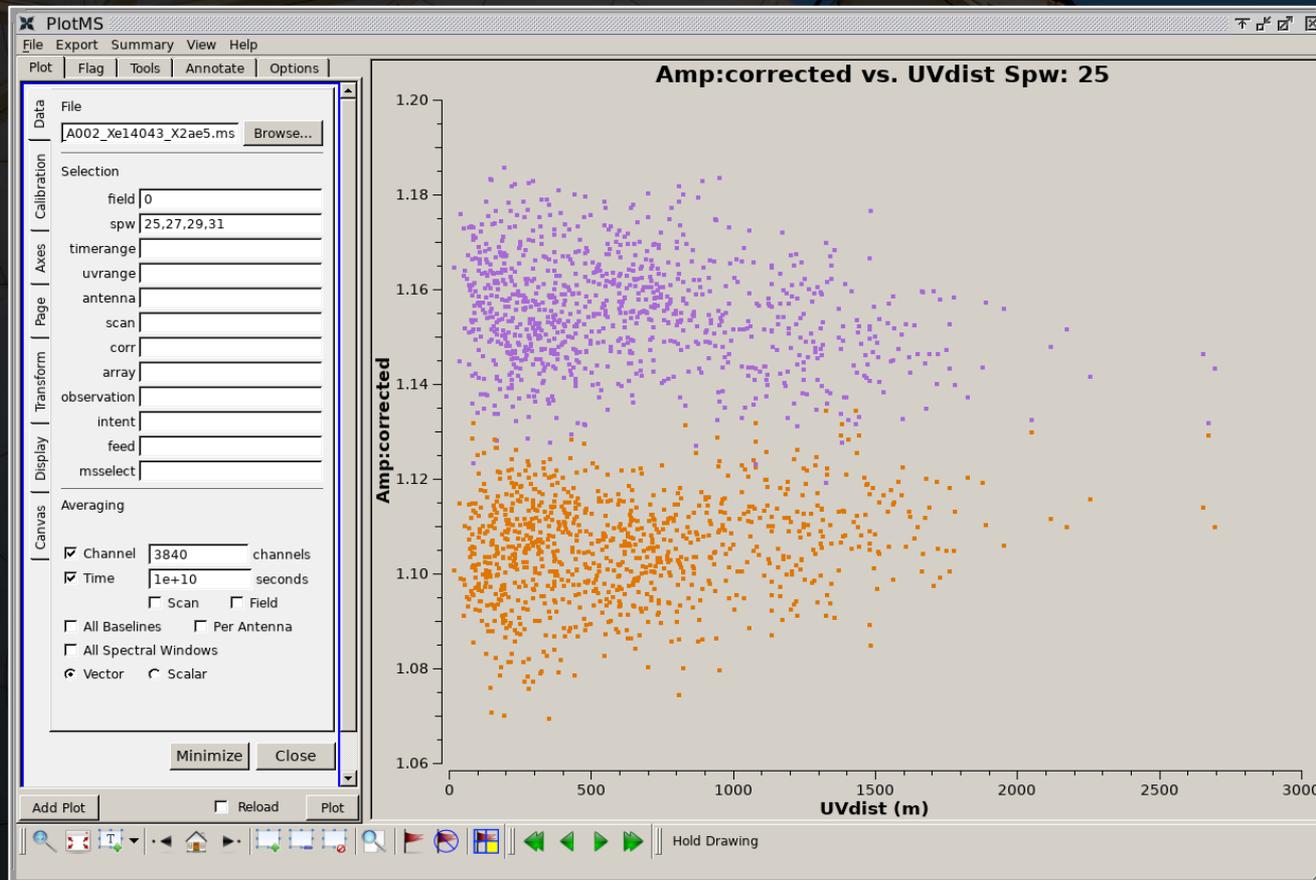
The following checks are recommended:

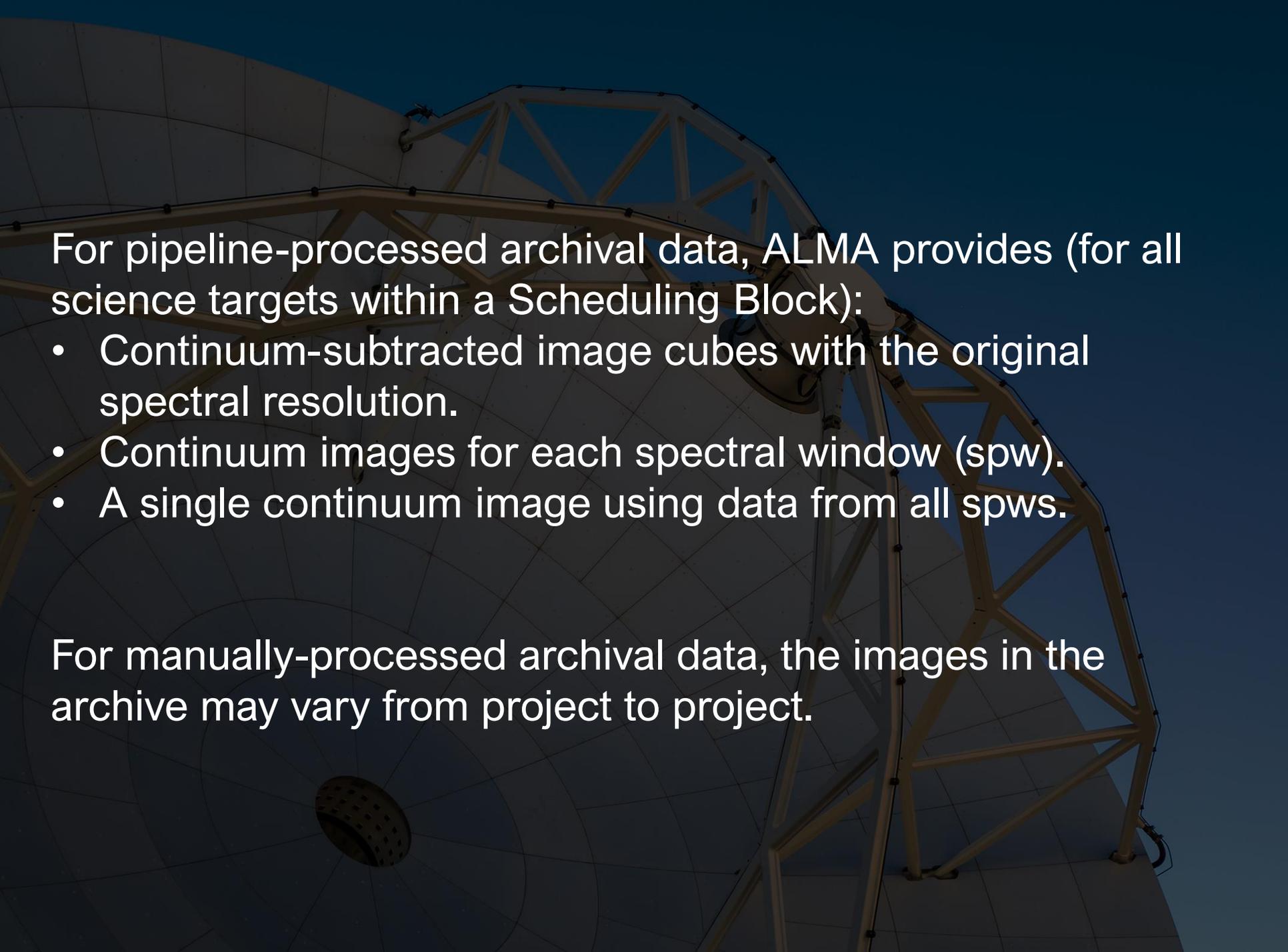
- Plot phase versus time for the phase calibrator
- Plot amplitude versus time for the phase calibrator
- Plot amplitude versus channel for the bandpass calibrator
- Plot amplitude versus uv distance for the flux calibrator



The following checks are recommended:

- Plot phase versus time for the phase calibrator
- Plot amplitude versus time for the phase calibrator
- Plot amplitude versus channel for the bandpass calibrator
- Plot amplitude versus uv distance for the flux calibrator

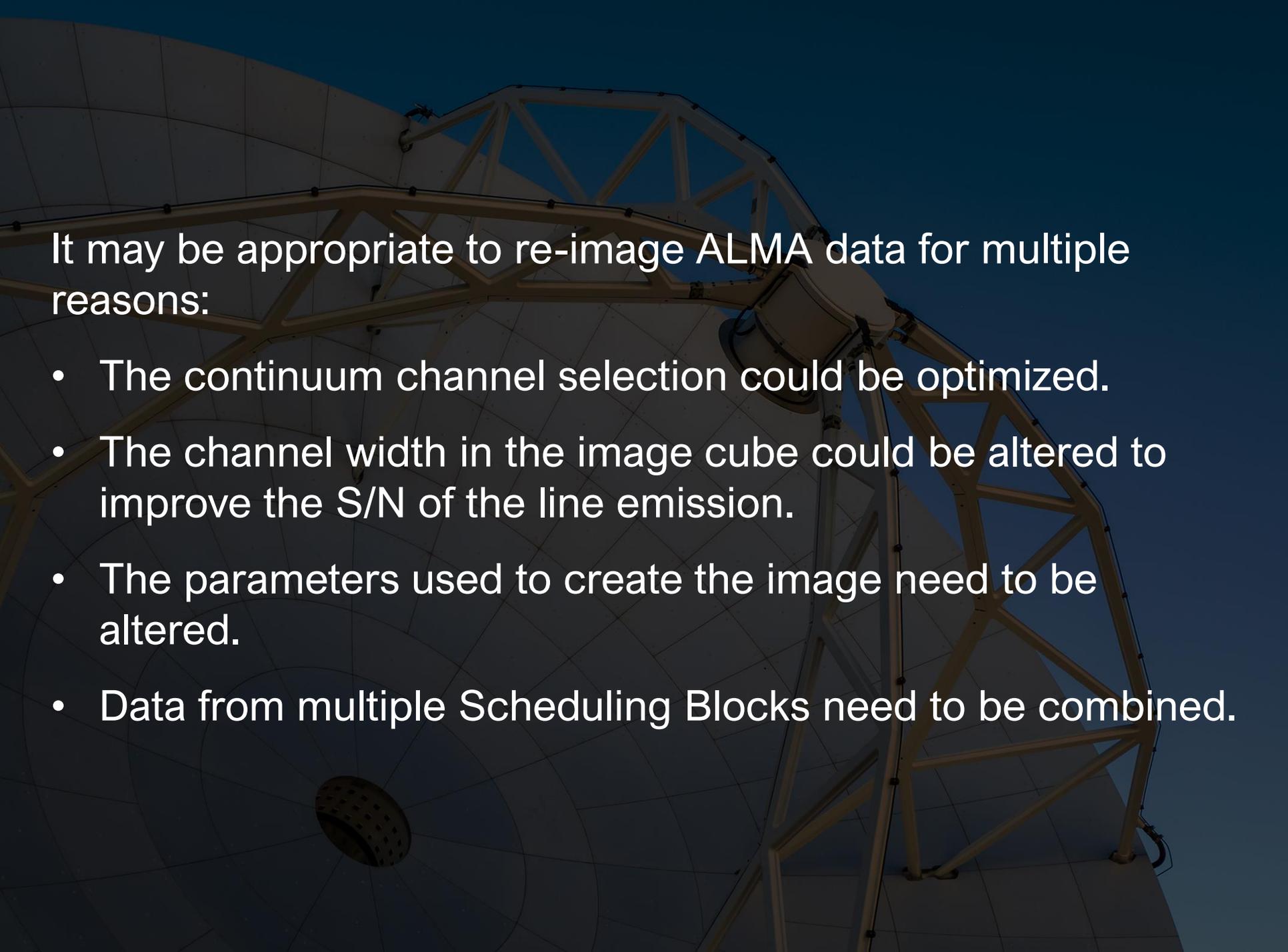


A photograph of an ALMA (Atacama Large Millimeter/submillimeter Array) telescope dish and its supporting structure. The dish is a large, white, segmented parabolic reflector. The structure is a complex metal truss system. The background is a clear blue sky. The text is overlaid on the image in white.

For pipeline-processed archival data, ALMA provides (for all science targets within a Scheduling Block):

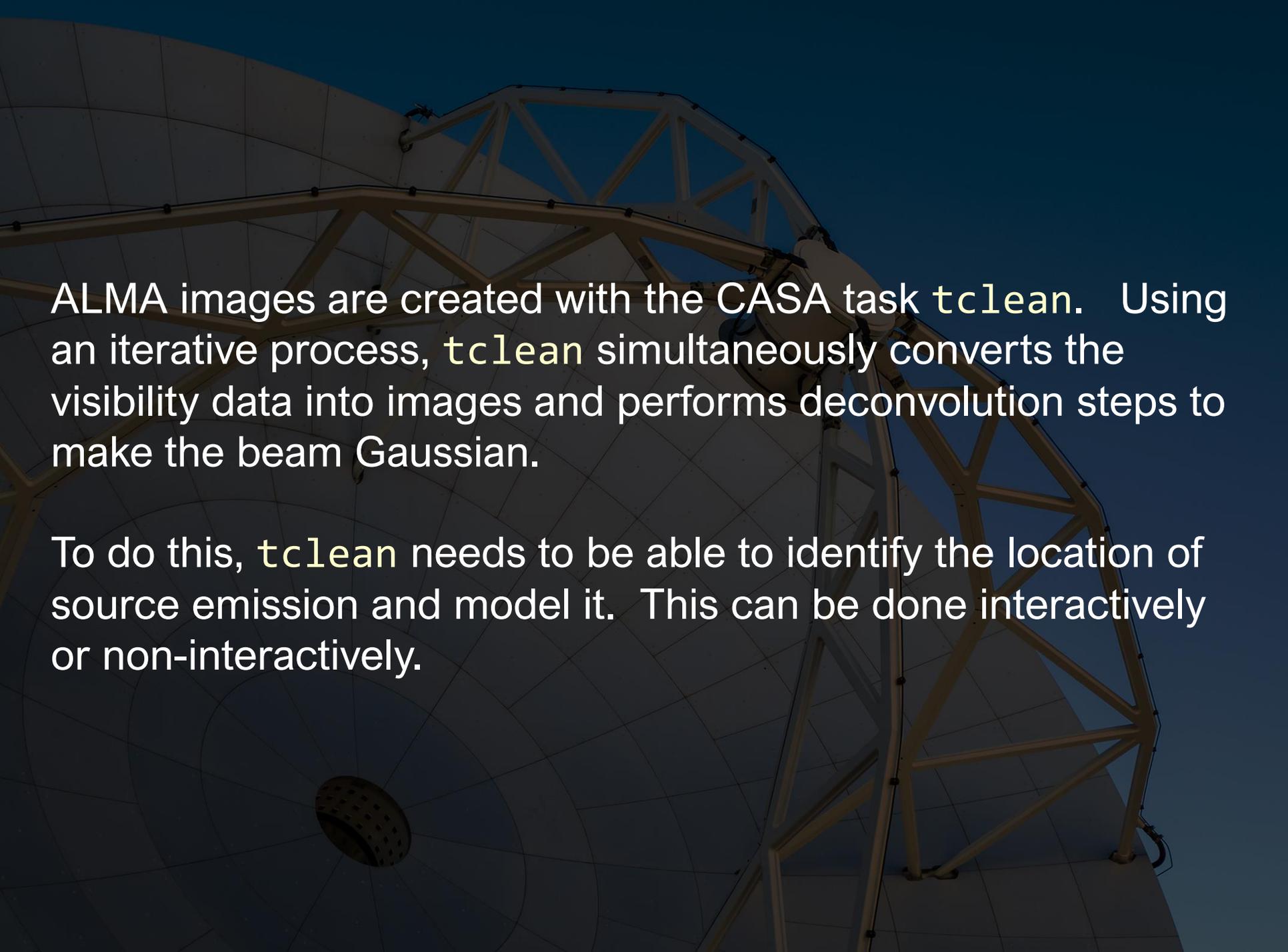
- Continuum-subtracted image cubes with the original spectral resolution.
- Continuum images for each spectral window (spw).
- A single continuum image using data from all spws.

For manually-processed archival data, the images in the archive may vary from project to project.



It may be appropriate to re-image ALMA data for multiple reasons:

- The continuum channel selection could be optimized.
- The channel width in the image cube could be altered to improve the S/N of the line emission.
- The parameters used to create the image need to be altered.
- Data from multiple Scheduling Blocks need to be combined.



ALMA images are created with the CASA task `tclean`. Using an iterative process, `tclean` simultaneously converts the visibility data into images and performs deconvolution steps to make the beam Gaussian.

To do this, `tclean` needs to be able to identify the location of source emission and model it. This can be done interactively or non-interactively.

tclean example (continuum imaging):

```
tclean(vis='uid__A002_Xd98580_X354.ms.split.cal',  
        imagename='ZCMA_continuum',  
        field='2',  
        imsize=[320,320],  
        cell='0.15arcsec',  
        phasecenter=2,  
        specmode='mfs',  
        spw='25,27,29,31,33,35,37,39,41:300~959,43:0~85;115~959,45',  
        outframe='LSRK',  
        deconvolver='hogbom',  
        chanchunks=-1,  
        niter=500,  
        cycleniter=500,  
        threshold='0mJy',  
        weighting='natural',  
        gridding='standard',  
        restoringbeam='common',  
        pbcor=True,  
        interactive=True)
```



For creating image cubes of spectral line emission, it is often useful to subtract the continuum emission from the visibility data. This can be done using `uvcontsub`, as shown in the example below:

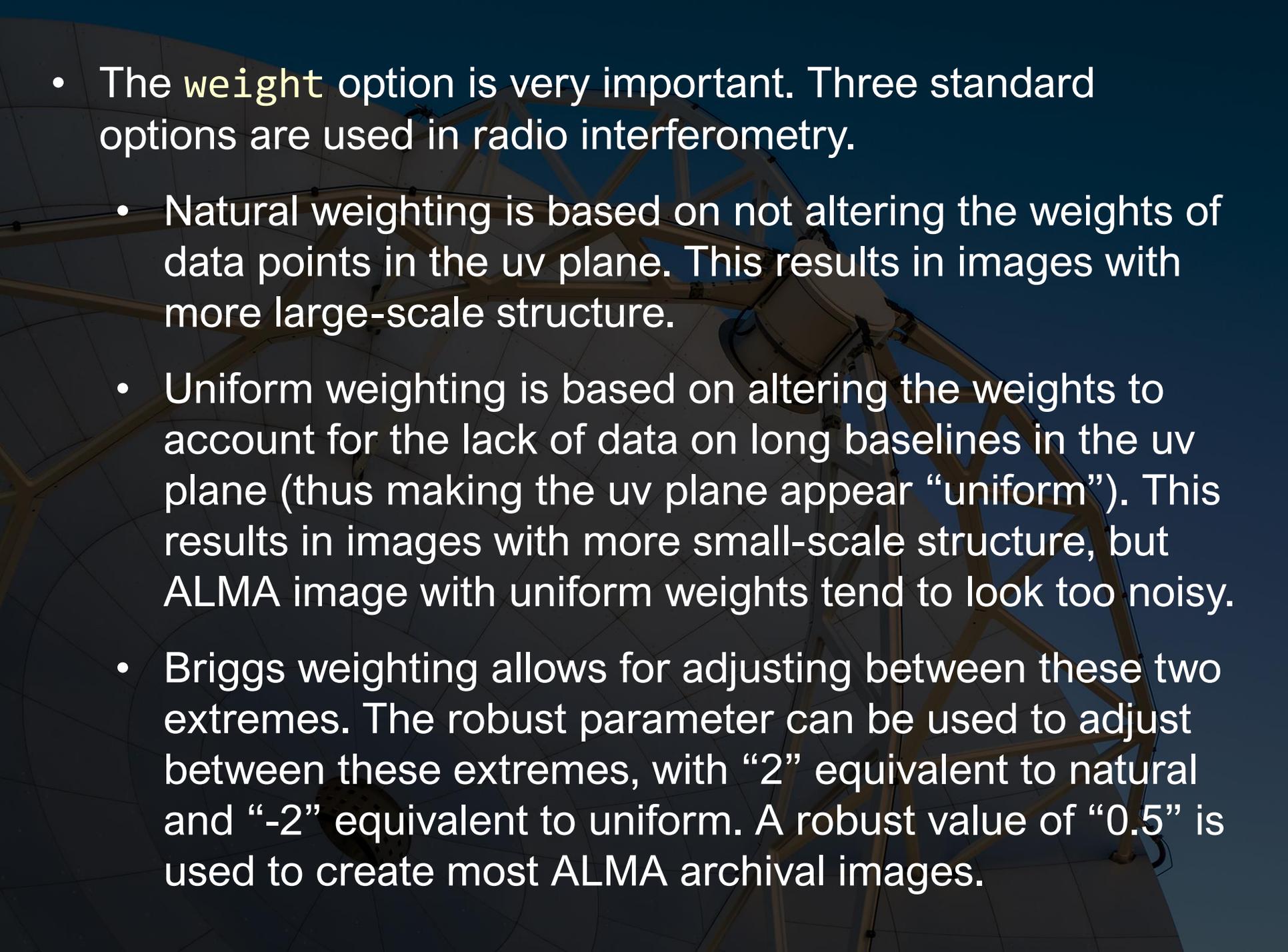
```
uvcontsub(vis='uid__A002_Xd98580_X354.ms.split.cal',  
          field='2',  
          spw='43',  
          fitspw='43:0~85;115~959')
```

tclean example (spectral line imaging):

```
tclean(vis='uid__A002_Xd98580_X354.ms.split.cal.contsub',  
       imagename='ZCma_spw45_cube',  
       field='0',  
       imsize=[320,320],  
       cell='0.15arcsec',  
       phasecenter=0,  
       specmode='cube',  
       spw='0',  
       start=40,  
       nchan=160,  
       width=1,  
       outframe='LSRK',  
       restfreq = '231.2206GHz',  
       deconvolver='multiscale',  
       scales=[0,5,15],  
       chanchunks=-1,  
       niter=500,  
       cycleniter=500,  
       threshold='0mJy',  
       weighting='briggs',  
       robust=0.5,  
       gridding='standard',  
       restoringbeam='common',  
       pbcor=True,  
       interactive=True)
```

Important points on `tclean` settings:

- The `cell` value should be at least $2\times$ (and preferable $3-4\times$) smaller than the size of the beam.
- The primary beam (PB) correction needs to be applied (using `pbcor=True`) to measure accurate flux densities for sources near the edge of the field.
- The channel width for spectral cubes may be adjusted to optimize line detection (often by using wider channels) or to measure detail in line shapes (by using narrower channels).
- The `gridder` parameter should be set to "standard" for single pointings and "mosaic" for multiple pointings.

- 
- The **weight** option is very important. Three standard options are used in radio interferometry.
 - Natural weighting is based on not altering the weights of data points in the uv plane. This results in images with more large-scale structure.
 - Uniform weighting is based on altering the weights to account for the lack of data on long baselines in the uv plane (thus making the uv plane appear “uniform”). This results in images with more small-scale structure, but ALMA image with uniform weights tend to look too noisy.
 - Briggs weighting allows for adjusting between these two extremes. The robust parameter can be used to adjust between these extremes, with “2” equivalent to natural and “-2” equivalent to uniform. A robust value of “0.5” is used to create most ALMA archival images.

Viewer Display Panel (gc)

Data Display Panel Tools View Help

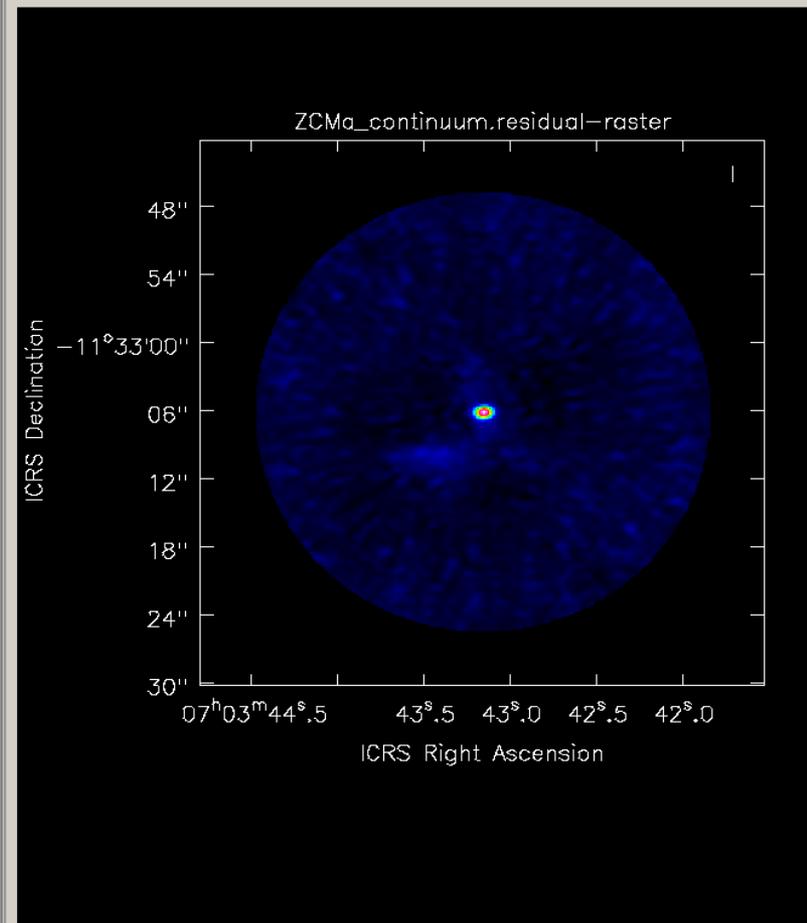


Add This Channel This Polarization Next Action:

Erase All Channels All Polarizations

max cycleniter: 500 iterations left: 500 threshold: 0jy cyclethreshold: 0.00329734jy

Display



Animators

Stokes

Images

Rate: 10 Jump 0 2

0 1

Cursors

ZCma_continuum.residual-raster

+0.00178681 Pixel: 204 82 0 0
07:03:42.706 -11.33.17.947 I -8949.68 km/s (lsrk/radio velocity)

ZCma_continuum.mask

+0 Pixel: 204 82 0 0
07:03:42.706 -11.33.17.947 I -8949.68 km/s (lsrk/radio velocity)
Contours: -0.6 -0.2 0.2 0.6

Viewer Display Panel (gc)

Data Display Panel Tools View Help

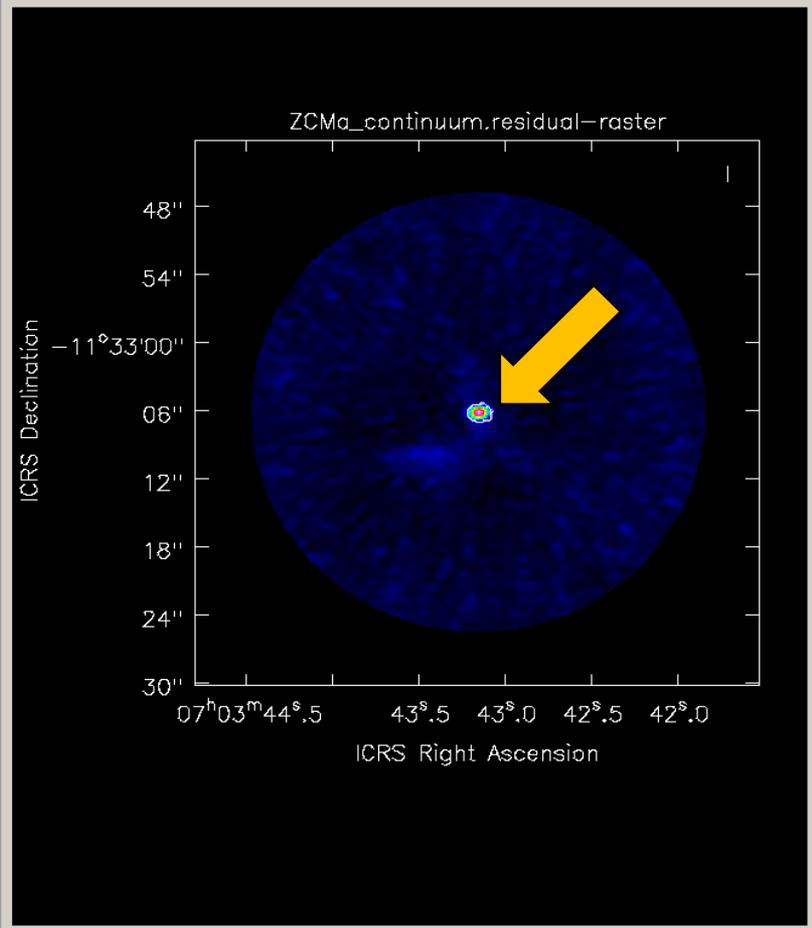


Add This Channel This Polarization Next Action:

Erase All Channels All Polarizations

max cycleniter: 500 iterations left: 500 threshold: 0jy cyclethreshold: 0.00329734jy

Display



Animators

Stokes

Images

Cursors

ZCma_continuum.residual-raster

-0.000606519	Pixel: 184 85 0 0
07:03:42.917 -11.33.17.430 I	-8949.68 km/s (lsrk/radio velocity)

ZCma_continuum.mask

+0	Pixel: 184 85 0 0
07:03:42.917 -11.33.17.430 I	-8949.68 km/s (lsrk/radio velocity)
Contours: -0.6 -0.2 0.2 0.6	

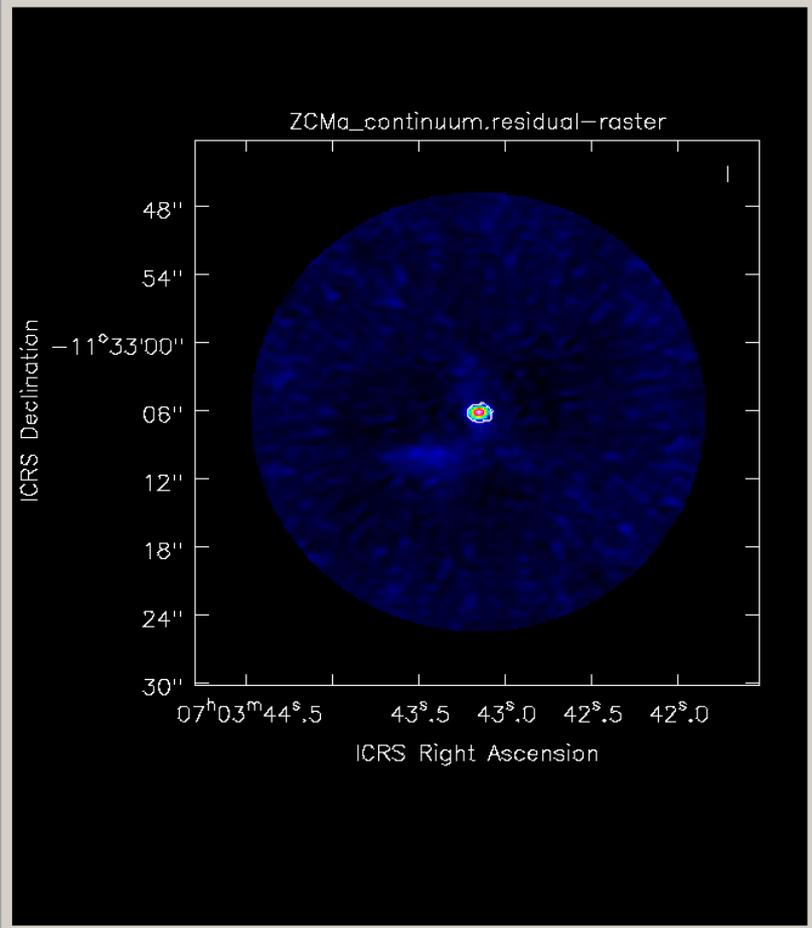


Add This Channel This Polarization Next Action:  

Erase All Channels All Polarizations

max cycleniter: 500 iterations left: 500 threshold: 0jy cyclethreshold: 0.00329734jy

Display [Icons]



Animators [Icons]

Stokes

Images

 Rate: 10 Jump 0 2

0  1

Cursors [Icons]

ZCMa_continuum.residual-raster

-0.000606519	Pixel: 184 85 0 0
07:03:42.917	-11.33.17.430 I -8949.68 km/s (lsrk/radio velocity)

ZCMa_continuum.mask

+0	Pixel: 184 85 0 0
07:03:42.917	-11.33.17.430 I -8949.68 km/s (lsrk/radio velocity)
Contours: -0.6 -0.2 0.2 0.6	

Viewer Display Panel (gc)

Data Display Panel Tools View Help

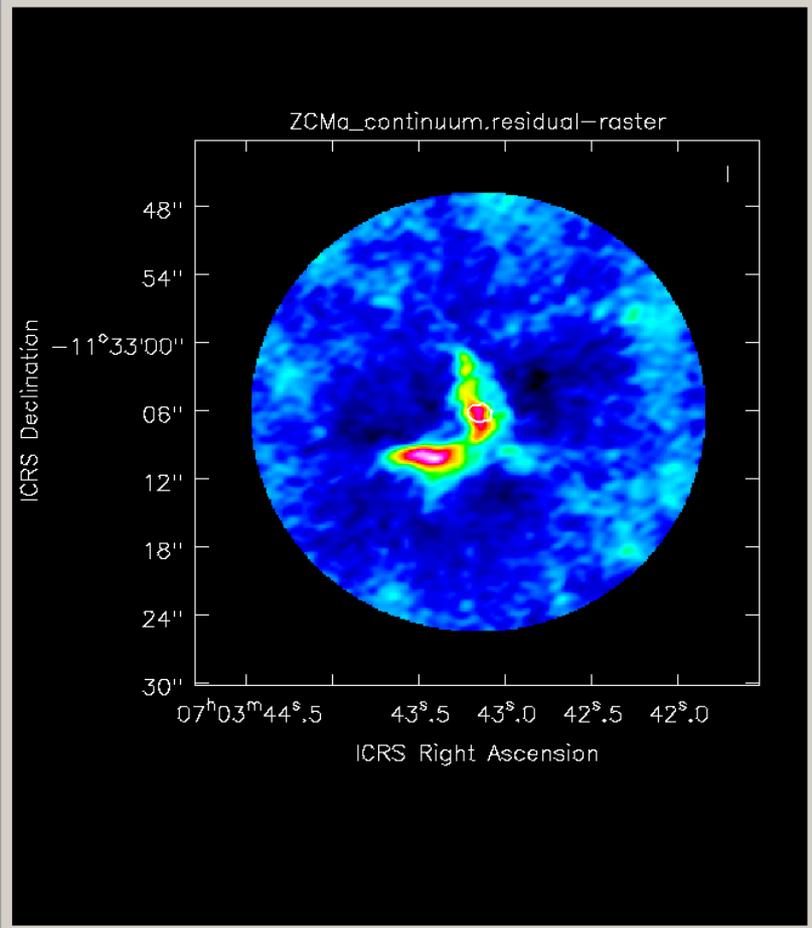


Add This Channel This Polarization Next Action:

Erase All Channels All Polarizations

max cycleniter: 500 iterations left: 474 threshold: 0Jy cyclethreshold: 0Jy

Display



Animators

Stokes

Images

Rate: 10 Jump 0 2

0 1

Cursors

ZCma_continuum.residual-raster

-1.01193e-05 Pixel: 163 37 0 0
07:03:43.128 -11.33.24.568 I -8949.68 km/s (lsrk/radio velocity)

ZCma_continuum.mask

+0 Pixel: 163 37 0 0
07:03:43.128 -11.33.24.568 I -8949.68 km/s (lsrk/radio velocity)
Contours: 0.2 0.4 0.6 0.8

Viewer Display Panel (gc)

Data Display Panel Tools View Help

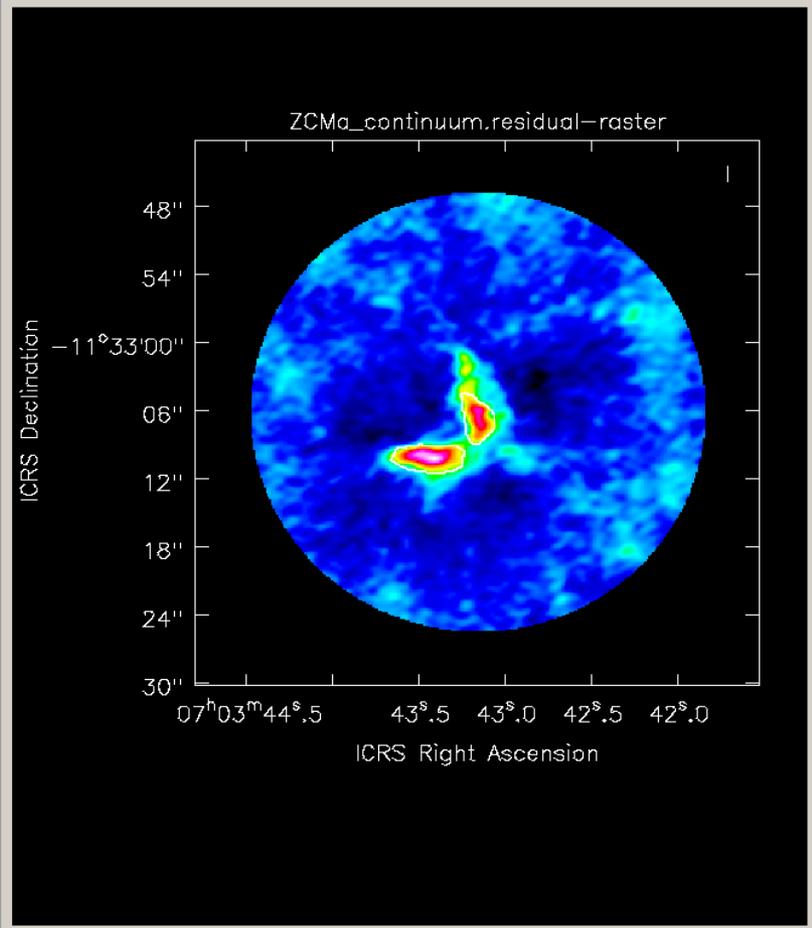


Add This Channel This Polarization Next Action:

Erase All Channels All Polarizations

max cycleniter: 500 iterations left: 474 threshold: 0jy cyclethreshold: 0jy

Display



Animators

Stokes

Images

Rate: 10 Jump 0 2

0 1

Cursors

ZCMa_continuum.residual-raster

masked Pixel: 198 10 0 0
07:03:42.769 -11.33.28.706 I -8949.68 km/s (lsrk/radio velocity)

ZCMa_continuum.mask

+0 Pixel: 198 10 0 0
07:03:42.769 -11.33.28.706 I -8949.68 km/s (lsrk/radio velocity)
Contours: 0.2 0.4 0.6 0.8

Viewer Display Panel (gc)

Data Display Panel Tools View Help

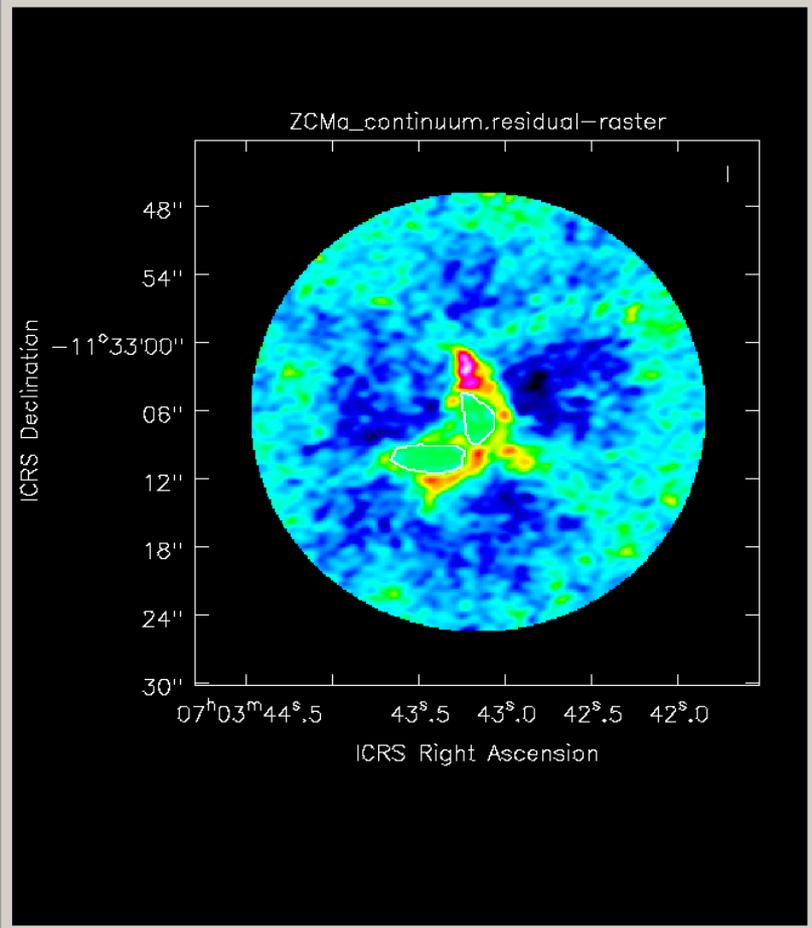


Add This Channel This Polarization Next Action:

Erase All Channels All Polarizations

max cycleniter: iterations left: threshold: cyclethreshold:

Display



loaded: ZCma_continuum.mask

Animators

Stokes
 Images

Rate: Jump

Cursors

ZCma_continuum.residual-raster
 masked Pixel: 32 46 0 0
 07:03:44.466 -11.33.23.223 I -8949.68 km/s (lsrk/radio velocity)

ZCma_continuum.mask
 +0 Pixel: 32 46 0 0
 07:03:44.466 -11.33.23.223 I -8949.68 km/s (lsrk/radio velocity)
 Contours: 0.2 0.4 0.6 0.8

Viewer Display Panel (gc)

Data Display Panel Tools View Help



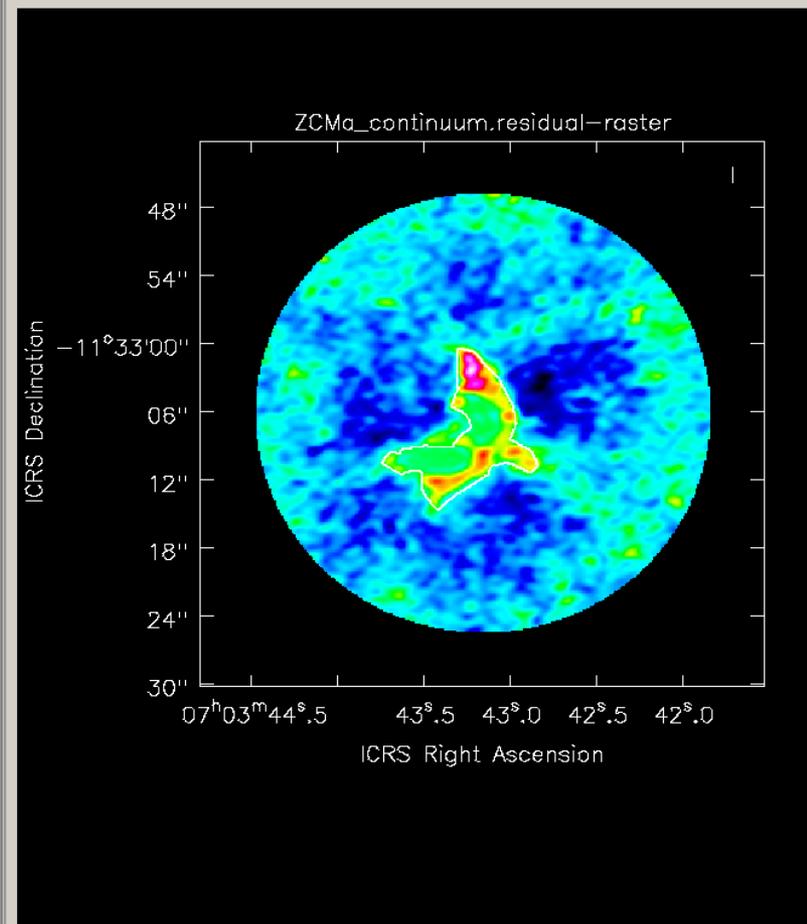
Add This Channel This Polarization Next Action:

Erase All Channels All Polarizations

max cycleniter iterations left threshold cyclethreshold

500 500 0Jy 0Jy

Display



Animators

Stokes

Images

Rate: 10 Jump 0 2

0 1

Cursors

ZCma_continuum.residual-raster

masked Pixel: 1 279 0 0
07:03:44.783 -11.32.48.257 I -8949.68 km/s (lsrk/radio velocity)

ZCma_continuum.mask

+0 Pixel: 1 279 0 0
07:03:44.783 -11.32.48.257 I -8949.68 km/s (lsrk/radio velocity)
Contours: 0.2 0.4 0.6 0.8

Viewer Display Panel (gc)

Data Display Panel Tools View Help

max cycleniter iter left threshold cyclethreshold

500 500 0jy 0jy

Display

Animators

Stokes

Images

Rate: 10 Jump 0 2

0 1

Cursors

ZCma_continuum.residual-raster

masked Pixel: 1 279 0 0
07:03:44.783 -11.32.48.257 I -8949.68 km/s (lsrk/radio velocity)

ZCma_continuum.mask

+0 Pixel: 1 279 0 0
07:03:44.783 -11.32.48.257 I -8949.68 km/s (lsrk/radio velocity)
Contours: 0.2 0.4 0.6 0.8

ZCma_continuum.residual-raster

ICRS Declination

ICRS Right Ascension

Viewer Display Panel (gc)

Data Display Panel Tools View Help

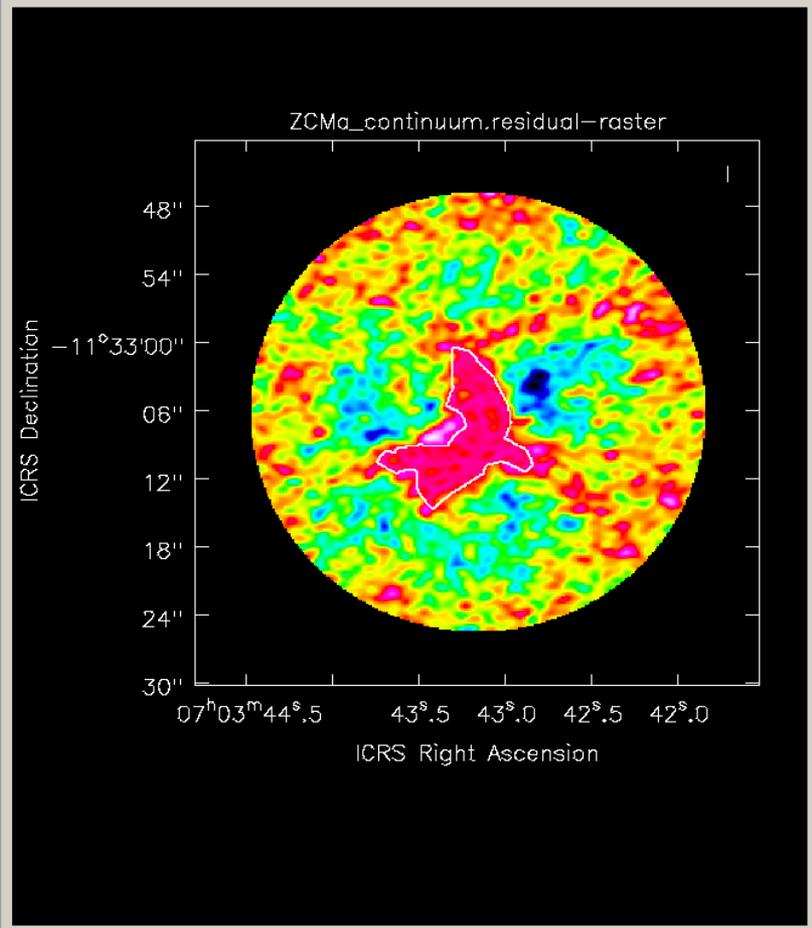


Add This Channel This Polarization Next Action:

Erase All Channels All Polarizations

max cycleniter: 500 iterations left: 0 threshold: 0Jy cyclethreshold: 0Jy

Display



loaded: ZCma_continuum.mask

Animators

Stokes

Images

Rate: 10 Jump 0 2

0 1

Cursors

ZCma_continuum.residual-raster

masked Pixel: 108 11 0 0
07:03:43.684 -11.33.28.499 I -8949.68 km/s (lsrk/radio velocity)

ZCma_continuum.mask

+0 Pixel: 108 11 0 0
07:03:43.684 -11.33.28.499 I -8949.68 km/s (lsrk/radio velocity)
Contours: 0.2 0.4 0.6 0.8

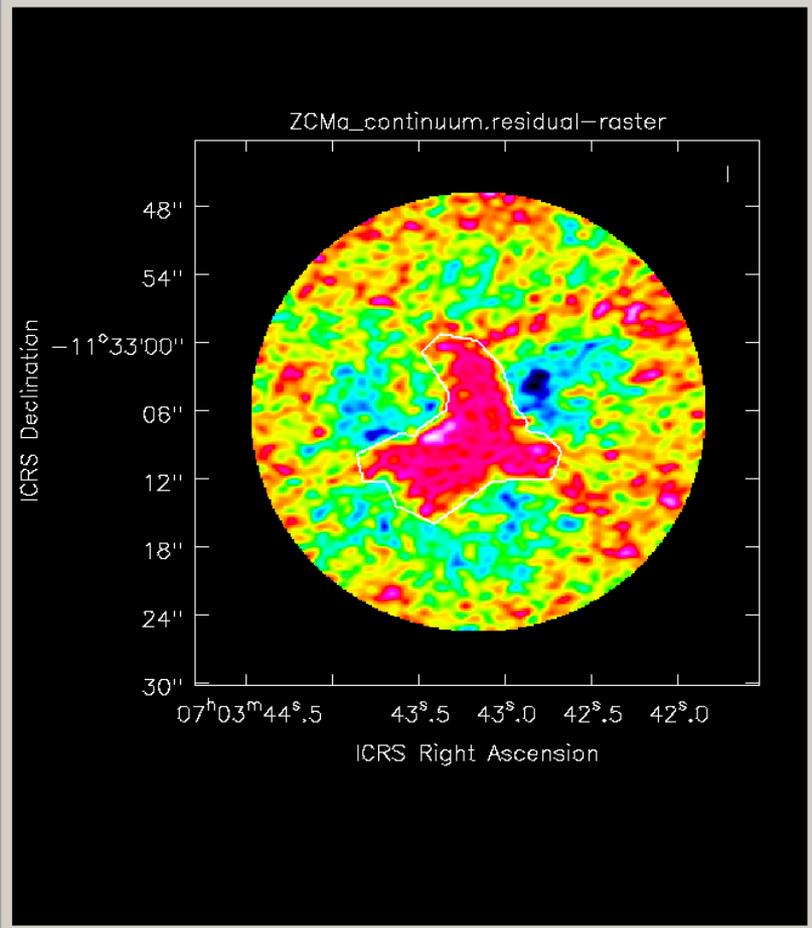


Add This Channel This Polarization Next Action: 

Erase All Channels All Polarizations

max cycleniter: 5000 iterations left: 5000 threshold: 0jy cyclethreshold: 0jy

Display [Icons]



Animators [Icons]

Stokes

Images

 Rate: 10 Jump 0 2

0  1

Cursors [Icons]

ZCMa_continuum.residual-raster

masked Pixel: 304 54 0 0
07:03:41.692 -11.33.22.085 I -8949.68 km/s (lsrk/radio velocity)

ZCMa_continuum.mask

+0 Pixel: 304 54 0 0
07:03:41.692 -11.33.22.085 I -8949.68 km/s (lsrk/radio velocity)
Contours: 0.2 0.4 0.6 0.8

Multiple files are created after cleaning:

image: Science image

image.pbcor: Science image with a PB correction

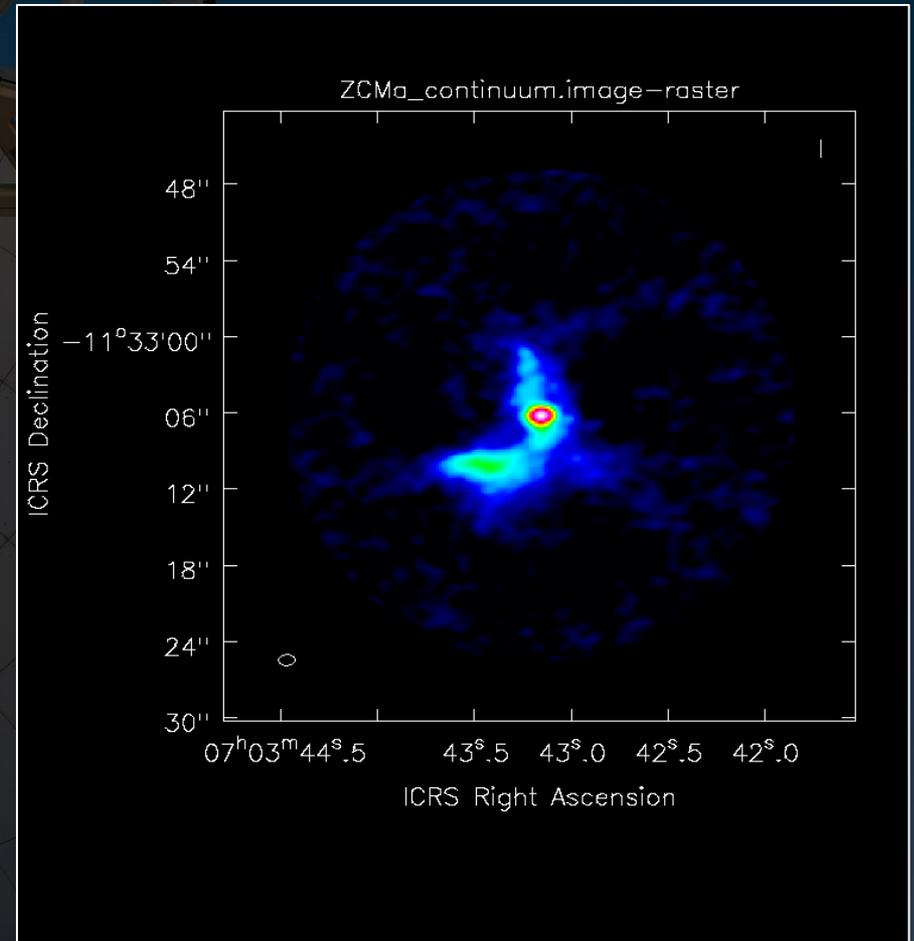
mask: Image mask created while cleaning

model: Model of the emission used for deconvolution

pb: Primary beam (area where the telescope was sensitive)

psf: Beam before cleaning

residual: Residuals after the final iteration of cleaning



Multiple files are created after cleaning:

`image`: Science image

`image.pbcor`: Science image with a PB correction

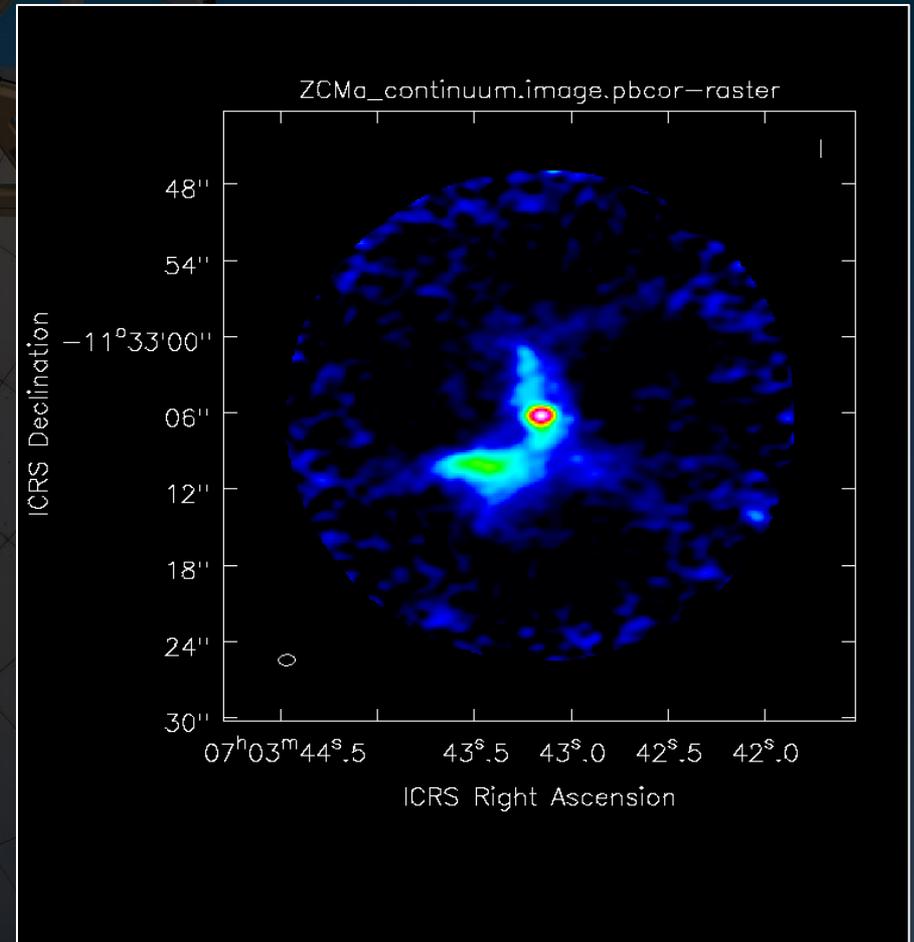
`mask`: Image mask created while cleaning

`model`: Model of the emission used for deconvolution

`pb`: Primary beam (area where the telescope was sensitive)

`psf`: Beam before cleaning

`residual`: Residuals after the final iteration of cleaning



Multiple files are created after cleaning:

image: Science image

image.pbcor: Science image with a PB correction

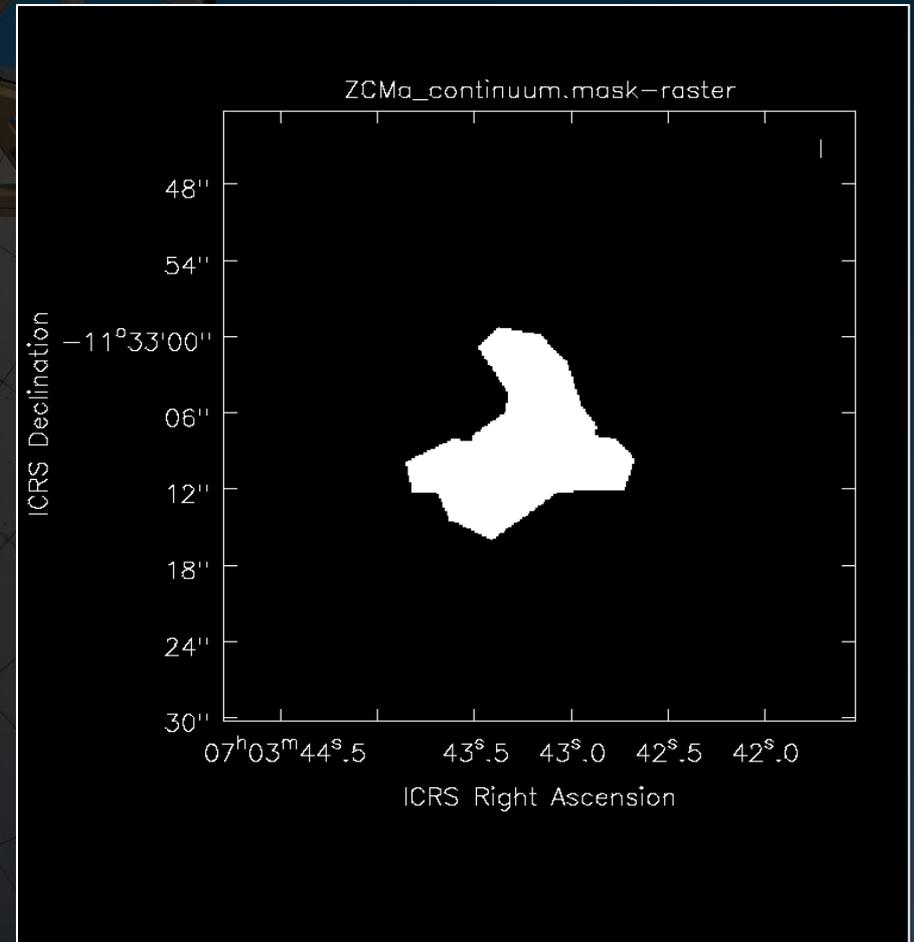
mask: Image mask created while cleaning

model: Model of the emission used for deconvolution

pb: Primary beam (area where the telescope was sensitive)

psf: Beam before cleaning

residual: Residuals after the final iteration of cleaning



Multiple files are created after cleaning:

image: Science image

image.pbcor: Science image with a PB correction

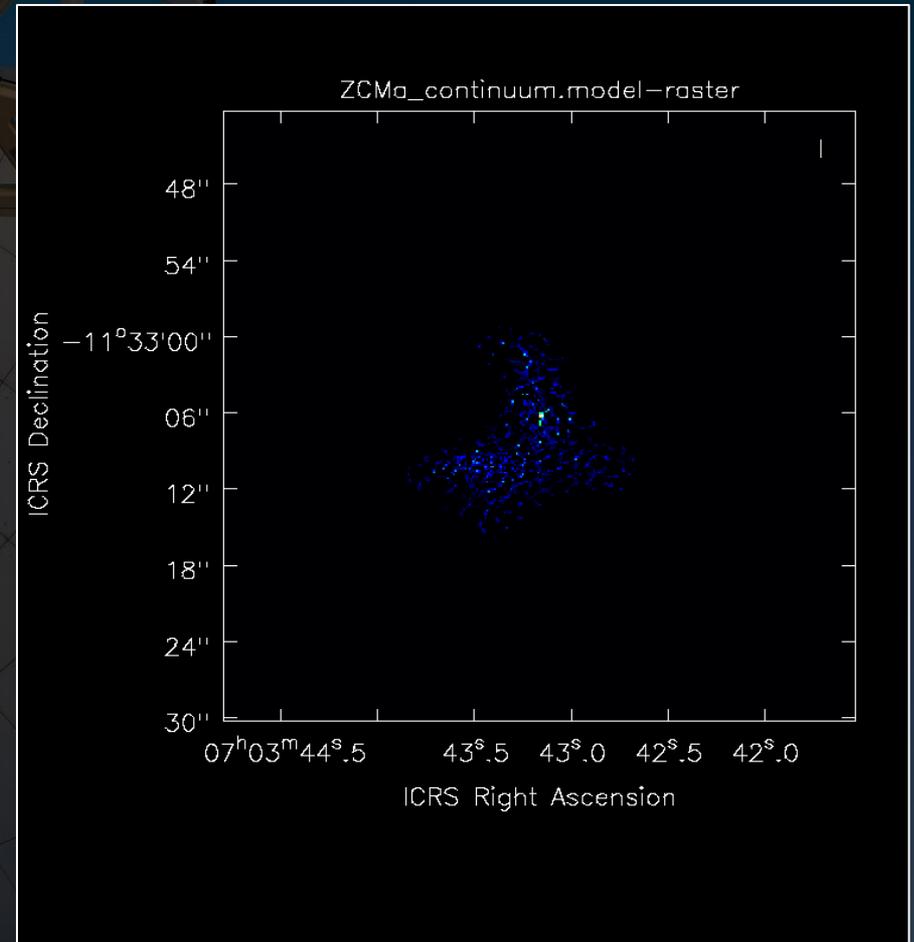
mask: Image mask created while cleaning

model: Model of the emission used for deconvolution

pb: Primary beam (area where the telescope was sensitive)

psf: Beam before cleaning

residual: Residuals after the final iteration of cleaning



Multiple files are created after cleaning:

`image`: Science image

`image.pbcor`: Science image with a PB correction

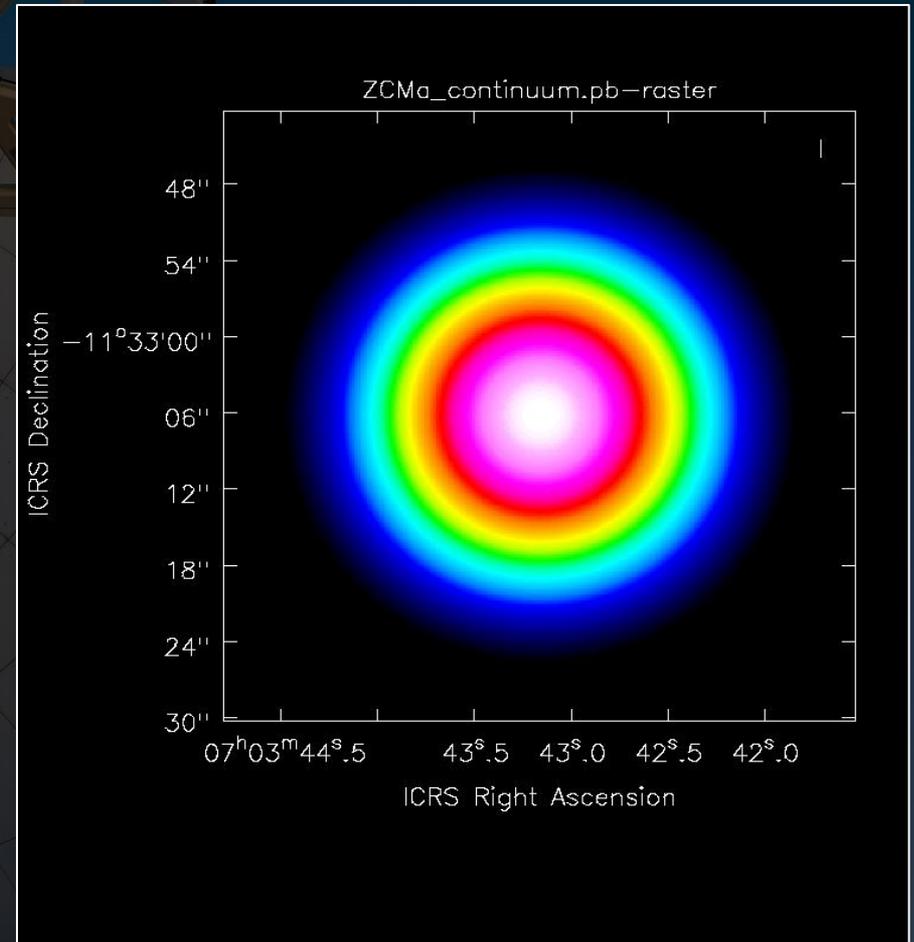
`mask`: Image mask created while cleaning

`model`: Model of the emission used for deconvolution

`pb`: Primary beam (area where the telescope was sensitive)

`psf`: Beam before cleaning

`residual`: Residuals after the final iteration of cleaning



Multiple files are created after cleaning:

image: Science image

image.pbcor: Science image with a PB correction

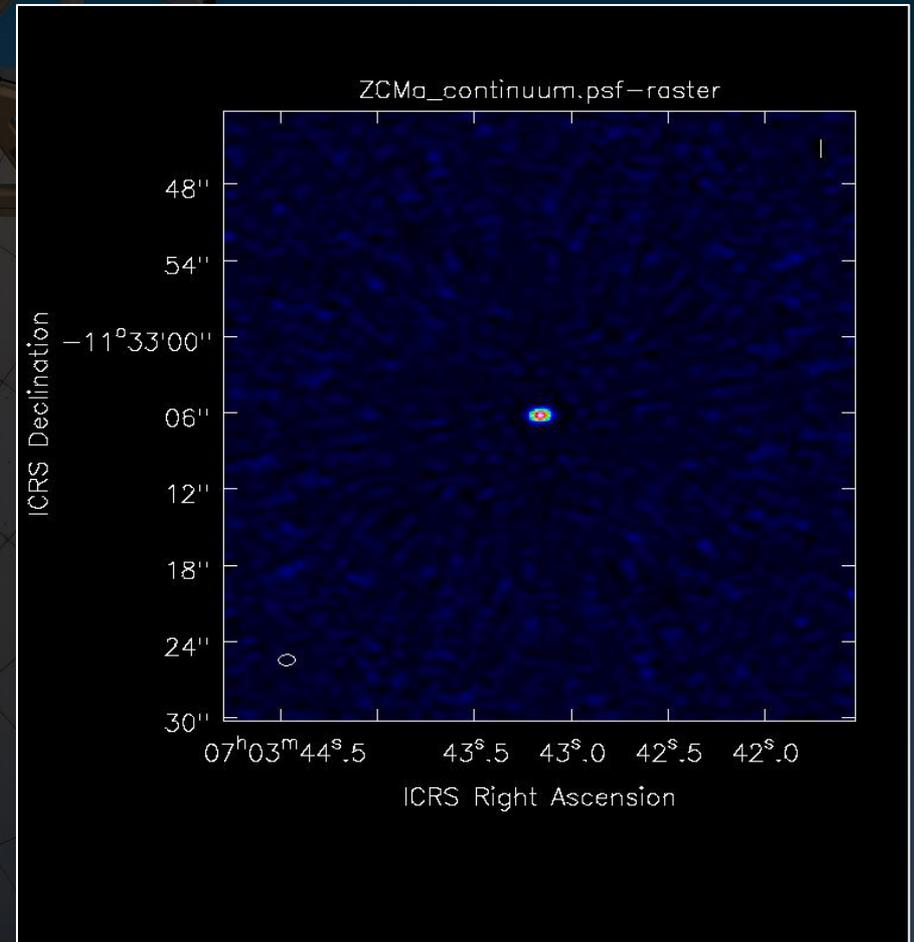
mask: Image mask created while cleaning

model: Model of the emission used for deconvolution

pb: Primary beam (area where the telescope was sensitive)

psf: Beam before cleaning

residual: Residuals after the final iteration of cleaning



Multiple files are created after cleaning:

`image`: Science image

`image.pbcor`: Science image with a PB correction

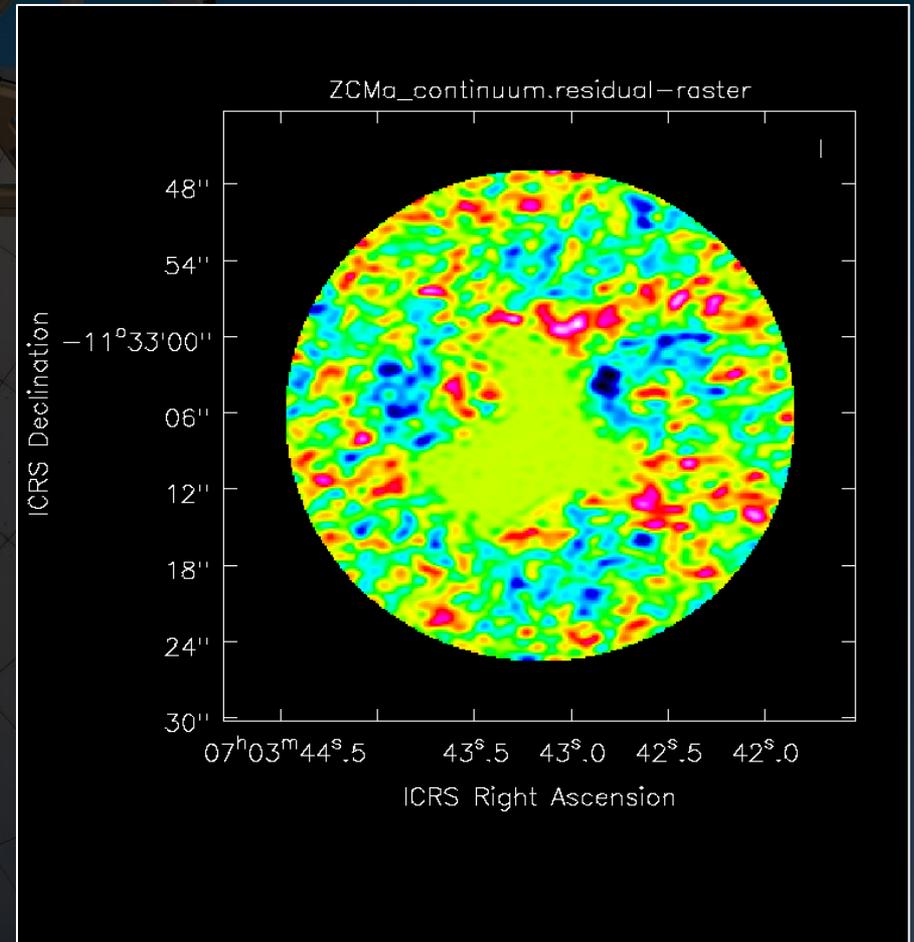
`mask`: Image mask created while cleaning

`model`: Model of the emission used for deconvolution

`pb`: Primary beam (area where the telescope was sensitive)

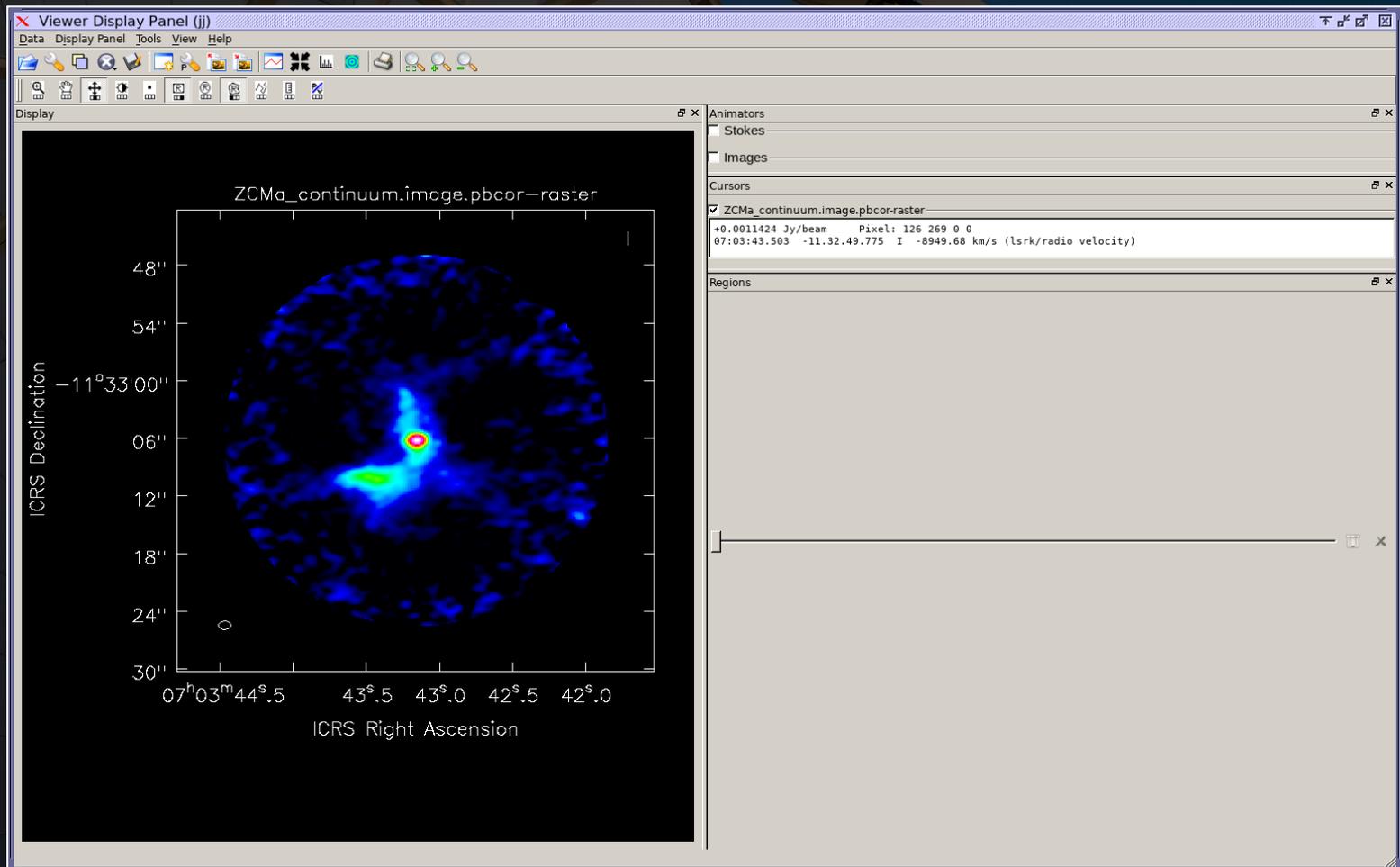
`psf`: Beam before cleaning

`residual`: Residuals after the final iteration of cleaning



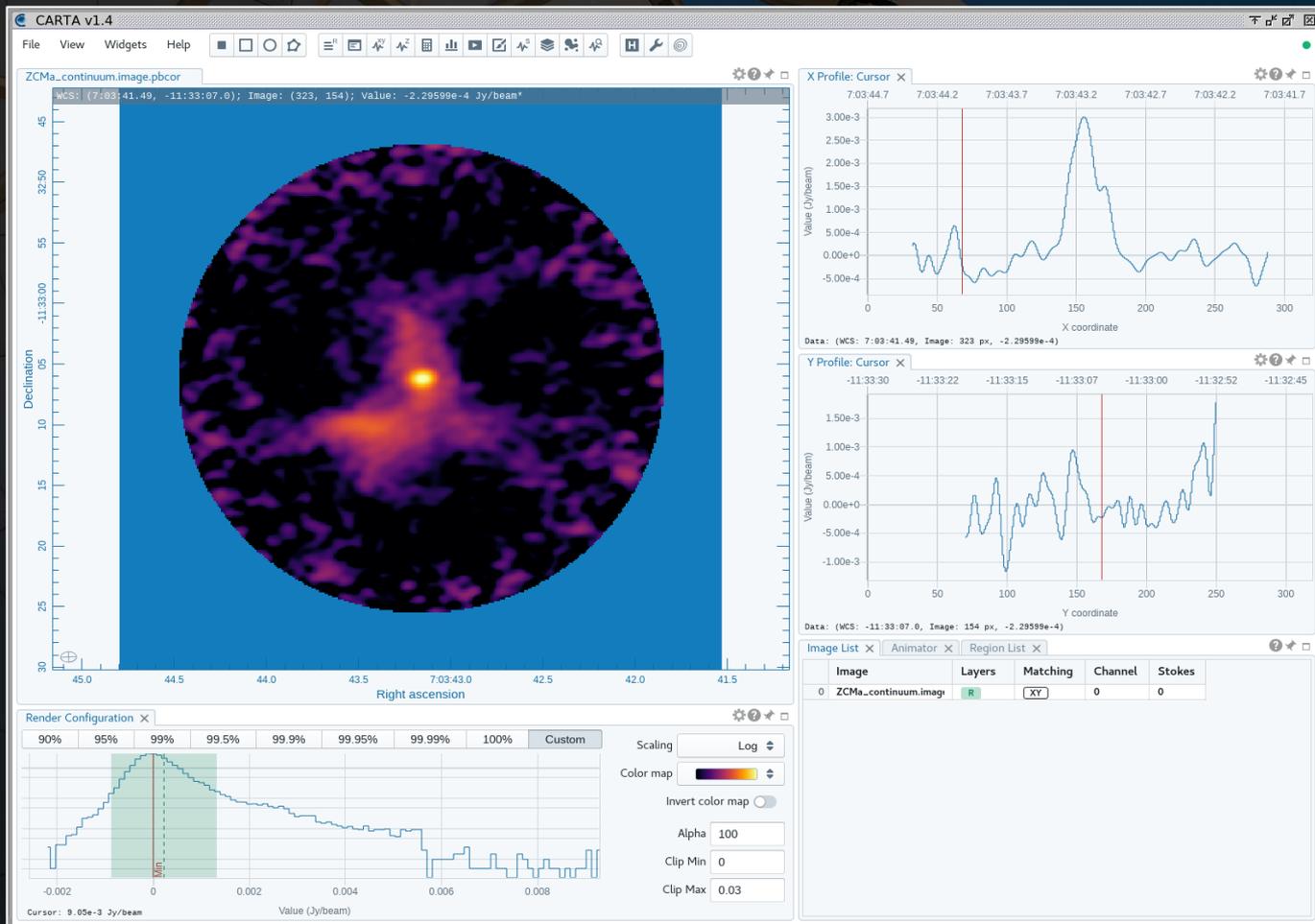
CASA creates images in an object oriented file structure format. Two image viewers are available to view these images:

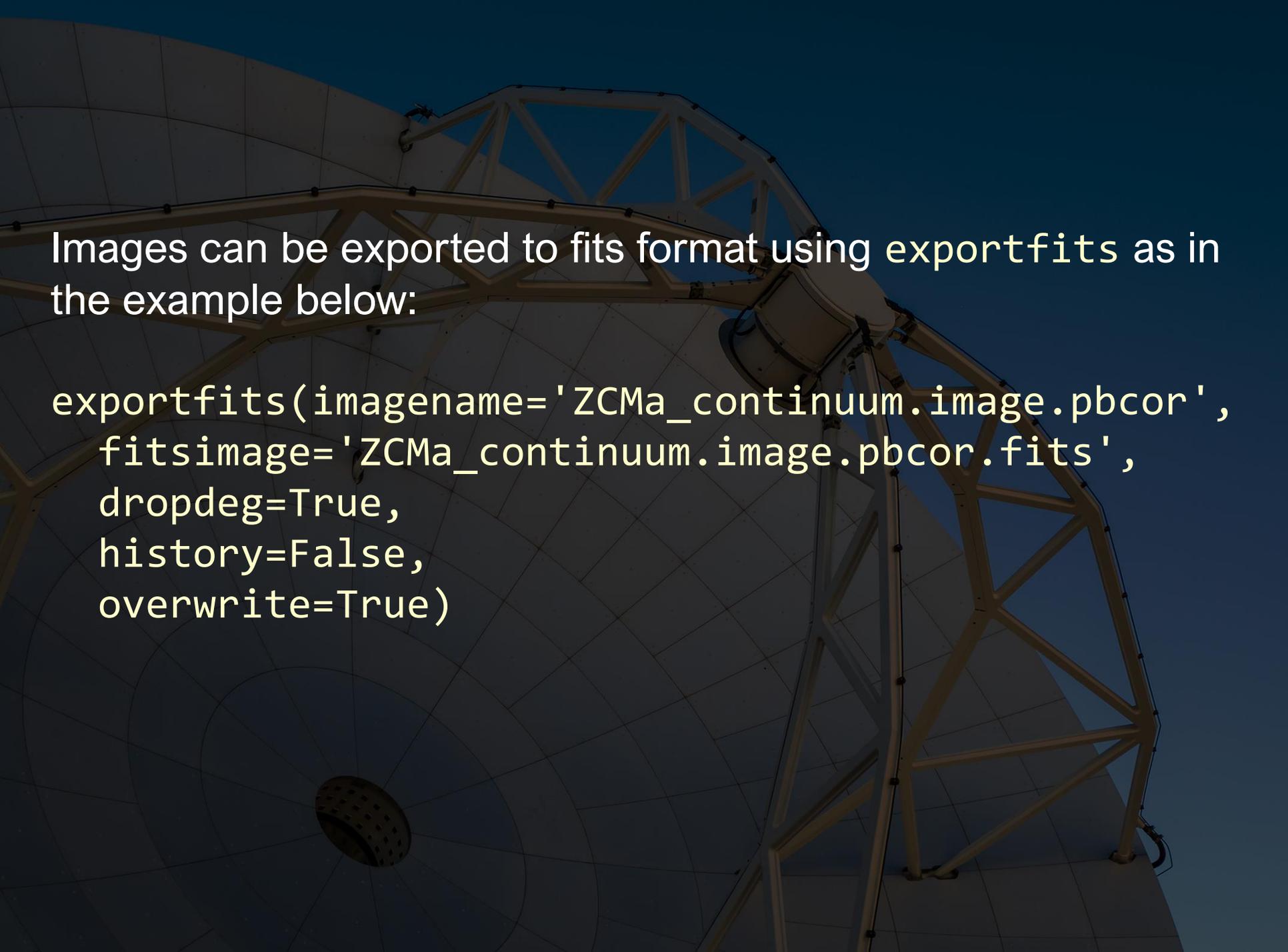
- casaviewer
- CARTA



CASA creates images in an object oriented file structure format. Two image viewers are available to view these images:

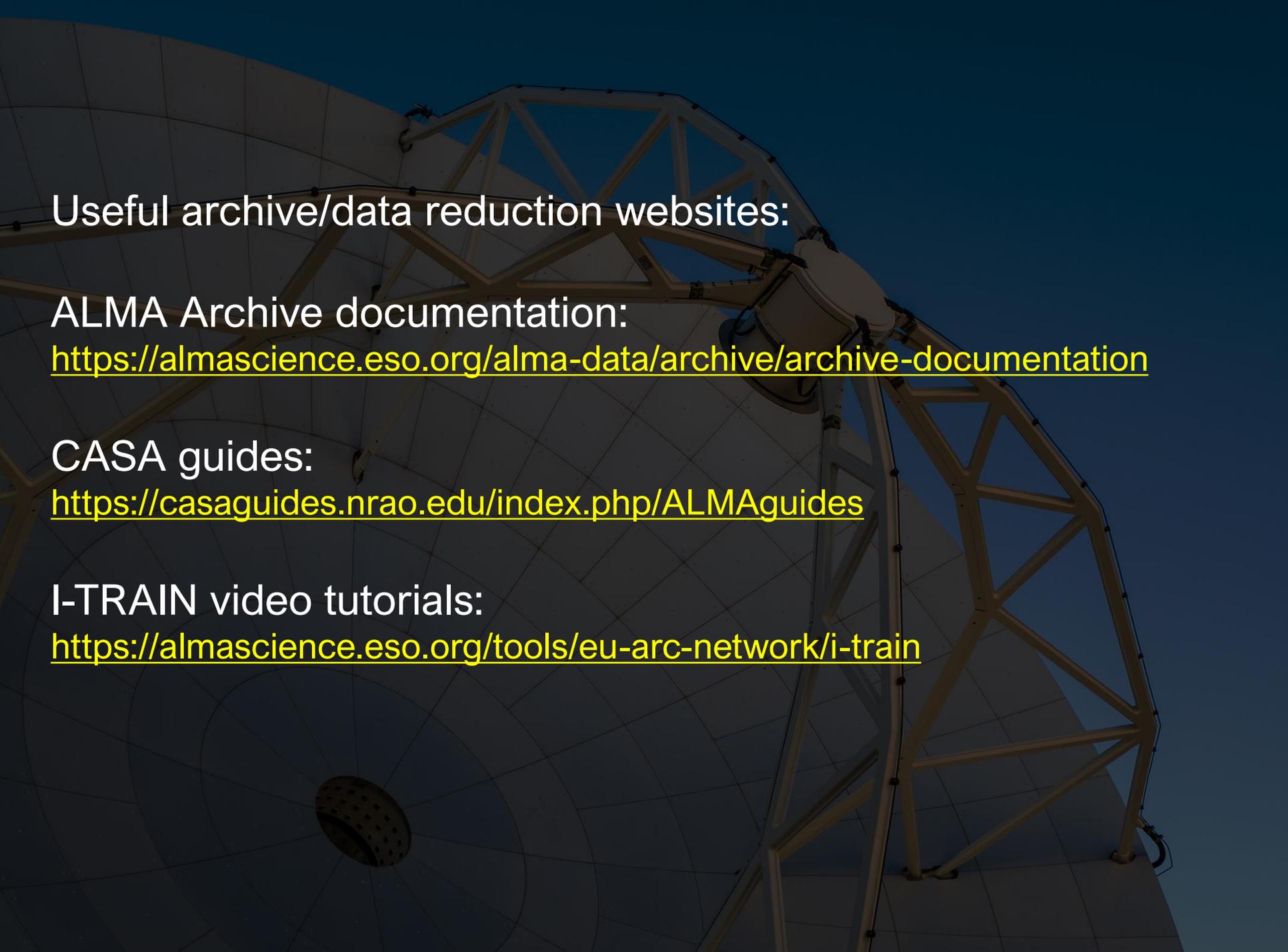
- casaviewer
- CARTA





Images can be exported to fits format using `exportfits` as in the example below:

```
exportfits(imagename='ZCma_continuum.image.pbcor',  
          fitsimage='ZCma_continuum.image.pbcor.fits',  
          dropdeg=True,  
          history=False,  
          overwrite=True)
```



Useful archive/data reduction websites:

ALMA Archive documentation:

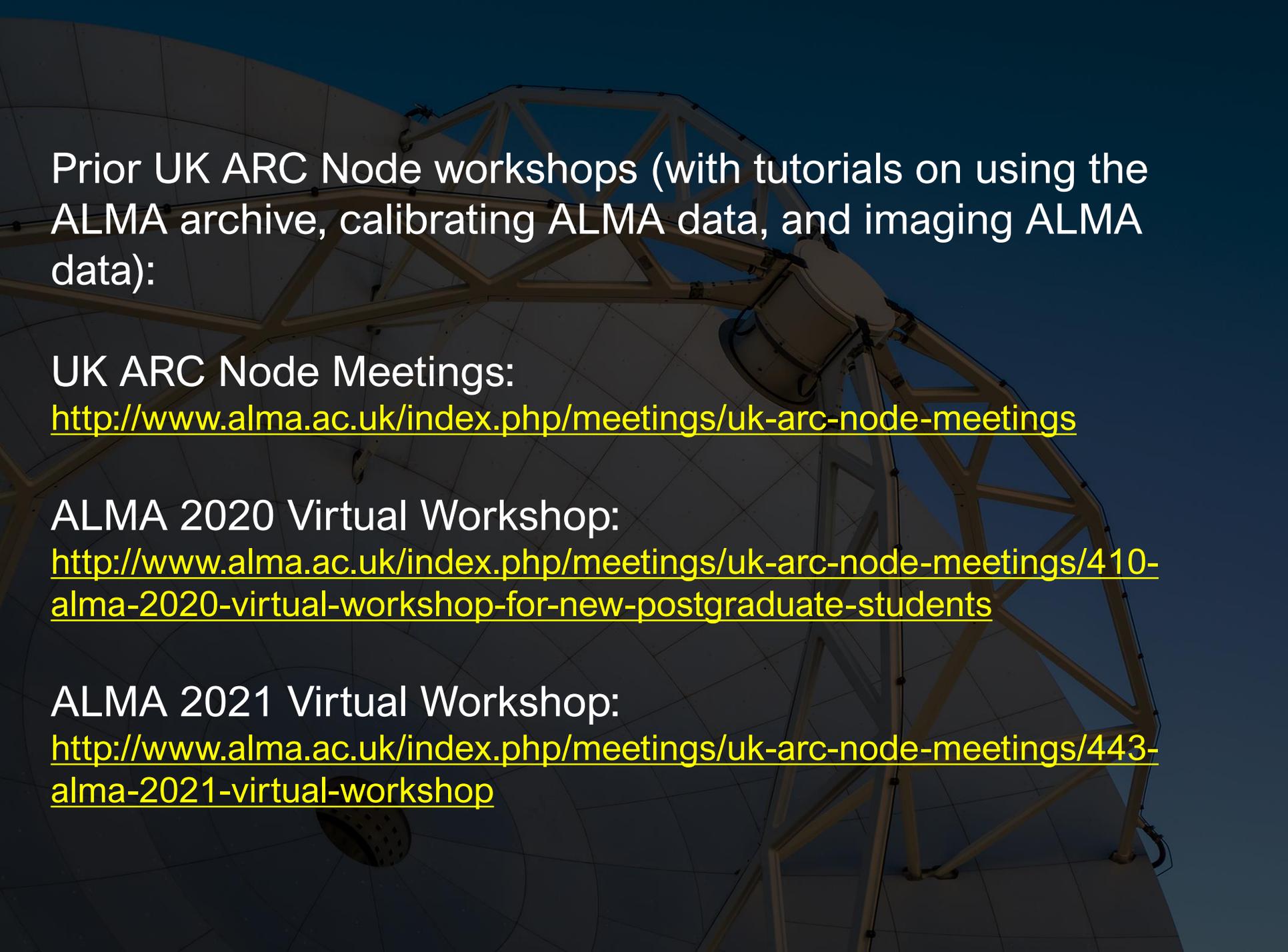
<https://almascience.eso.org/alma-data/archive/archive-documentation>

CASA guides:

<https://casaguides.nrao.edu/index.php/ALMAGuides>

I-TRAIN video tutorials:

<https://almascience.eso.org/tools/eu-arc-network/i-train>



Prior UK ARC Node workshops (with tutorials on using the ALMA archive, calibrating ALMA data, and imaging ALMA data):

UK ARC Node Meetings:

<http://www.alma.ac.uk/index.php/meetings/uk-arc-node-meetings>

ALMA 2020 Virtual Workshop:

<http://www.alma.ac.uk/index.php/meetings/uk-arc-node-meetings/410-alma-2020-virtual-workshop-for-new-postgraduate-students>

ALMA 2021 Virtual Workshop:

<http://www.alma.ac.uk/index.php/meetings/uk-arc-node-meetings/443-alma-2021-virtual-workshop>