

Reducing Observations from the JVL A, ALMA, ATCA and EVLBI Radio-Telescope Archives

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www.DSES.Science

The large interferometry antenna systems maintain online archives of all of the observations conducted through their history. These observations can be processed (reduced) using CASA software. The results provide images of the astronomical objects as well as polarization, Jansky signal strength, relative velocity as well as chemical signature measurements. A number of archive files were downloaded and reduced. The analysis of the results, as well as the research on the astronomical objects, provides an excellent learning opportunity for the amateur radio astronomer.



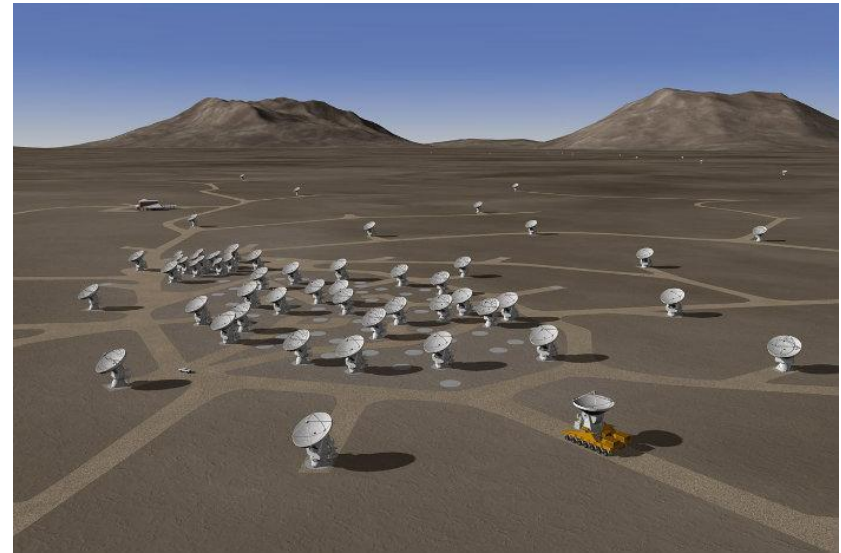
Antenna Systems

Karl G. Jansky Very Large Array (VLA)



<https://www.atlasobscura.com/places/very-large-array>

Atacama Large Millimeter/ submillimeter Array *ALMA)



<http://wikimapia.org/12830127/Atacama-Large-Millimeter-submillimeter-Array-ALMA>

European Very Long Baseline Interferometer (EVLBI)



<https://www.evlbi.org/telescopes>

Australian Telescope Compact Array (ATCA)



https://www.narrabri.atnf.csiro.au/observing/users_guide/html/chunked/index.html

Basic Data Reduction



Preparation

- 1) Imaging and Data Reduction Workshops at NRAO Socorro, N.M.
- 2) Obtained laptop with 4 CPUs, 16GB ram, 1TB solid state hard drive
- 3) Red Hat Linux
- 4) Downloaded CASA from NRAO website
(<https://casa.nrao.edu/installlinux.shtml>)
- 5) Practice using NRAO Tutorials
(https://casaguides.nrao.edu/index.php/Main_Page)

Pulling Data from VLA and ALMA Archives

NRAO Science Data Archive : Advanced Search Tool
Historical VLA, Jansky VLA, VLBA and GBT Data Products

Submit Query Check Query Clear Form

Output Control Parameters :

Choose Query Return Type :

- ☒ Download Archive Data Files
- ☐ VLA Observations Summary
- ☐ List of Observation Scans
- ☐ List of Projects

Output Tbl Format: HTML Sort Order Column 1: Starttime Asc
Max Output Tbl Rows: NO LIMIT Sort Order Column 2: Starttime Asc

General Search Parameters :

Telescopes: ☒ All ☐ Jansky VLA ☐ Historical VLA ☐ VLBA ☐ GBT

Project Code: Project Session: Dates From:
JVLBA: 12A-256

Observer Name: Archive File ID: To:
(partial strings allowed) (2010-06-21 14:20:30)

Position Search :

Target Name: Search Type: SIMBAD or NED Min. Exposure: (secs)
RA or Longitude: DEC or Latitude: Equinox: J2000
(04h33m11.1s or 68.29d) (05d21'15.5" or 5.352d)

Search Radius: 1.0' - OR - ☐ Check for automatic VLA field-of-view, freq. dependent.??
(1.00/700" or 0.2d)

Observing Configurations Search :

Telescope: ☒ All ☐ A ☐ AB ☐ BnA ☐ B ☐ BC ☐ CnB
Config: ☐ C ☐ CD ☐ DnC ☐ D ☐ DA

Sub_array: ☒ All ☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5

Polarization: ALL Data Type: ALL

Observing Bands: ☒ All ☐ X ☐ U ☐ K ☐ Ka ☐ Q ☐ W
Frequency Range:
(In MHz: 1665.401 - 1720.500)

Enter Locked Project Access key: Unique keywords may be used to unlock proprietary data from individual observing projects. Contact the [NRAO Data Analysts](#) for project access keys.

Submit Query Check Query Clear Form

Please direct feedback and/or questions concerning this page and its associated search engine to [NRAO DAS contact](#).
Version 5.9.15 (25948)

<https://archive.nrao.edu>

NEW: Please try out our [new archive query interface](#) and give us feedback through the [Helpdesk](#).

Query Form Results Table ALMA Science Archive

Search Reset

Query Help

Position

Source name (Resolver)
Source name (ALMA)
RA Dec
Galactic
Target list
Angular resolution
Largest angular scale
Field of view

Energy

Frequency
Bandwidth
Spectral resolution
Band

Time

Observation date
Integration time

Polarisation

Polarisation type

Observation

Line sensitivity (10 km/s)
Continuum sensitivity
Water vapour

Project

Project code
Project title
PI name
Proposal authors
Project abstract
Publication count
Science keyword

Publication

Bibcode
Title
First author
Authors
Abstract
Year

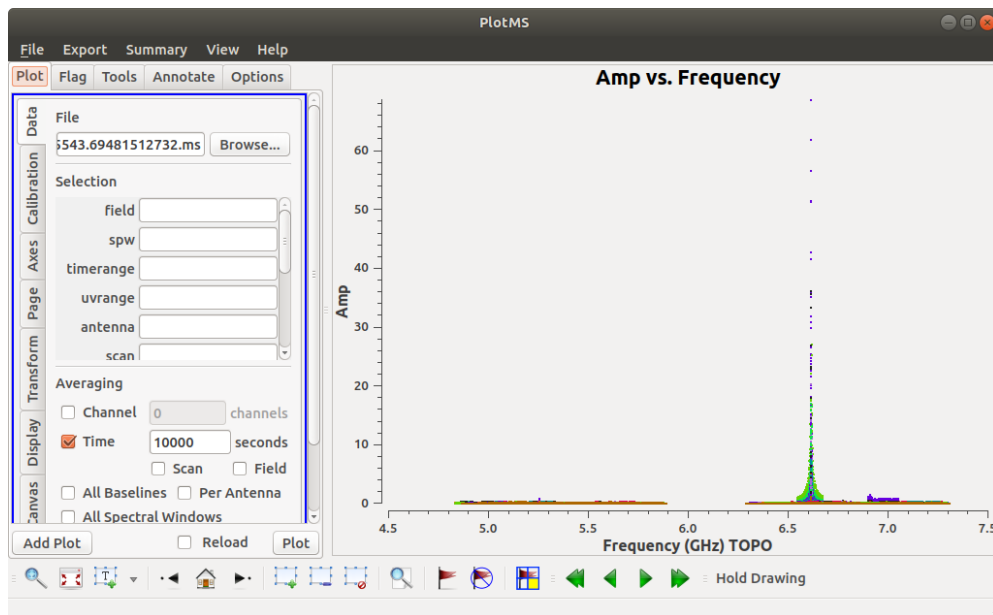
Options

View:
☒ observation
☐ project
☐ publication
☐ public data only
☒ science observations only

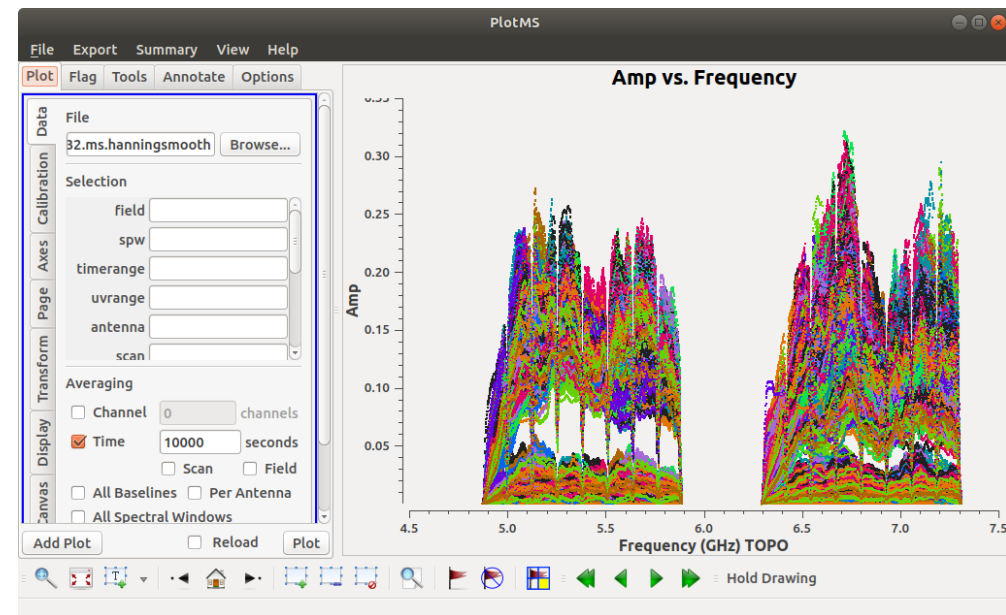
<http://almascience.nrao.edu/aq/>

Data Before and After Flagging

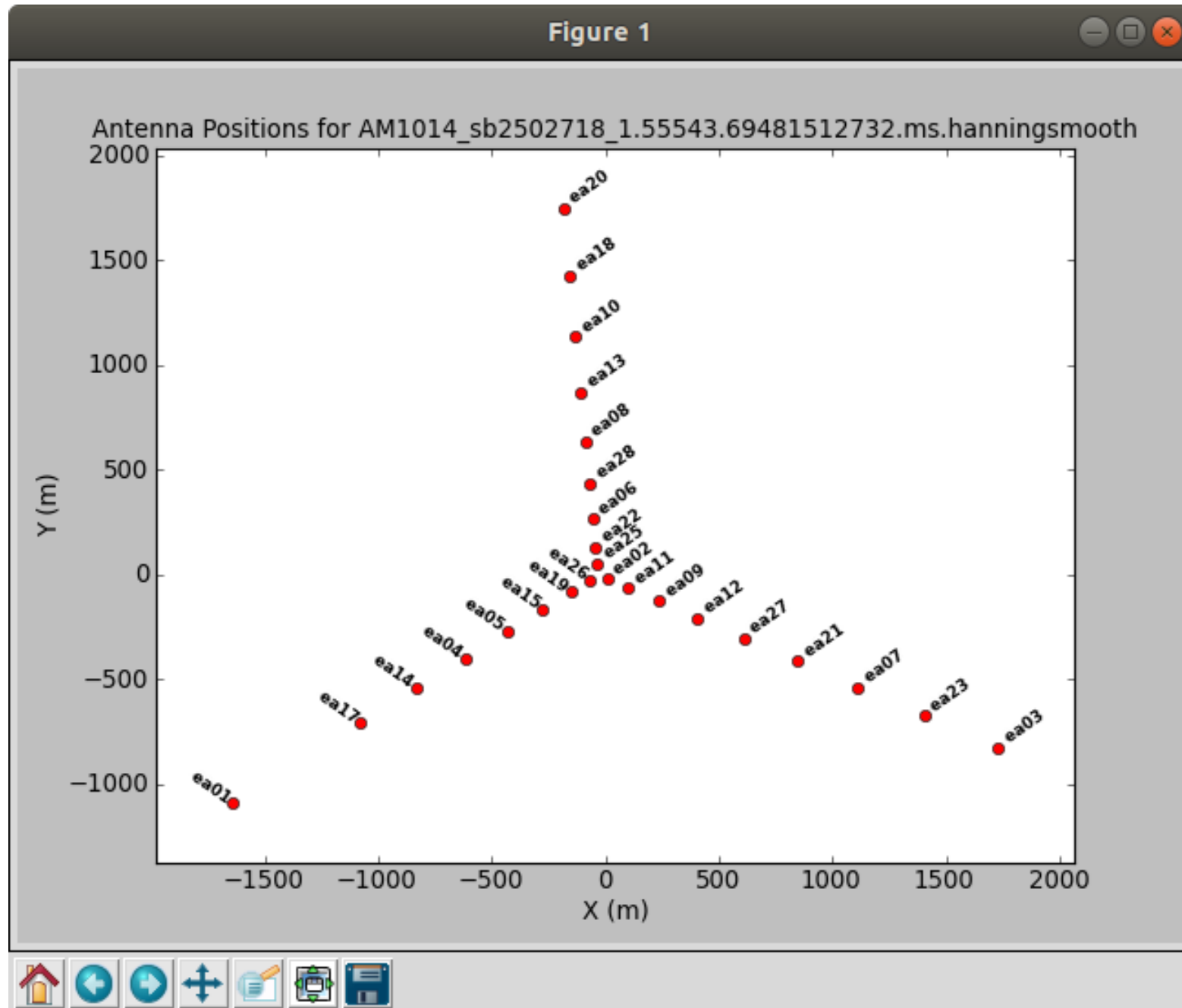
Before Flagging



After Flagging



EVLA Antenna Pattern

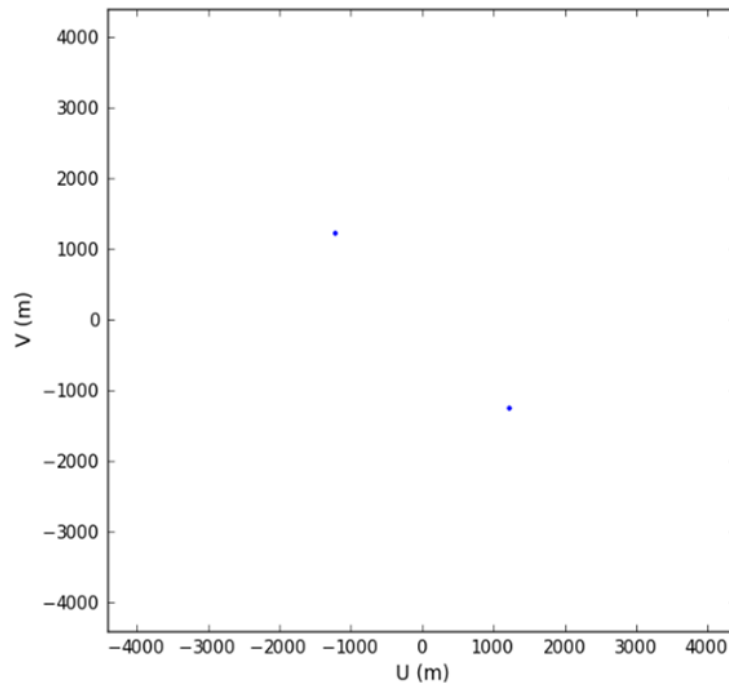
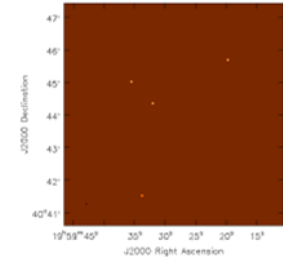


2 Antenna Example

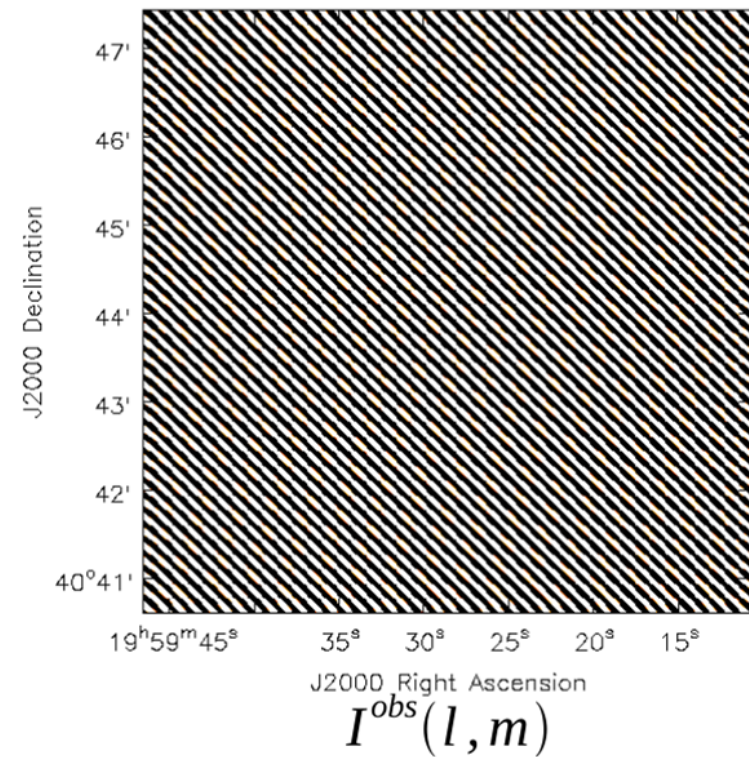
Spatial Frequency (uv) coverage + Observed Image

$$\begin{bmatrix} u \\ v \\ w \end{bmatrix} = \frac{1}{\lambda} R(h, \theta) \begin{bmatrix} \delta x \\ \delta y \\ \delta z \end{bmatrix}$$

Image of the sky
using 2 antennas



$S(u, v)$



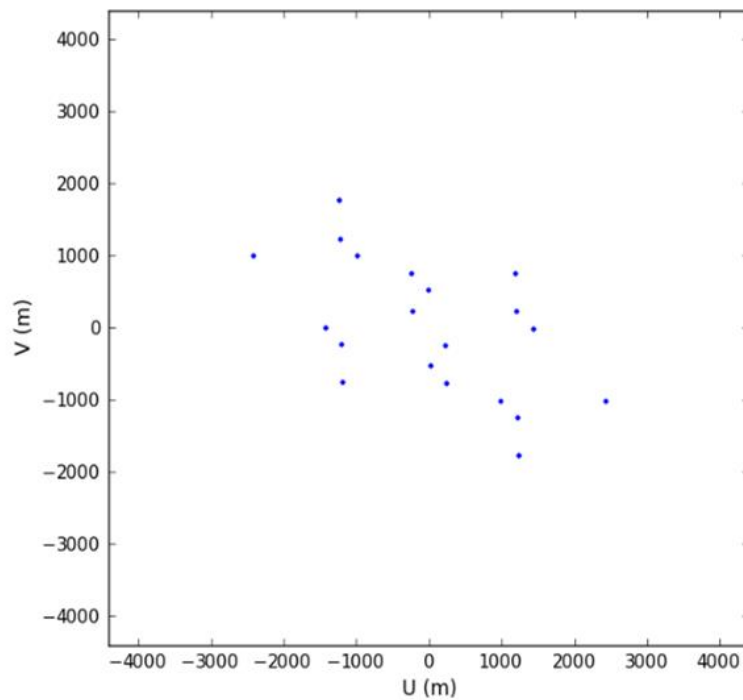
J2000 Right Ascension

$I^{obs}(l, m)$

5 Antenna Example

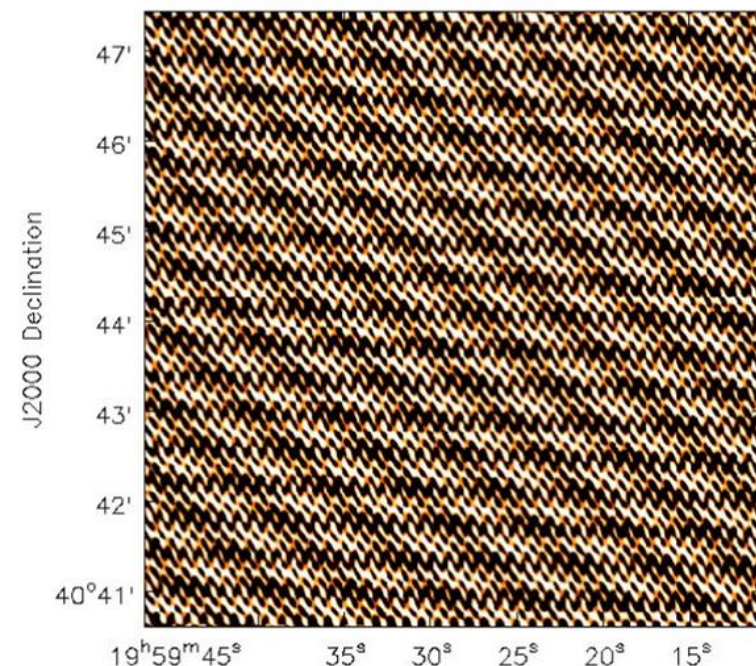
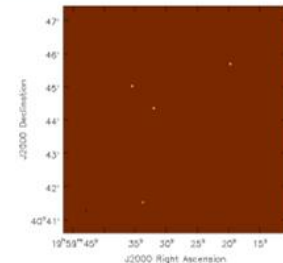
Spatial Frequency (uv) coverage + Observed Image

$$\begin{bmatrix} u \\ v \\ w \end{bmatrix} = \frac{1}{\lambda} R(h, \theta) \begin{bmatrix} \delta x \\ \delta y \\ \delta z \end{bmatrix}$$



$S(u, v)$

Image of the sky
using 5 antennas



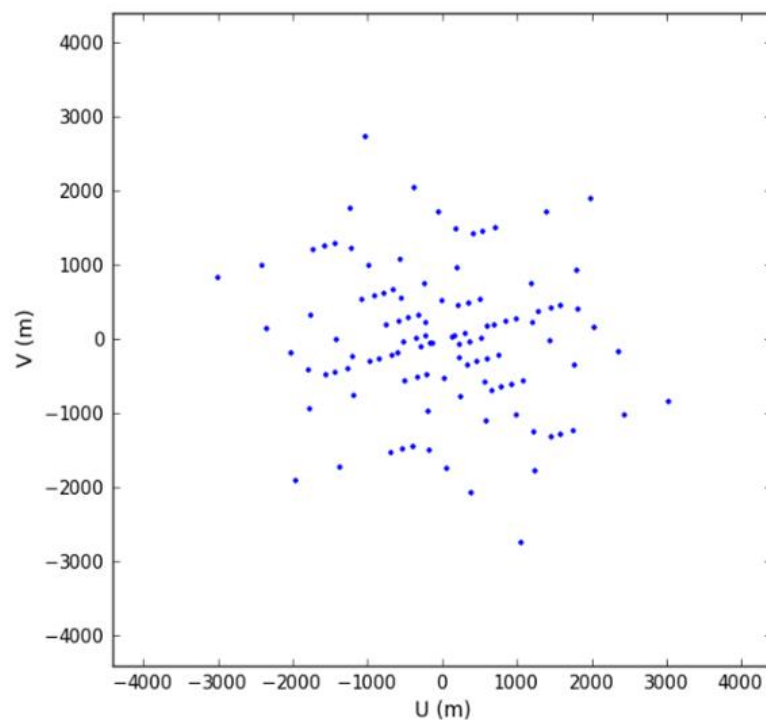
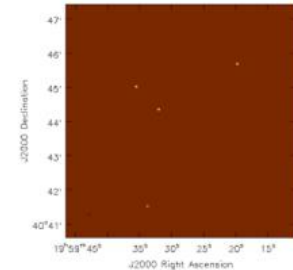
$I^{obs}(l, m)$

11 Antenna Example

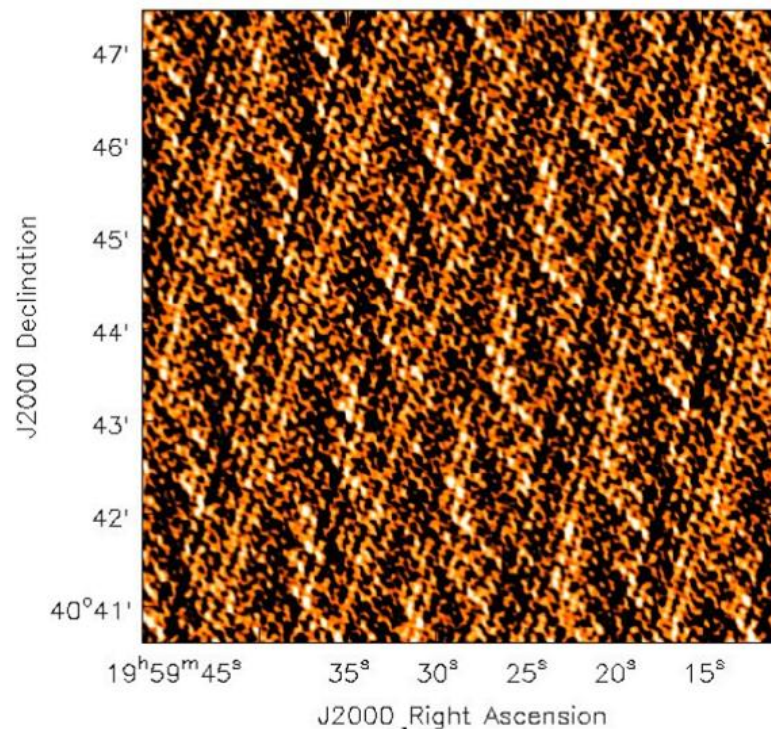
Spatial Frequency (uv) coverage + Observed Image

$$\begin{bmatrix} u \\ v \\ w \end{bmatrix} = \frac{1}{\lambda} R(h, \theta) \begin{bmatrix} \delta x \\ \delta y \\ \delta z \end{bmatrix}$$

Image of the sky
using 11 antennas



$S(u, v)$



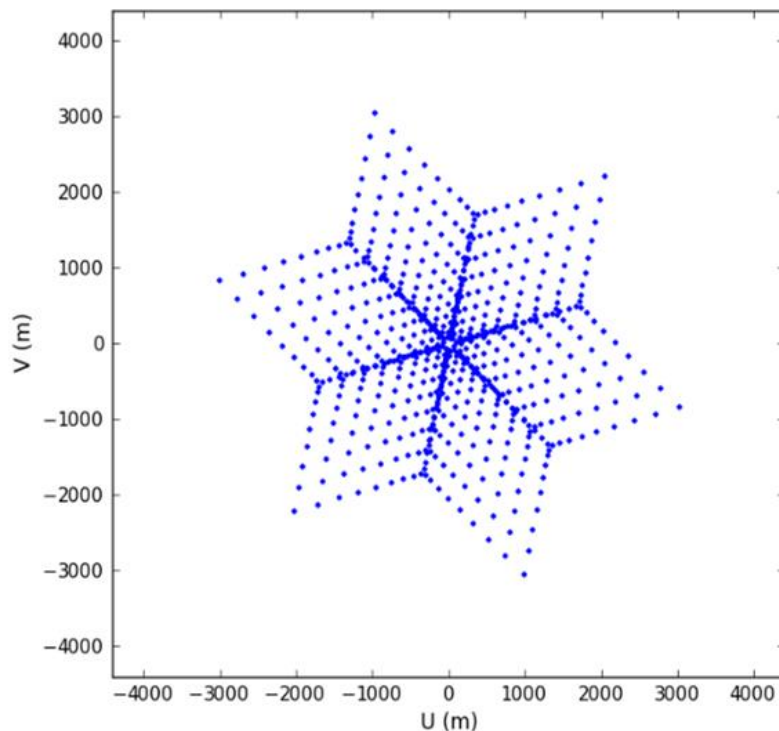
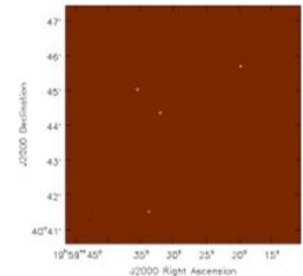
$I^{obs}(l, m)$

27 Antenna Example

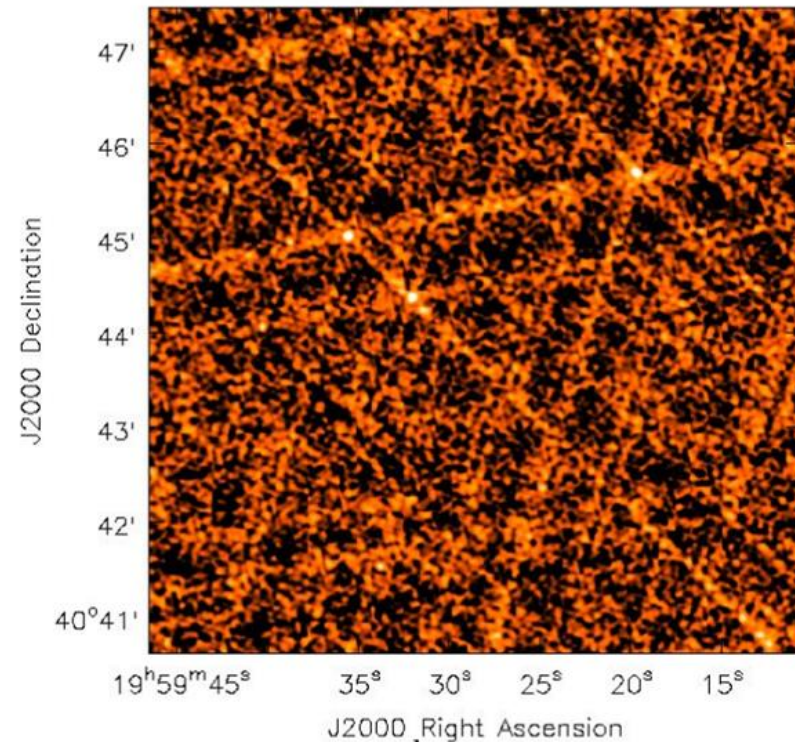
Spatial Frequency (uv) coverage + Observed Image

$$\begin{bmatrix} u \\ v \\ w \end{bmatrix} = \frac{1}{\lambda} R(h, \theta) \begin{bmatrix} \delta x \\ \delta y \\ \delta z \end{bmatrix}$$

Image of the sky
using 27 antennas



$S(u, v)$



J2000 Right Ascension

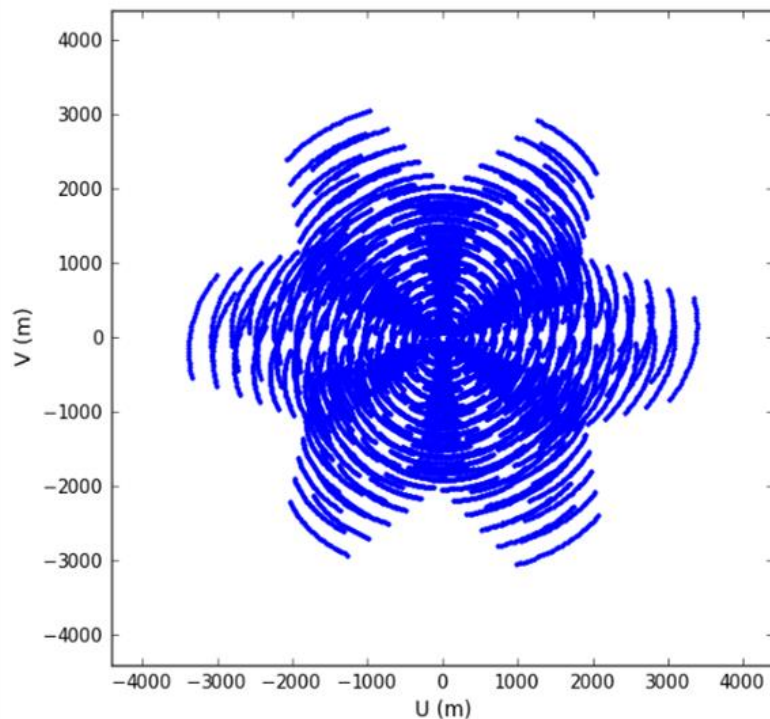
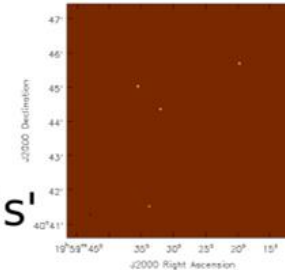
$I^{obs}(l, m)$

27 Antennas with 2-hour Rotation

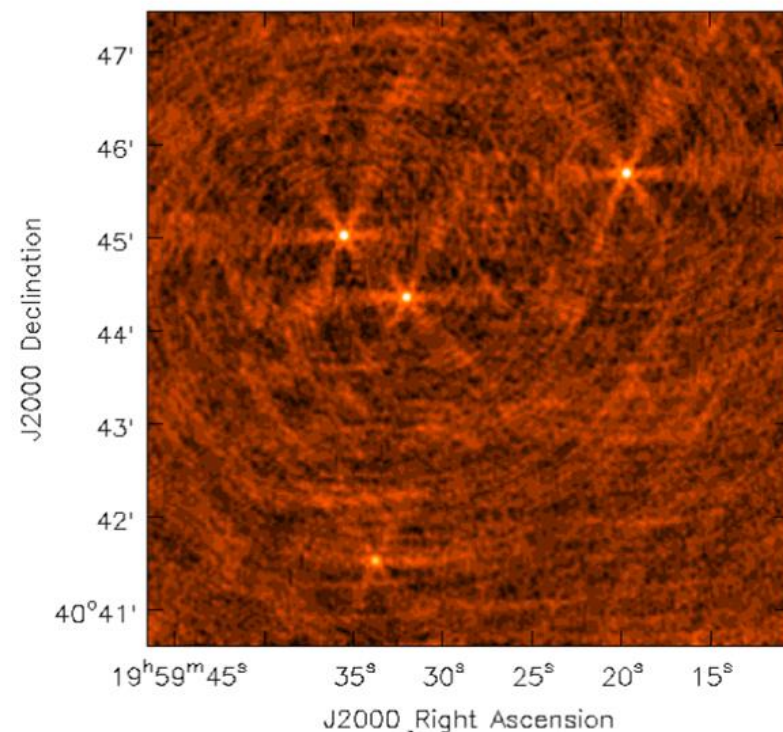
Spatial Frequency (uv) coverage + Observed Image

$$\begin{bmatrix} u \\ v \\ w \end{bmatrix} = \frac{1}{\lambda} \begin{bmatrix} R(h, \theta) \end{bmatrix} \begin{bmatrix} \delta x \\ \delta y \\ \delta z \end{bmatrix}$$

Image of the sky
using 27 antennas
over 2 hours
'Earth Rotation Synthesis'



$S(u, v)$



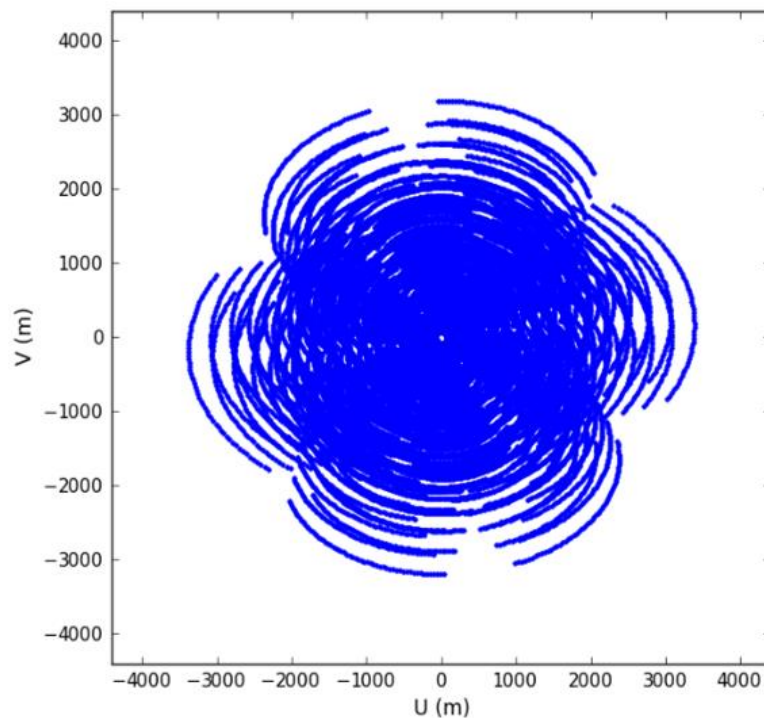
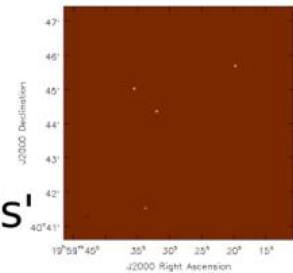
$I^{obs}(l, m)$

27 Antennas with 4-hours Rotation

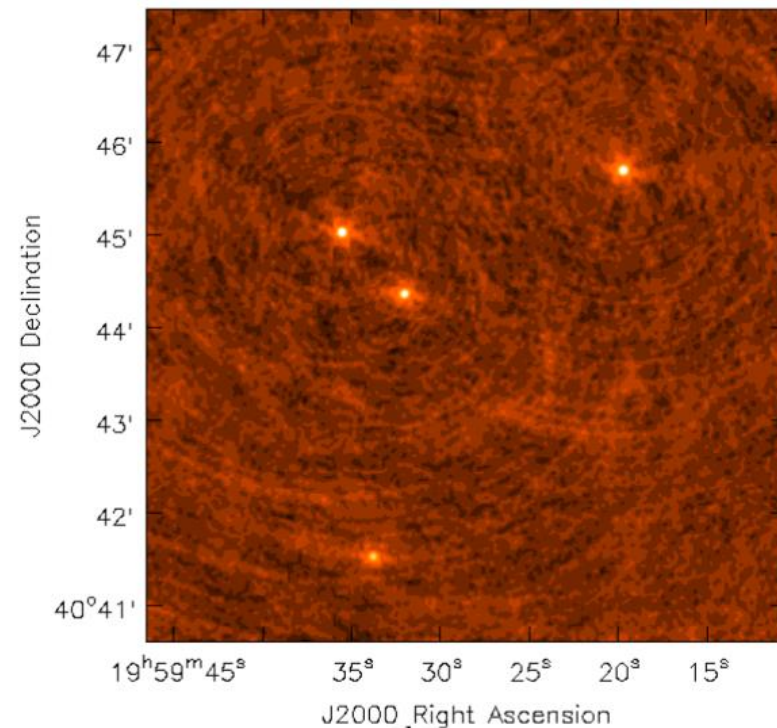
Spatial Frequency (uv) coverage + Observed Image

$$\begin{bmatrix} u \\ v \\ w \end{bmatrix} = \frac{1}{\lambda} \begin{bmatrix} R(h, \theta) \end{bmatrix} \begin{bmatrix} \delta x \\ \delta y \\ \delta z \end{bmatrix}$$

Image of the sky
using 27 antennas
over 4 hours
'Earth Rotation Synthesis'



$S(u, v)$



$I^{obs}(l, m)$

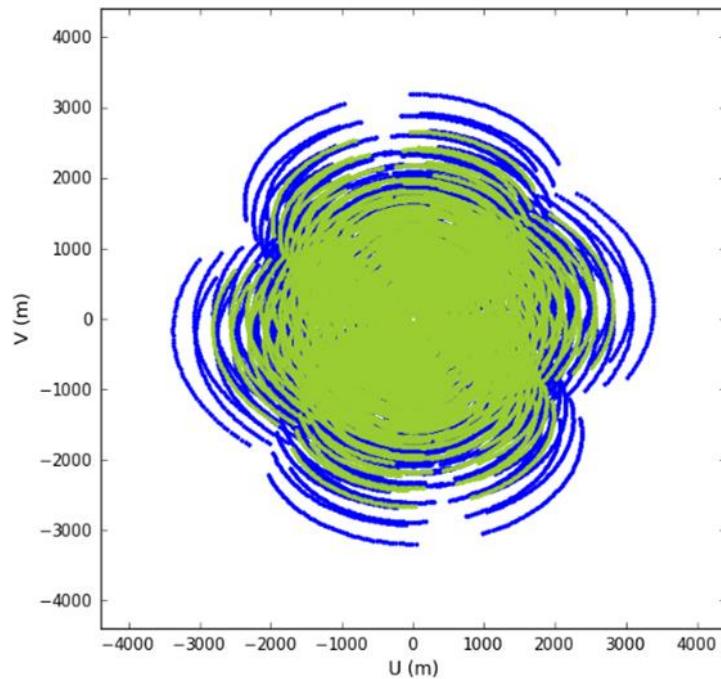
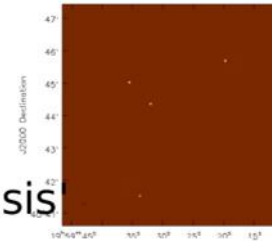
Source - Urvashi Rau : www.NRAO.edu

27 Antennas with 4-hours Rotation and 2 Frequencies

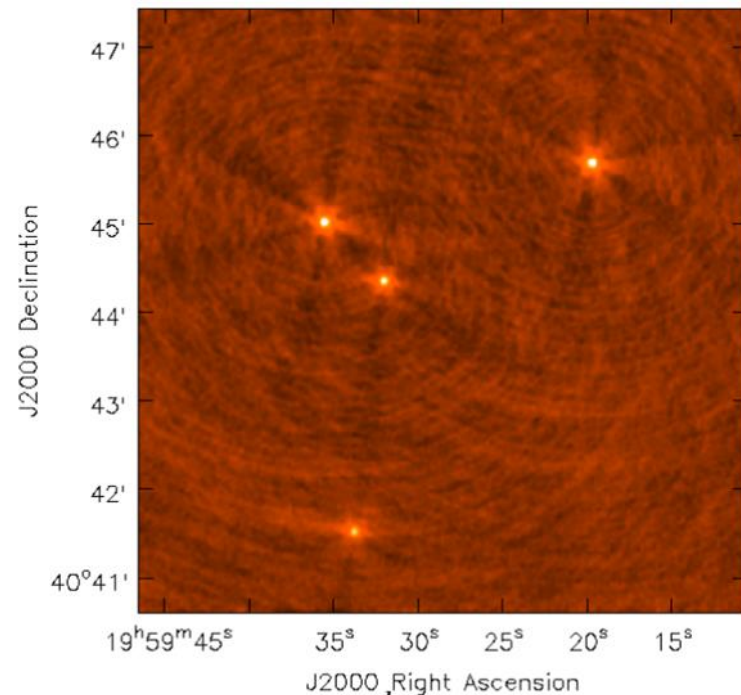
Spatial Frequency (uv) coverage + Observed Image

$$\begin{bmatrix} u \\ v \\ w \end{bmatrix} = \frac{1}{\lambda} R(h, \theta) \begin{bmatrix} \delta x \\ \delta y \\ \delta z \end{bmatrix}$$

Image of the sky
using 27 antennas
over 4 hours, 2 freqs
'Multi-Frequency Synthesis'



$S(u, v)$



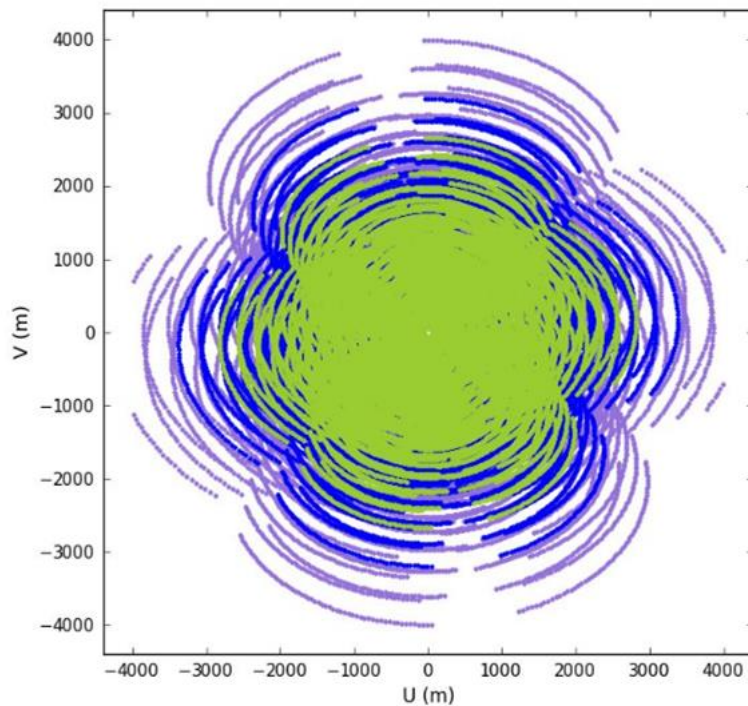
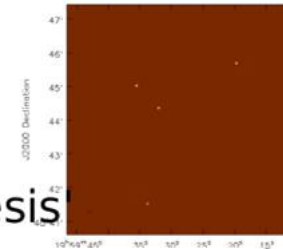
$I^{obs}(l, m)$

27 Antennas with 4-hours Rotation and 3 Frequencies

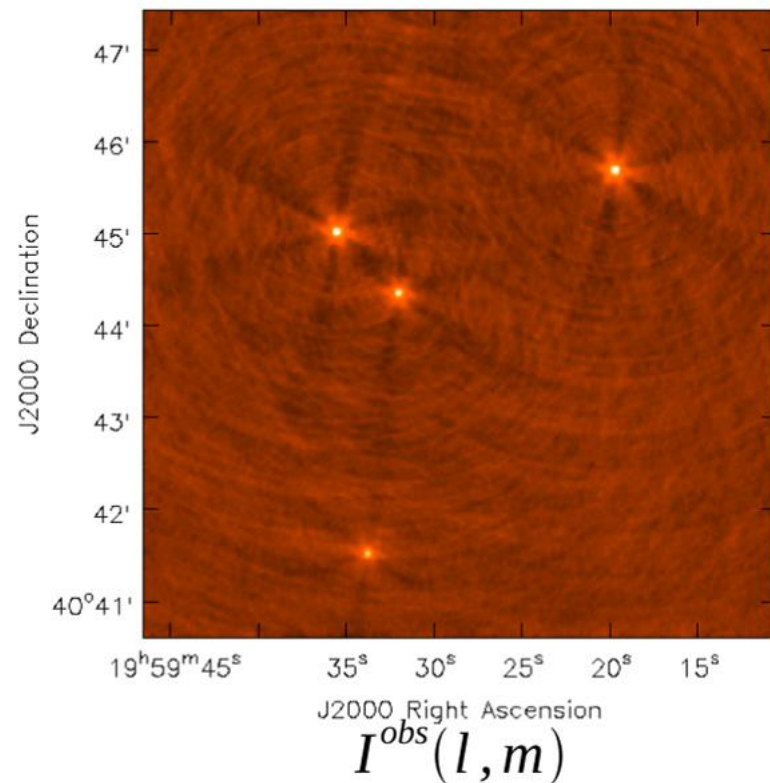
Spatial Frequency (uv) coverage + Observed Image

$$\begin{bmatrix} u \\ v \\ w \end{bmatrix} = \frac{1}{\lambda} R(h, \theta) \begin{bmatrix} \delta x \\ \delta y \\ \delta z \end{bmatrix}$$

Image of the sky
using 27 antennas
over 4 hours, 3 freqs
'Multi-Frequency Synthesis'

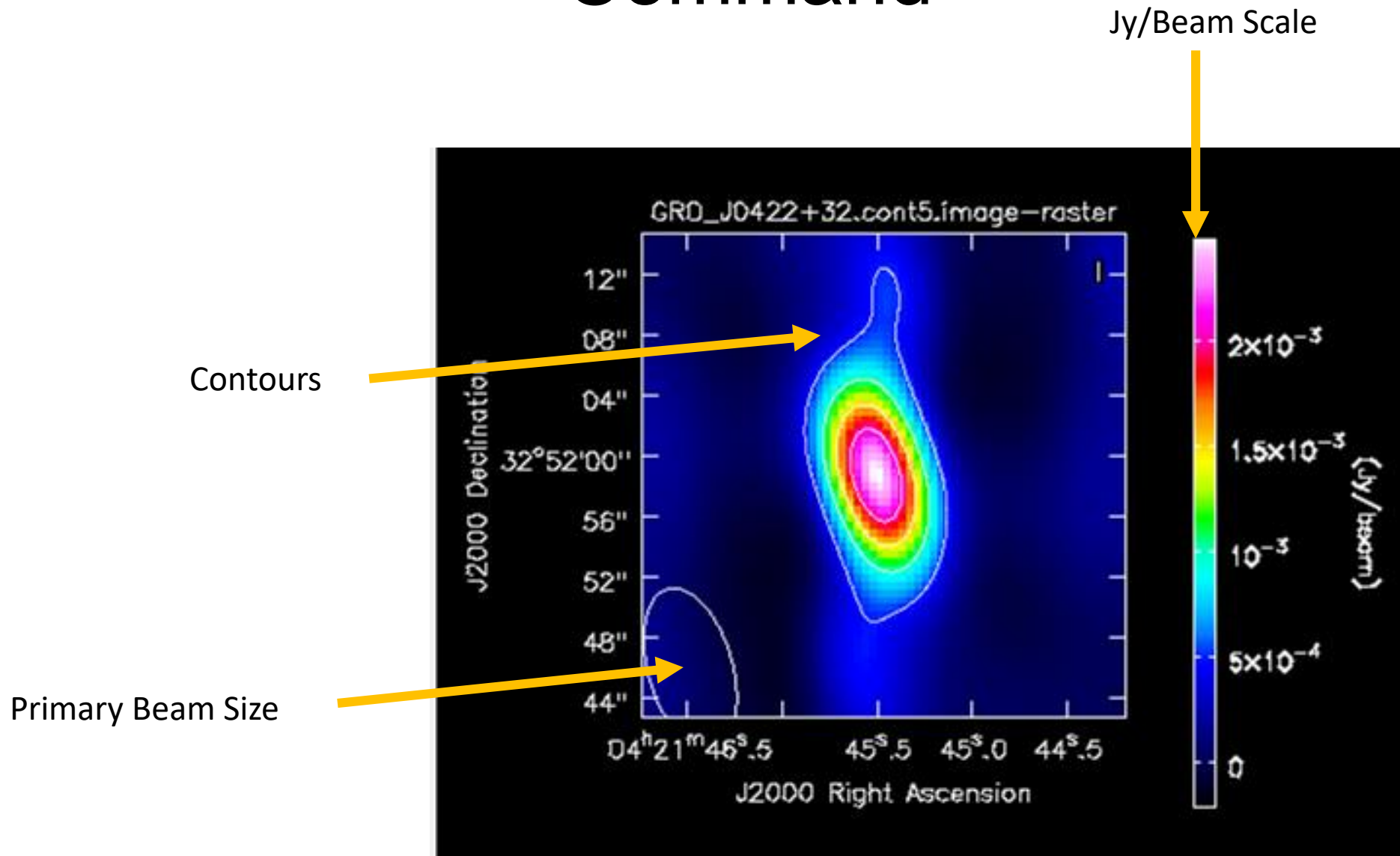


$S(u, v)$



$I^{obs}(l, m)$

Final Images using TCLEAN Command



Data Reduction Categories

- Stellar Black Holes
- Supermassive Black Holes
- Supernova Remnants
- Active Galactic Nuclei
- Gravitational Lenses
- Stars, Planets, Dwarf Planets, Moons and Planetesimals
- Galaxies
- Protoplanetary Systems

Stellar Black Holes



3C75 Binary Black Hole System (VLA Archive)

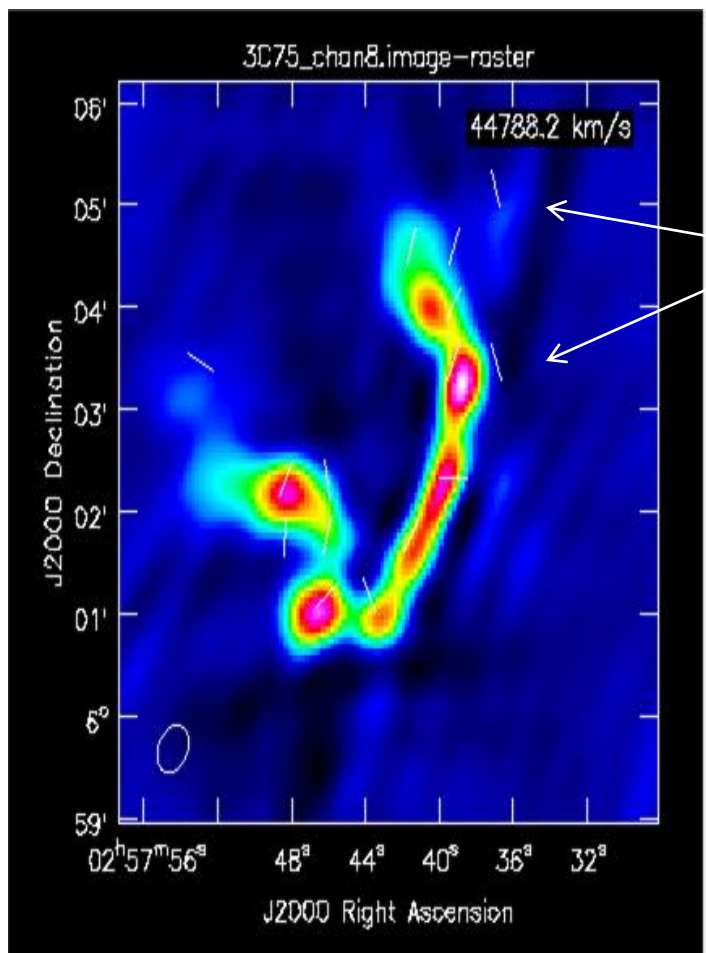
VLA OBSERVING LOG

2018-10-04_0541_TDRW0001

Observing Date: 04-Oct-2018
Configuration: D
Decommissioned: 27

Project:	TDRW0001	# Subarrays: 1	Observation Type: Test
Observer(PI):	Dr Emmanuel Momjian	Band(s) Used: C S	
SBID(s):	35624494		
Source File(s):	TDRW0001_sb35624494_1_1		
Observer E-mail:	emomjian@nrao.edu		
Operator(s):	Kenneth Gibson		

Data Reduction Results



Polarization vectors

Background Information Wikipedia

"3C75 (a.k.a. 3C 75) is a [binary black hole](#) system in the [Abell 400 cluster of galaxies](#). It has four radio jets (two from each accreting black hole). It is travelling at 1200 kilometers per second through the cluster plasma, causing the jets to be swept back. The binary [supermassive black holes](#) are themselves contained in the dumbbell shaped galaxy [NGC 1128](#). 3C 75 may be X-ray source 2A 0252+060 (1H 0253+058, XRS 02522+060).[\[4\]](#) Wikipedia"



Followed tutorial

https://casaguides.nrao.edu/index.php/Polarization_Calibration_based_on_CASA_pipeline_standard_reduction:_The_radio_galaxy_3C75-CASA4.5.2

Data Reduced by Dr. Richard A. Russel 10/16/19

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

ASASSN-14li

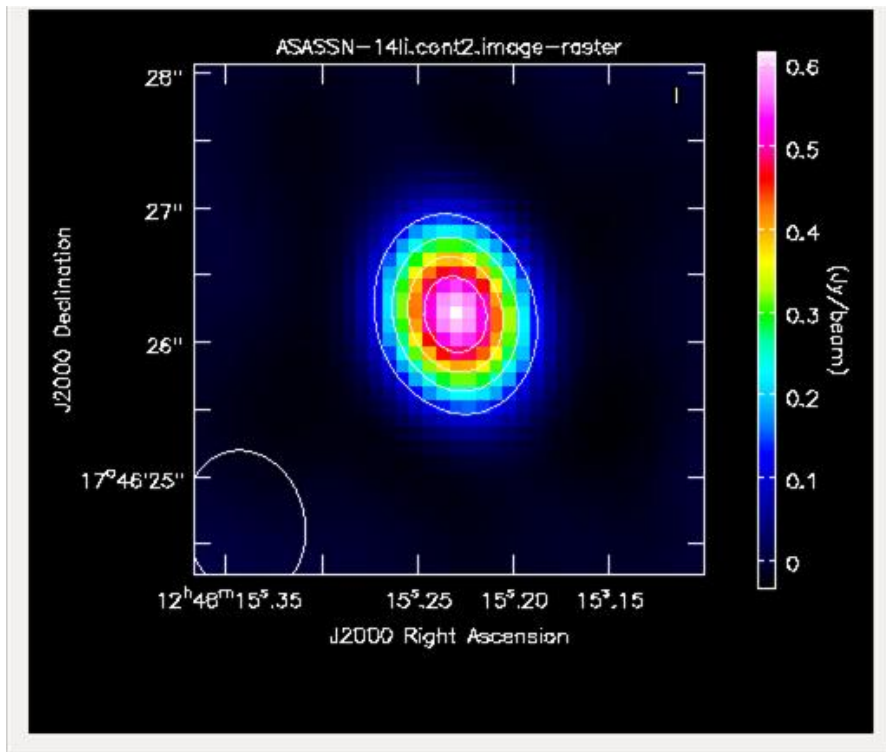
Tidal disruption event

A star is torn apart by a black hole

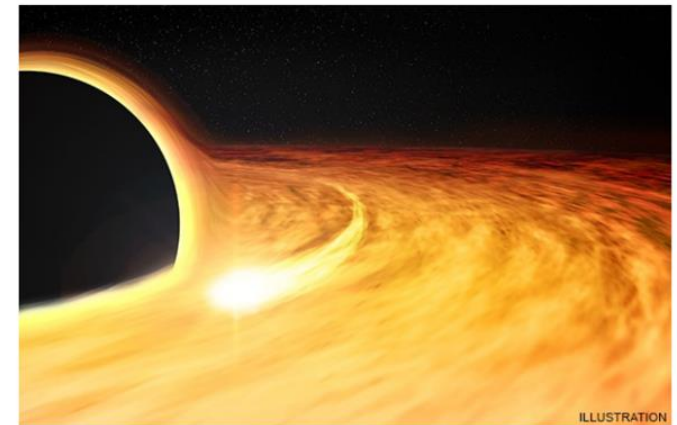
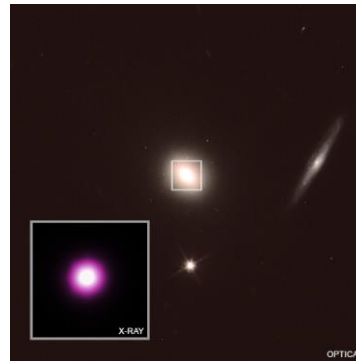
VLA Archive

Observer: Prof. Edo Berger Project: uid://evla/pdb/30597145
Observation: EVLA
Computing scan and subscan properties...
Data records: 4585464 Total elapsed time = 3579 seconds
Observed from 21-Apr-2015/05:29:45.0 to 21-Apr-2015/06:29:24.0 (UTC)

Data Reduction Results



Background Information



Chandra X-ray
Observatory Center

Harvard-Smithsonian Center for Astrophysics
60 Garden St. Cambridge, MA 02138 USA
<http://chandra.harvard.edu>

ASASSN-14li: A tidal disruption event in a galaxy about 290 million light years from Earth.
(Credit: Illustration: NASA/CXC/M.Weiss; X-ray: NASA/CXC/MIT/D. Pasham et al; Optical: HST/STScI, Arcavi)

Caption: This artist's illustration shows the region around a supermassive black hole after a star wandered too close and was ripped apart by extreme gravitational forces in a source called ASASSN-14li. Some of the remains of the star are pulled into an X-ray-bright disk where they circle the black hole before passing over the "event horizon," the boundary beyond which nothing, including light, can escape. Scientists used Chandra and other telescopes to study this event and determine the spin rate of the black hole, a fundamental property that has been difficult for astronomers to measure.

Chandra X-ray Observatory ACIS Image

CXC operated for NASA by the Smithsonian Astrophysical Observatory

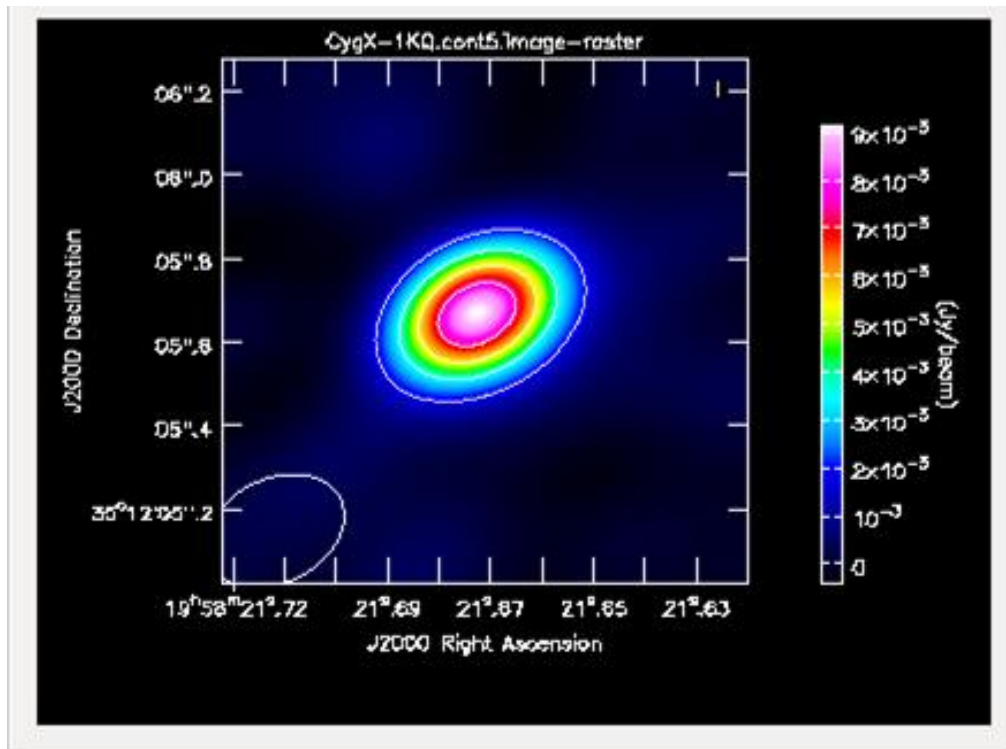
<https://chandra.harvard.edu/photo/2019/bhspin/>

Data reduction completed by Dr. Richard Russel 11-6-2019 using download from VLA database.

Cygnus X-1 (Black Hole) (VLA Archive)

```
=====
Observer: Dr. James Miller-Jones      Project: uid://evla/pdb/31100250
Observation: EVLA(27 antennas)
Computing scan and subscan properties...
Data records: 1858896      Total elapsed time = 675 seconds
Observed from 08-Jun-2016/06:05:09.0 to 08-Jun-2016/06:16:24.0 (UTC)
=====
```

Data Reduction Results



Background Information NASA



www.nasa.gov

Data reduction completed by Dr. Richard Russel 11-20-2019 using download from VLA database.

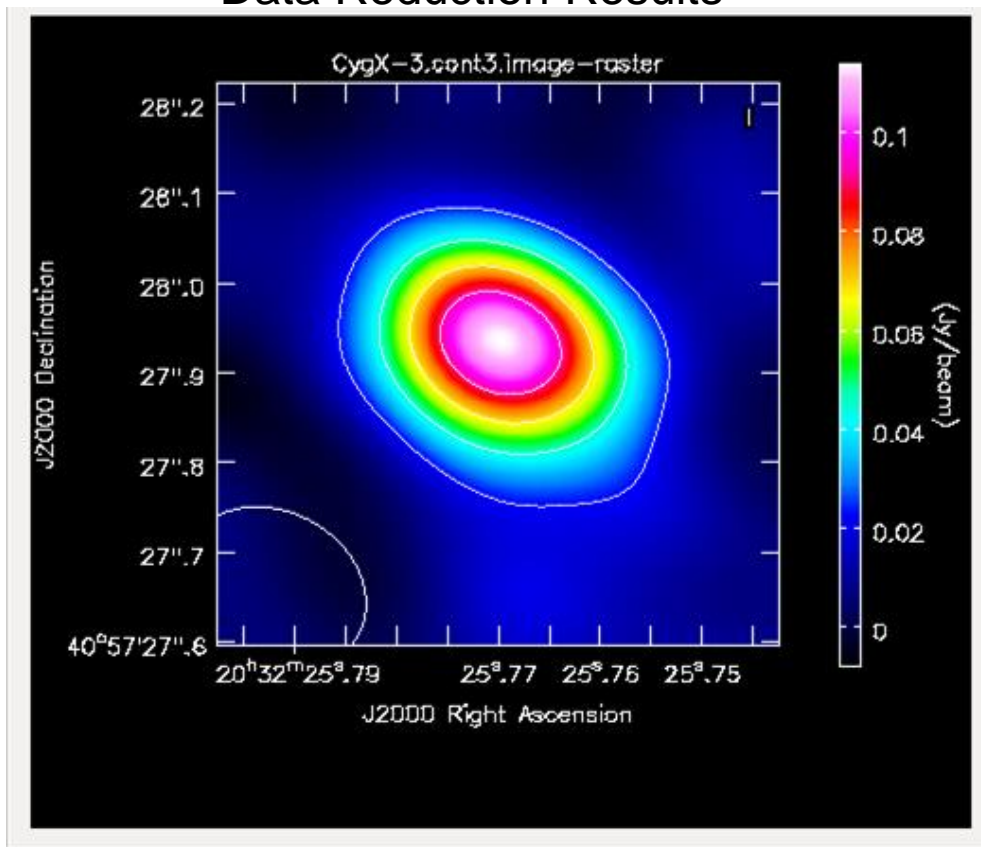
"The National Radio Astronomy Observatory is a facility of the National Science Foundation operated under cooperative agreement by Associated Universities, Inc."

Cygnus X-3 (Black Hole or Neutron Star) (VLA Archive)

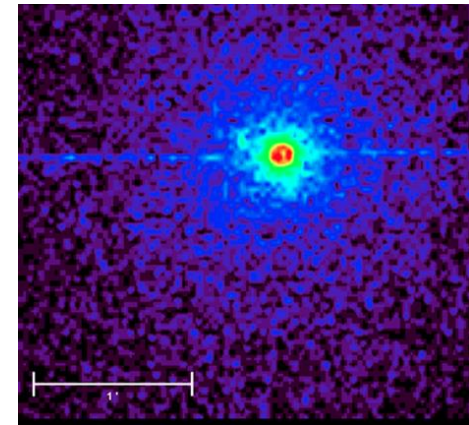
Observer: Dr. James Miller-Jones	Project: uid://evla/pdb/1521136
Observation: EVLA	
Computing scan and subscan properties...	
Data records: 213948	Total elapsed time = 1686.85 seconds
Observed from 08-Apr-2011/13:05:37.5 to 08-Apr-2011/13:33:44.3 (UTC)	

Background Information Wikipedia

Data Reduction Results



"Cygnus X-3 is a [high-mass X-ray binary](#) (HMXB), one of the stronger [binary X-ray sources](#) in the sky. It is often considered to be a [microquasar](#), and it is believed to be a [compact object](#) in a [binary system](#) which is pulling in a stream of gas from an ordinary [star](#) companion. It is the only known HMXB containing a [Wolf-Rayet star](#). It is invisible visually, but can be observed at [radio](#), [infrared](#), [X-ray](#), and [gamma-ray](#) wavelengths."



https://en.wikipedia.org/wiki/Cygnus_X-3

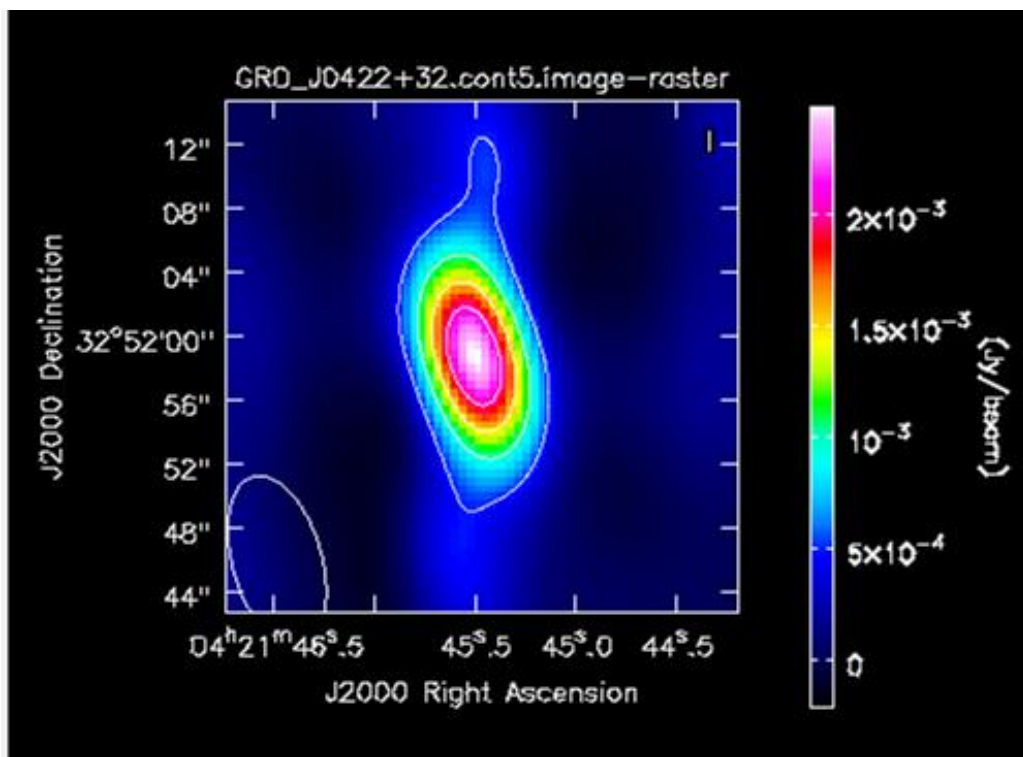
Data reduction completed by Dr. Richard Russel 11-21-2019 using download from VLA database.

GRO J0422+32

Possible Black Hole or Neutron Star Binary with a M4.5 Star (VLA Archive)

=====						
Observer: Dr. James Miller-Jones			Project: uid://evla/pdb/1072557			
Observation: EVLA						
Computing scan and subscan properties...						
Data records: 13882050			Total elapsed time = 12564.8 seconds			
Observed from 15-Nov-2010/01:34:01.4 to 15-Nov-2010/05:03:26.2 (UTC)						
Fields: 3						
ID	Code	Name	RA	Decl	Epoch	nRows
0	K	J0137+3309	01:37:41.299431	+33.09.35.13299	J2000	1144962
1	D	J0414+3418	04:14:37.255748	+34.18.51.20738	J2000	2364336
2	NONE	GRO J0422+32	04:21:42.746000	+32.54.26.97999	J2000	10372752

Data Reduction Results



Background Information Wikipedia

"GRO J0422+32^[1] is an [X-ray nova](#) and [black hole](#) candidate that was discovered by the [BATSE](#) instrument on the [CGRO](#) satellite on 5 August 1992.^{[3][4]} During outburst, it was observed to be stronger than the [Crab Nebula](#) gamma-ray source out to photon energies of about 500 [keV](#).^[2]

The mass of the black hole in GRO J0422+32 falls in the range 3.66 to 4.97 [solar masses](#).^[5] This is the smallest yet found for any [stellar black hole](#), and near the theoretical upper mass limit (~2.7 [M_⊙](#)) for a [neutron star](#). Further analysis in 2012 calculated a mass of 2.1 [M_⊙](#), which raises questions as to what the object actually is.^[6]

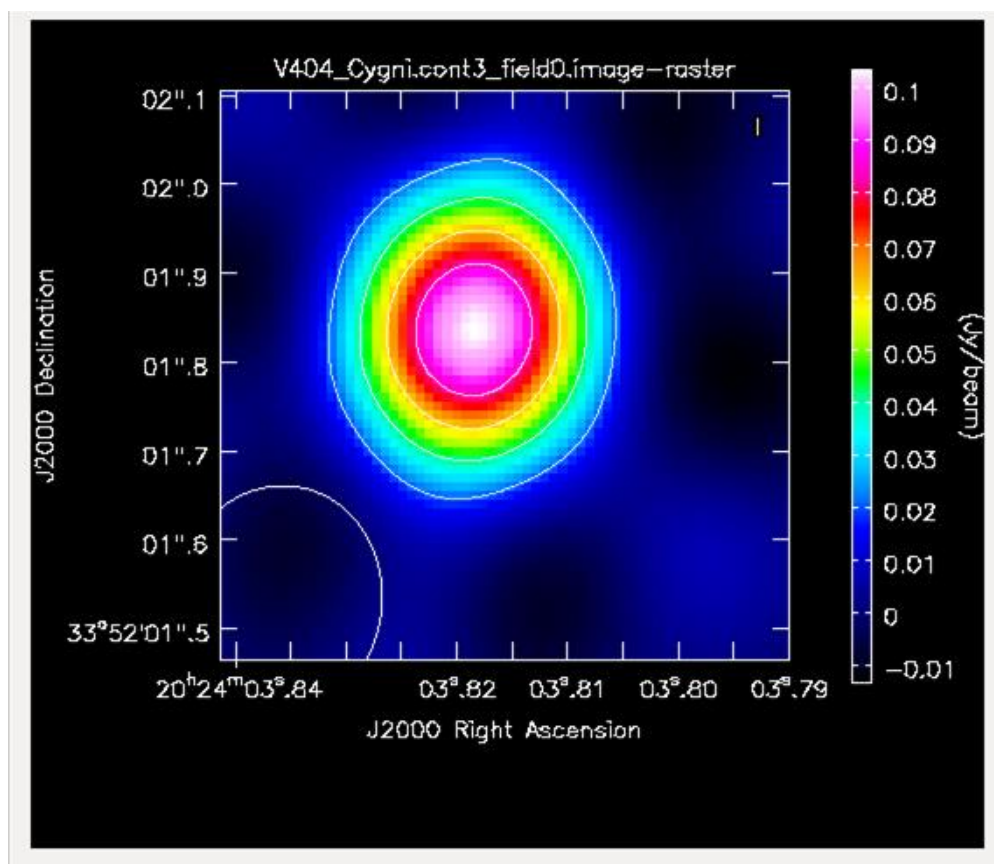
It is also known to have a companion [M-type main-sequence star](#), V518 Per,^[7] in the constellation [Perseus](#). It has a magnitude of 13.5 in the B spectral band, and 13.2 in the visible band."

Data reduction completed by Dr. Richard Russel 11-24-2019 using download from VLA database.

V404 Cygni (Black Hole & Q-type Star Binary) (VLA Archive)

```
Observer: Dr. James Miller-Jones      Project: uid://evla/pdb/30107161
Observation: EVLA
Computing scan and subscan properties...
Data records: 5479812      Total elapsed time = 1195 seconds
Observed from 17-Jun-2015/10:34:01.0 to 17-Jun-2015/10:53:56.0 (UTC)
```

Data Reduction Results



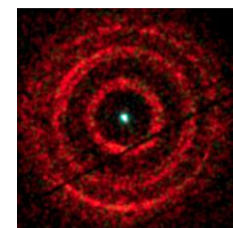
Background Information Wikipedia

"V404 Cygni is a [microquasar](#) and a [binary](#) system in the constellation of [Cygnus](#). It contains a [black hole](#) with a mass of about 9 [M_☉](#) and an [early K giant star](#) companion with a mass slightly smaller than the [Sun](#). The star and the black hole [orbit](#) each other every 6.47129 days at fairly close range. Due to their proximity and the intense gravity of the black hole, the companion star loses mass to an accretion disk around the black hole and ultimately to the black hole itself.^[9] The "V" in the name indicates that it is a [variable star](#), which repeatedly gets brighter and fainter over time. It is also considered a [nova](#), because at least three times in the 20th century it produced a bright outburst of energy. Finally, it is a [soft X-ray transient](#) because it periodically emits short bursts of X-rays.

In 2009, the black hole in the V404 Cygni system became the first black hole to have an accurate [parallax](#) measurement for its distance from the [Solar System](#). Measured by [very-long-baseline interferometry](#) using the [High Sensitivity Array](#), the distance is 2.39 ± 0.14 [kiloparsecs](#),^[10] or 7800 ± 460 [light-years](#).

In April 2019, astronomers announced that jets of particles shooting from the black hole were wobbling back and forth on the order of a few minutes, something that had never before been seen in the particle jets streaming from a black hole. Astronomers believe that the wobble is caused by the warping of space/time by the huge gravitational field in the vicinity of the black hole.^[11]

The black hole companion has been proposed as a [Q star](#) candidate.^[12]



Data reduction completed by Dr. Richard Russel 11-23-2019 using download from VLA database.

A large, white, parabolic radio telescope dish is the central focus of the image. It is mounted on a complex metal structure. At the top of the dish, there is a large, white, cylindrical feed horn. Several smaller antennas and sensors are also visible on the top edge of the dish. The dish is set against a clear blue sky. The text "Supermassive Black Holes" is overlaid in the center of the image.

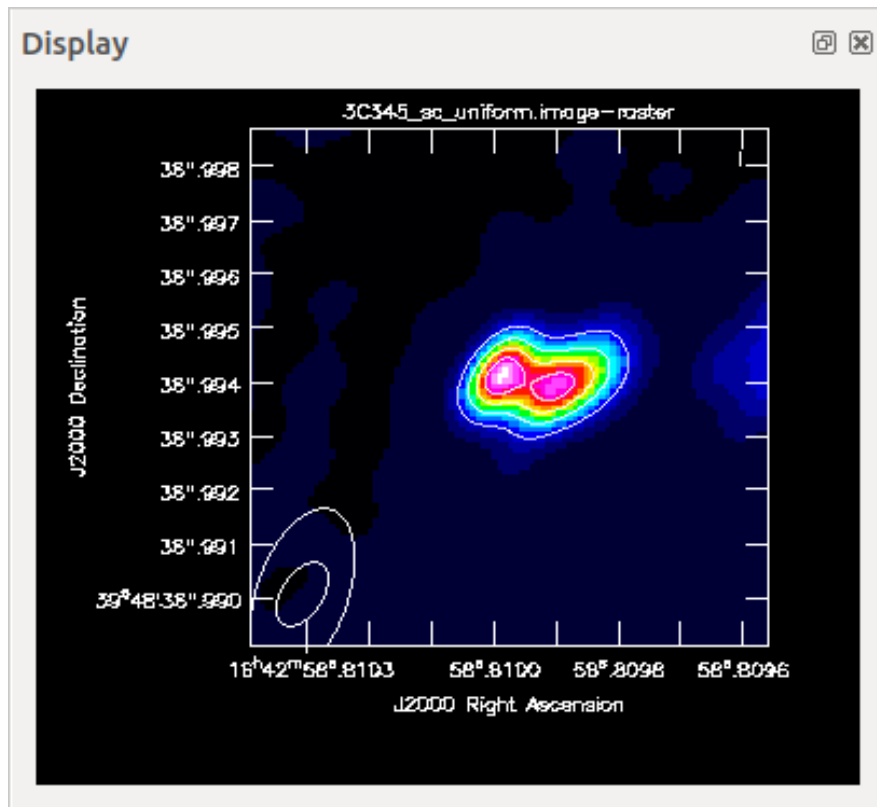
Supermassive Black Holes

3C345

Binary Supermassive Blackhole Quasar using the European Very Long Baseline Interferometer (EVLBI Archive)

```
Observer: N14C3    Project: N14C3
Observation: EVN
Computing scan and subscan properties...
Data records: 1846080    Total elapsed time = 10800 seconds
Observed from 22-Oct-2014/12:00:00.0 to 22-Oct-2014/15:00:00.0 (UTC)
```

Data Reduction Results



Conducted VLBI Imaging Tutorial at:

http://www.jb.man.ac.uk/DARA/unit4/Workshops/EVN_continuum.html

Data reduction conducted on VLBI archive data by Dr. Richard Russel on 10-25-19

A supermassive binary black hole in the quasar [3C345](#).

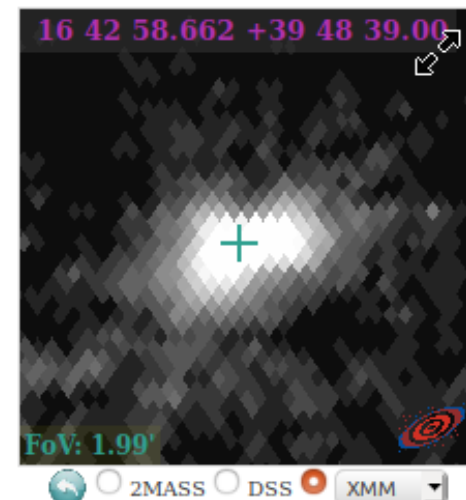
LOBANOV A.P. and ROLAND J.

Abstract (from CDS):

“Radio loud active galactic nuclei present a remarkable variety of signs indicating the presence of periodical processes possibly originating in binary systems of supermassive black holes, in which orbital motion and precession are ultimately responsible for the observed broad-band emission variations, as well as for the morphological and kinematic properties of the radio emission on parsec scales. This scenario, applied to the quasar 3C345, explains the observed variations of radio and optical emission from the quasar, and reproduces the structural variations observed in the parsec-scale jet of this object. The binary system in 3C345 is described by two equal-mass black holes with masses of $\approx 7.1 \times 10^8 M_\odot$ separated by ≈ 0.33 pc and orbiting with a period ~ 480 yr. The orbital motion induces a precession of the accretion disk around the primary black hole, with a period of ≈ 2570 yr. The jet plasma is described by a magnetized, relativistic electron-positron beam propagating inside a wider and slower electron-proton jet. The combination of Alfvén wave perturbations of the beam, the orbital motion of the binary system and the precession of the accretion disk reproduces the variability of the optical flux and evolution of the radio structure in 3C345. The timescale of quasi-periodic flaring activity in 3C345 is consistent with typical disk instability timescales. The present model cannot rule out a small-mass orbiter crossing the accretion disk and causing quasi-periodic flares.”

<http://simbad.u-strasbg.fr/simbad/sim-ref?bibcode=2005A%26A...431..831L>

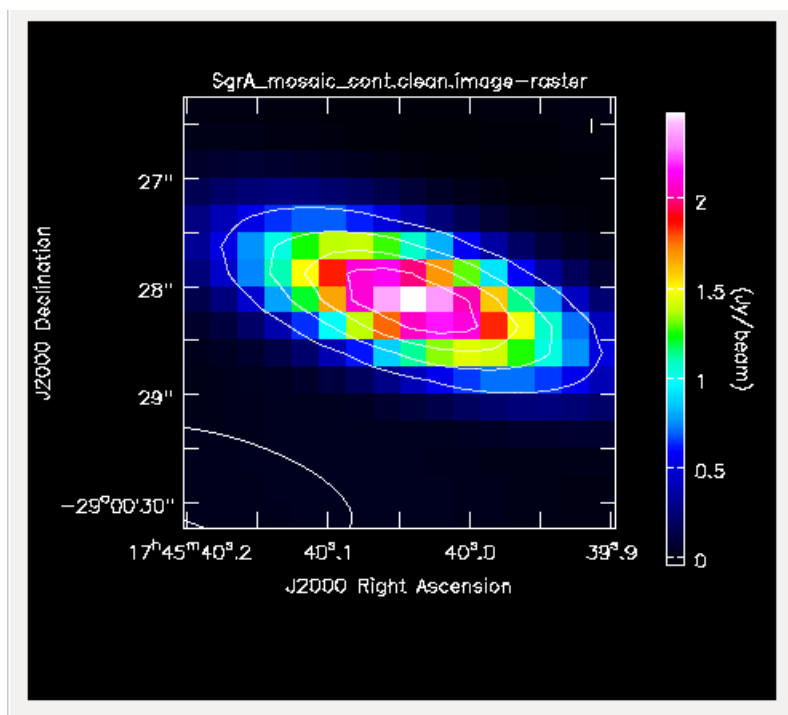
Interactive AladinLite view



SGR A* Band 6 (ALMA Archive)

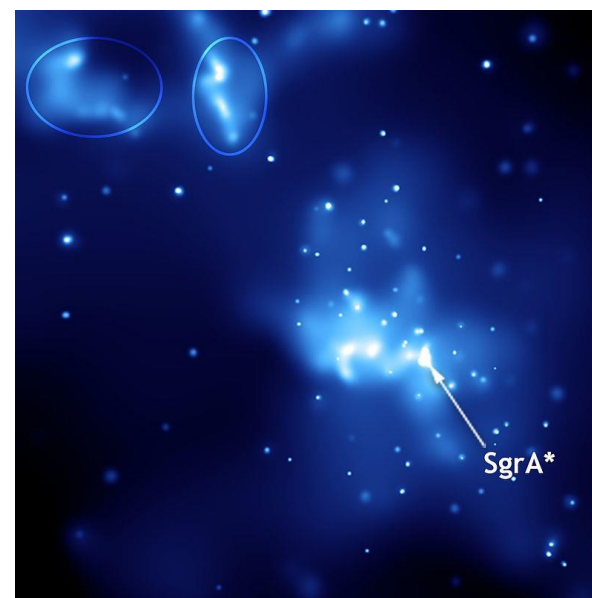
=====				
Observer:	Unknown	Project:	T.B.D.	
Observation: ALMA				
=====				
Telescope	Observation Date	Observer	Project	
ALMA	[	4.81578e+09, 4.81578e+09]	Unknown	T.B.D.
ALMA	[	4.81577e+09, 4.81578e+09]	Unknown	T.B.D.
ALMA	[	4.81578e+09, 4.81578e+09]	Unknown	T.B.D.
Computing scan and subscan properties...				
Data records:	32400	Total elapsed time =	11328.9 seconds	
observed from 26-Jun-2011/02:40:52.7 to 26-Jun-2011/05:49:41.6 (UTC)				

Data Reduction Results



Background Information Wikipedia

"Sagittarius A* (pronounced "Sagittarius A-Star", abbreviated Sgr A*) is a bright and very compact [astronomical radio source](#) at the [center](#) of the [Milky Way](#), near the border of the constellations [Sagittarius](#) and [Scorpius](#) about 5.6° south of the [ecliptic](#).^[6] It is likely the location of a [supermassive black hole](#).^{[7][8][9]} similar to those generally accepted to be at the centers of most if not all [spiral](#) and [elliptical galaxies](#)."



Data reduction conducted by Dr. Richard Russel on 11-3-19 using the ALMA Tutorial located at:
<https://almascience.nrao.edu/alma-data/science-verification/overview>

This paper makes use of the following ALMA data: ADS/JAO.ALMA project code: 2011.0.0005.SV. ALMA is a partnership of ESO (representing its member states), NSF (USA) and NINS (Japan), together with NRC (Canada), MOST and ASIAA (Taiwan), and KASI (Republic of Korea), in cooperation with the Republic of Chile. The Joint ALMA Observatory is operated by ESO, AUI/NRAO and NAOJ."

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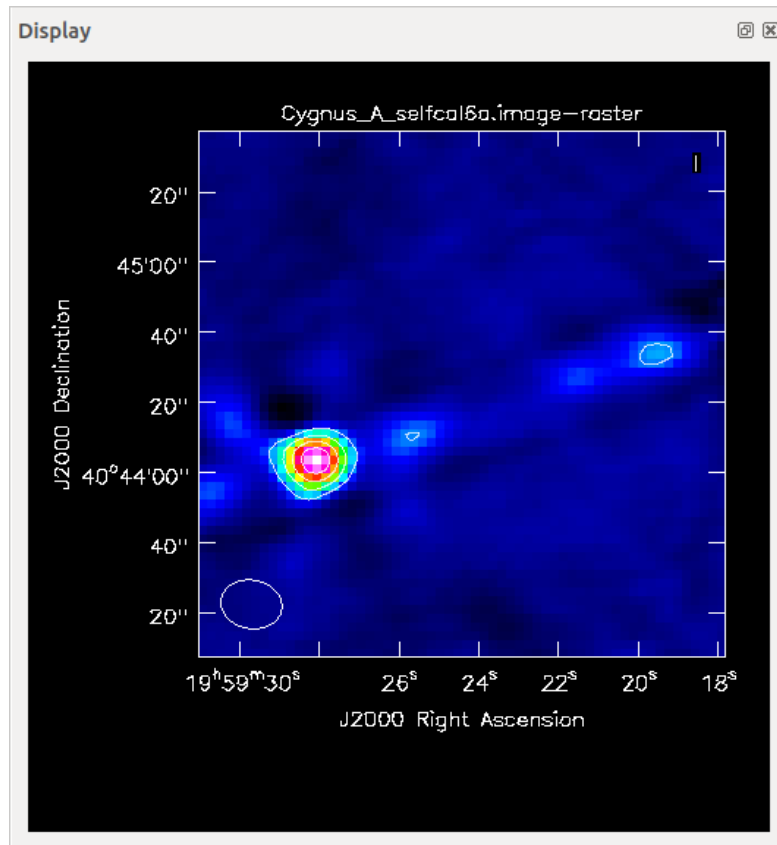


Supernova Remnants

Cygnus A (VLA Archive)

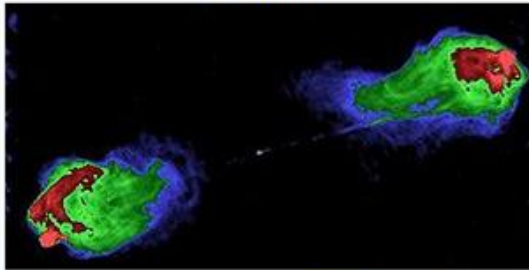
```
=====
Observer: Dr. Frank Schinzel   Project: uid://evla/pdb/1695465
Observation: EVLA
Computing scan and subscan properties...
Data records: 2045736         Total elapsed time = 508 seconds
Observed from 17-Oct-2019/22:34:08.0 to 17-Oct-2019/22:42:36.0 (UTC)
=====
```

Data Reduction Results



Background Information Wikipedia

"Cygnus A ([3C 405](#)) is a [radio galaxy](#), and one of the strongest radio sources in the sky. It was discovered by [Grote Reber](#) in 1939. In 1951, Cygnus A, along with [Cassiopeia A](#), and [Puppis A](#) were the first "radio stars" identified with an optical source. Of these, Cygnus A became the first radio galaxy; the other two being [nebulae](#) inside the [Milky Way](#).^[4] In 1953 [Roger Jennison](#) and [M K Das Gupta](#) showed it to be a double source.^[5] Like all radio galaxies, it contains an [active galactic nucleus](#). The [supermassive black hole](#) at the core has a mass of $(2.5 \pm 0.7) \times 10^9$ [M_☉](#).^[3]"

Cygnus A	
	
Observation data (J2000 epoch)	
Constellation	Cygnus
Right ascension	19 ^h 59 ^m 28.3566 ^s ^[1]
Declination	+40° 44′ 02.096″ ^{[1][2]}
Redshift	0.056075 ± 0.000067 ^{[1][2]}
Distance	232 ^[3] Mpc
Apparent magnitude (V)	16.22 ^{[1][2]}

First attempt of a raw data set from archive: Note – no log, or antpos – therefore had to do self calibration to get image. Image reduced by Dr. Richard Russel 10-20-19

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3C391 Supernova Remnant (VLA Archive)

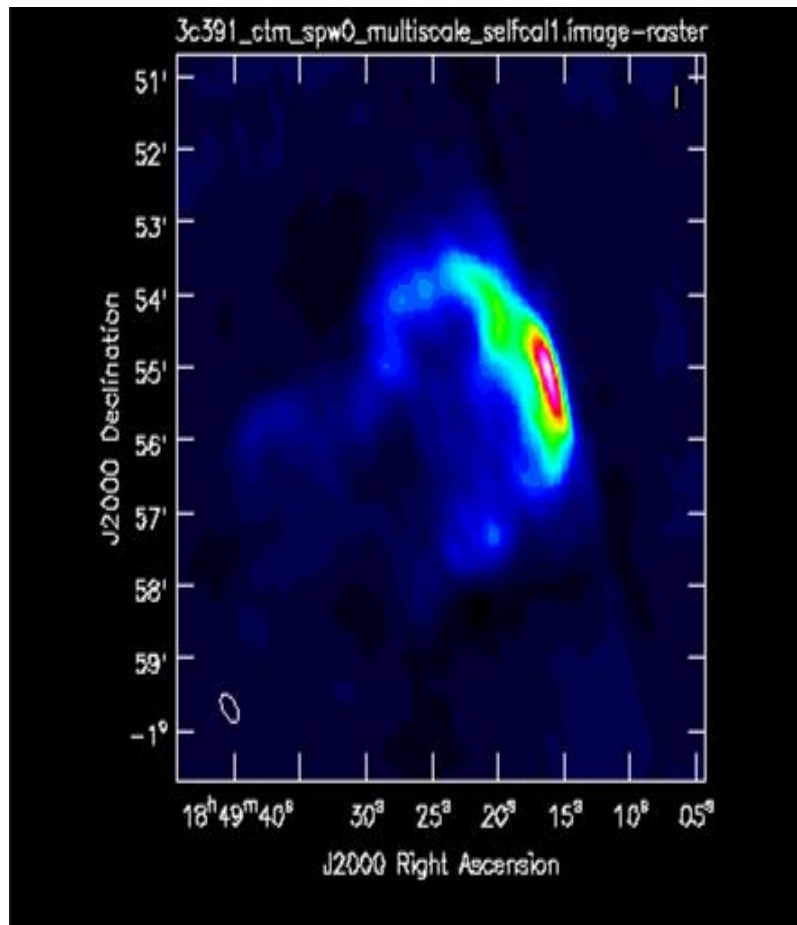
EVLA OBSERVING LOG

2010-04-24_0801_TDEM0001

Observing Date: 24-Apr-2010
Configuration: D
Decommissioned: 10
VLBI Ref Ant:
VLBI Ant Pad:

Program:	TDEM0001	Observing Mode:	Mixed Modes
Observer(s):	James Miller-Jones	Bands Used:	C
User #:	2398	# Subarrays:	1
Observer's E-mail:	jmliller@nrao.edu, mrupen@aoe.nrao.edu	Initial Source:	J1331+3030
Source File(s):	TDEM0001_sb1218006_1.evla		
Operator(s):	Sam Gilmore		

Data Reduction Results



Background Information Astronomy and Astrophysics 78,75-77 (1979)

Observations of the Supernova Remnant 3C391 at 1.4 and 10.7 GHz

W. M. Goss¹, D. J. Skellern², A. Watkinson², and P. A. Shaver^{1*}

¹ Kapteyn Astronomical Institute, University of Groningen, Postbus 800, 9700 AV Groningen, The Netherlands

² School of Electrical Engineering, University of Sydney, Australia

Received August 17, 1978

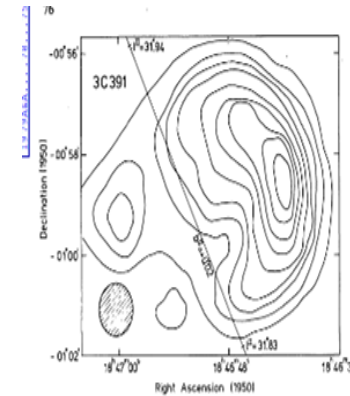


Fig. 1. Map of 3C391 observed with the Fleurs Synthesis Telescope. The HPBW is $54 \times 66''$ arc ($\alpha \times \delta$). The contour levels are 50, 100, 150, 200, 300, ..., 700 K (50 K = 0.27 Jy/beam)

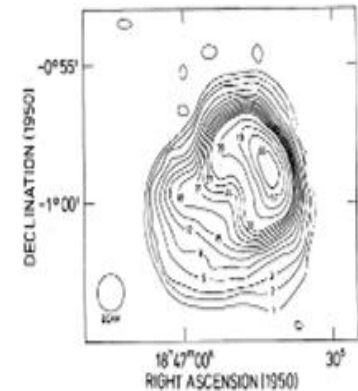


Fig. 2. Map of 3C391 observed at 10.7 GHz with the Effelsberg telescope. The half-power beamwidth is $77''$. The contour unit is 0.02°K in antenna temperature or 0.03°K in brightness temperature

Imaged based on VLA Tutorial and VLA Archive Data: Dr. Richard A. Russel 10/16/19 (Detailed file VLA Image Workshop Obs 3c391.odt)

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Active Galactic Nucleus



Asymptotic Giant Branch (AGB) Star IRC+10216 (VLA Archive)

Background Information Wikipedia

EVLA OBSERVING LOG

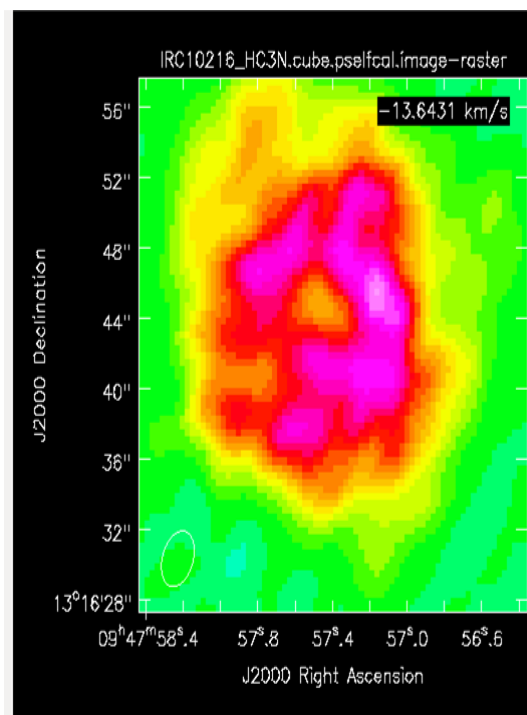
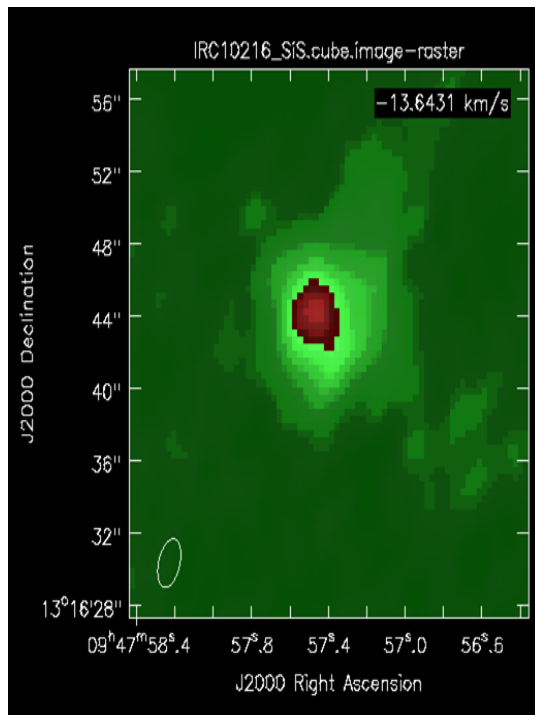
2010-04-26_0310_TDEM0003

Observing Date: 26-Apr-2010
Configuration: D
Decommissioned: 10
VLA Ref Ant:
VLA Ant Pad:

Program:	TDEM0003	Observing Mode:	Continuum
Observer(s):	Mark Clausen	Bands Used:	C, Ka
User #:	661	# Subarrays:	1
Observer's E-mail:	mclausen@nrao.edu, mrupe@nrao.edu	Initial Source:	J1008+0730
Source File(s):	TDEM0003_sb1345754_1.evla		
Operator(s):	Matt Gardner		

"IRC +10216 or CW Leonis is a well-studied [carbon star](#) that is embedded in a thick dust envelope. It was first discovered in 1969 by a group of astronomers led by [Eric Becklin](#), based upon infrared observations made with the 62 inches (1.6 m) [Caltech Infrared Telescope](#) at [Mount Wilson Observatory](#)."

Data Reduction Results



"Its energy is emitted mostly at infrared wavelengths. At a wavelength of 5 [um](#), it was found to have the highest flux of any object outside the [Solar System](#).^[12]"



Imaged based on VLA Tutorial and VLA Archive Data: Dr. Richard A. Russel 10/16/19 (Detailed file VLA ImageIRC+10216.odt.odt)

Gravitational Lenses



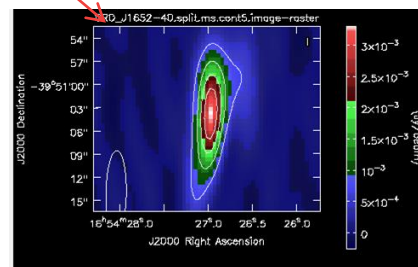
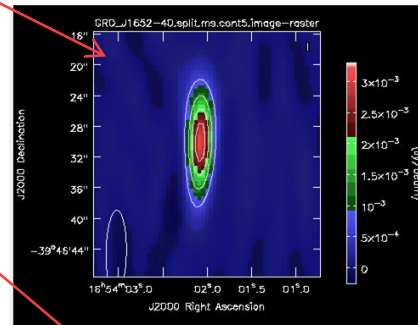
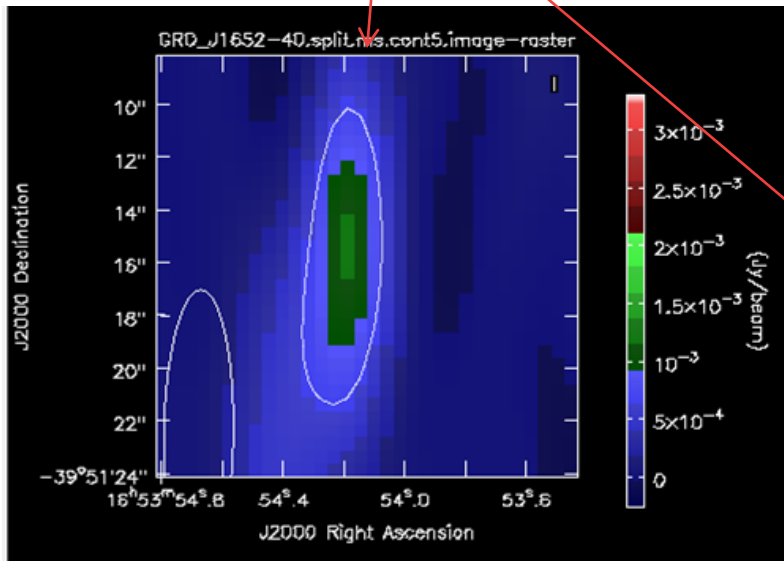
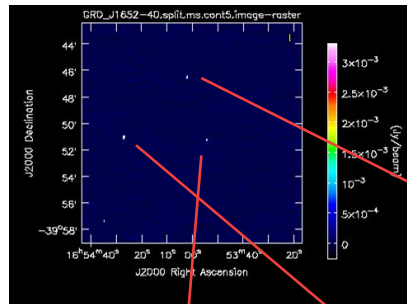
GRO J1635-40 Black Hole Binary with V1030 Sco (VLA Archive)

Three objects in close proximity- Bottom left is closest to expected position of J1635-40

```
=====
Observer: Dr. James Miller-Jones      Project: uid://evla/pdb/1072557
Observation: EVLA
Computing scan and subscan properties...
Data records: 12849200      Total elapsed time = 12564.6 seconds
Observed from 13-Dec-2010/16:40:33.4 to 13-Dec-2010/20:09:58.1 (UTC)
=====
```

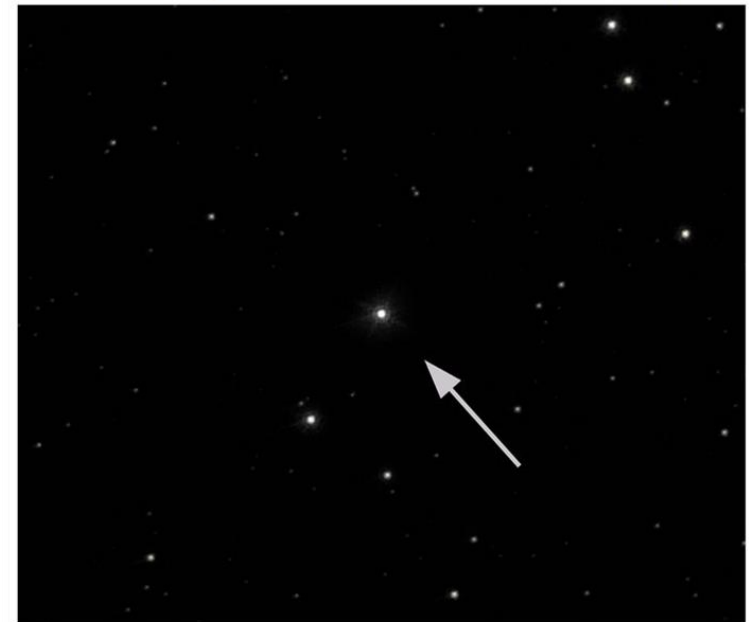
ID	Code	Name	RA	Decl	Epoch	SrcId	nRows
0	K	J1331+3030	13:31:08.287984	+30.30.32.95886	J2000	0	904800
1	D	J1607-3331	16:07:34.762344	-33.31.08.91313	J2000	1	2251600
2	NONE	GRO J1655-40	16:54:00.137000	-39.50.44.90001	J2000	2	9692800

Data Reduction Results



Background Information Hubble Website

Black-hole system GRO J1655-40 in Scorpius



NASA/ESA Hubble Space Telescope image shows the Year 2001 observation of the [black hole](#) system GRO J1655-40 in the constellation of Scorpius. Hubble's high resolution has allowed astronomers to measure the motion of this black-hole system across the sky using this image and an image taken in 1996. Scientists combined the Hubble data with those obtained from ground-based telescopes and found that the black hole is moving through space with a velocity of 400 000 kilometres per hour. This has provided possibly the best evidence yet that stellar-mass black holes are made in supernova explosions. The 720-second exposure was taken through a red filter.

<https://www.spacetelescope.org/images/heic0211c/>

Data reduction completed by Dr. Richard Russel 11-25-2019 using download from VLA database.

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MG0414+0534 Gravitational Lens HI Absorption Line (VLA Archive)

VLA OBSERVING LOG

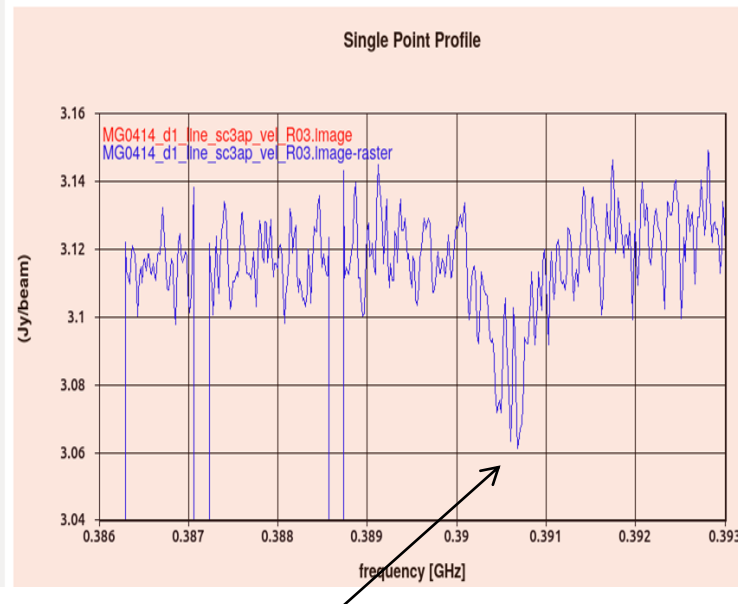
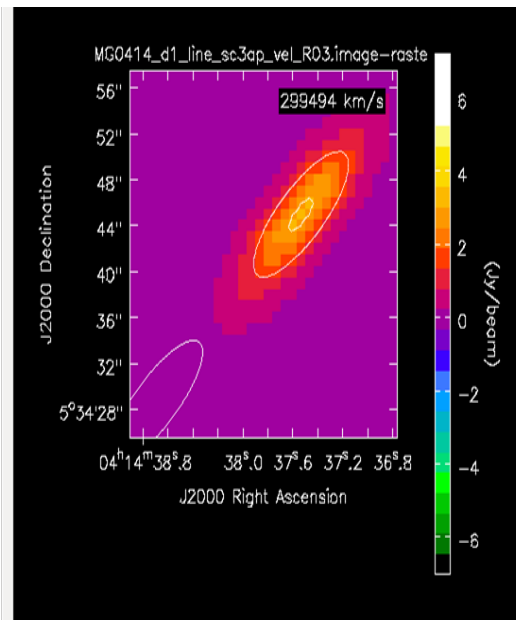
2016-09-14_0620_TSUB0001

Observing Date: 14-Sep-2016
Configuration: B>A
Decommissioned: 11

Project:	TSUB0001	# Subarrays: 1	Observation Type: Test
Observer(PI):	Frazer Owen	Band(s) Used:	X P
SB ID(s):	32720781		
Source File(s):	TSUB0001_sb32720781_1		
Observer E-mail:	fowen@nrao.edu		
Operator(s):	Blythe Guvenen		

Background Information
NRAO.edu

Data Reduction Results



Hydrogen Absorption Feature

“Goal was to reduce the spectral-line data in the low-frequency P-band of the VLA (230–470 MHz).

The goal is to make an image cube containing HI 21cm absorption against the strong radio continuum of gravitationally lensed radio galaxy MG0414+0534.

As a result of the high redshift of $z=2.6365$, the HI absorption signal in MG0414+0534 is redshifted to an observed frequency of 390.597 MHz.

The HI absorption in MG0414+0534 was previously imaged with the VLA by Moore, Carilli & Menten 1999 (ApJ, 510, 87), (at end of this file) before the upgrade to the WIDAR system.”

VLA tutorial reduced by Dr. Richard Russel 10/18/19 – full script of reduction in <file:VLA> Image MG0414+0534.odt [https://casaguides.nrao.edu/index.php/MG0414%2B0534_P-band_Spectral_Line_Tutorial - CASA 5.5.0](https://casaguides.nrao.edu/index.php/MG0414%2B0534_P-band_Spectral_Line_Tutorial_-_CASA_5.5.0)

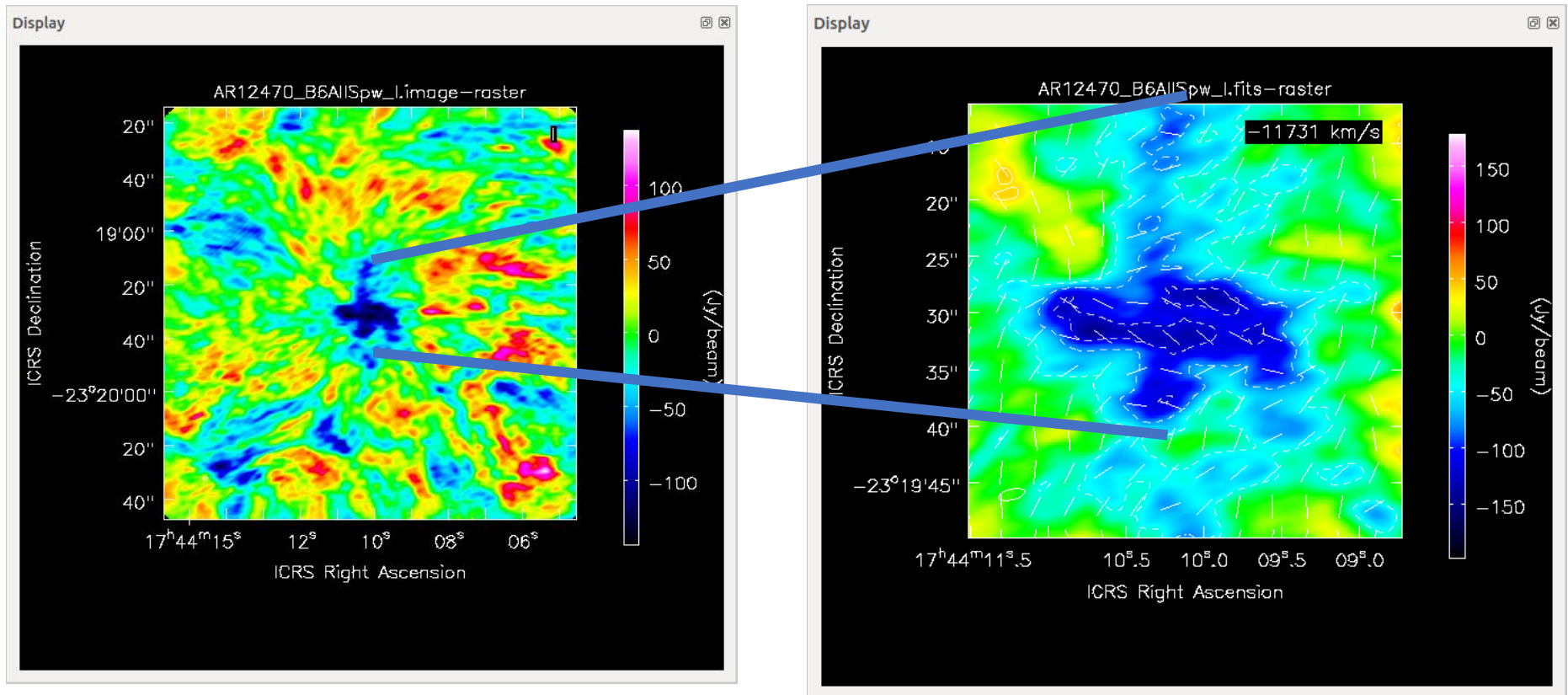
The background image shows a man in a yellow hard hat and a blue jacket standing in a technical room. He is looking towards the right. In the foreground, there are many cables hanging from a rack, some red and some black. The room has a white ceiling with some equipment and a black trash can in the background. The text "Stars, Planets, Dwarf Planets, Moons and Planetesimals" is overlaid on the image in a large, black, sans-serif font.

Stars, Planets, Dwarf Planets, Moons and Planetesimals

Sunspot Band 6 (ALMA Archive)

```
Observer: shimojo      Project: uid://A002/Xac494e/X3
Observation: ALMA
Computing scan and subscan properties...
Data records: 20923884      Total elapsed time = 3184.8 seconds
Observed from 18-Dec-2015/19:15:42.3 to 18-Dec-2015/20:08:47.1 (UTC)
```

Data Reduction Results



Data reduction conducted by Dr. Richard Russel 11/16/19 based on the NRAO tutorial https://casaguides.nrao.edu/index.php/Sunspot_Band6

"This paper makes use of the following ALMA data: ADS/JAO.ALMA#2011.0.00020.SV. ALMA is a partnership of ESO (representing its member states), NSF (USA) and NINS (Japan), together with NRC (Canada) and NSC and ASIAA (Taiwan), and KASI (Republic of Korea), in cooperation with the Republic of Chile. The Joint ALMA Observatory is operated by ESO, AUI/NRAO and NAOJ."

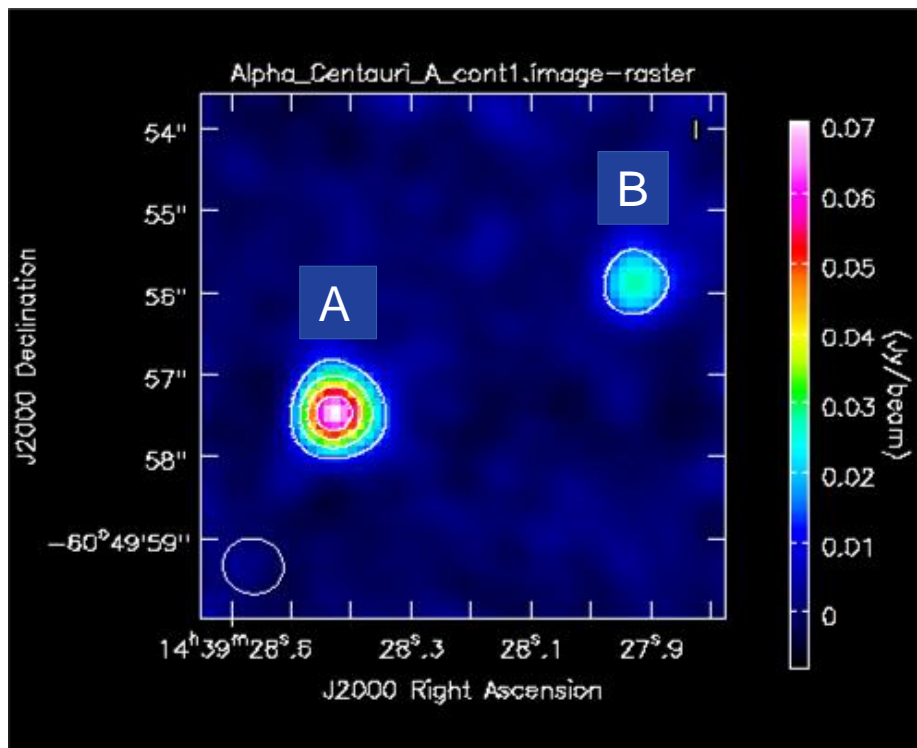
"The National Radio Astronomy Observatory is a facility of the National Science Foundation operated under cooperative agreement by Associated Universities, Inc."

Alpha Centauri A & B (ALMA Archive)

```
#Antenna System: ALMA
#Project: uid://A001/x10c/x121
#Project Code: 2013.1.00170.S
#obs date: 02 May 2015
#Observer: rliseau
#field 0: J1427-4206 wvr Bandpass
#field 1: Titan Flux
#field 2: J1617-5848 phase wvr
#field 3: alpha_centauri_A 14:39:28.247 -60.49:57.53
```

```
#scans:0-12
#SPWID(0~20)
#SPWID(0) WVR 184.5GHz
#SPWID(1-20) 397-412GHz XX YY
#Antennas (0-36)
```

Data Reduction Results



Background Information Wikipedia

"Alpha Centauri ([Latinized](#) from α Centauri, abbreviated Alpha Cen or α Cen) is the [closest star system](#) and closest [planetary system](#) to the [Solar System](#) at 4.37 [light-years](#) (1.34 [parsec](#)) from the [Sun](#). It is a triple star system, consisting of three [stars](#): α Centauri A (officially Rigil Kentaurus),[\[15\]](#) α Centauri B (officially Toliman),[\[15\]](#) and α Centauri C (officially [Proxima Centauri](#)).[\[15\]](#)"

ALMA observations of α Centauri

First detection of main-sequence stars at 3 mm wavelength

R. Liseau¹, W. Vlemmings¹, A. Bayo², E. Bertone³, J.H. Black¹, C. del Burgo³, M. Chavez³, W. Danchi⁴, V. De la Luz⁵, C. Eiroa⁶, S. Ertel⁷, M.C.W. Fridlund⁸, K. Justtanont¹, A. Krivov⁹, J.P. Marshall¹⁰, A. Mora¹¹, B. Montesinos¹², L.-A. Nyman¹³, G. Olofsson¹⁴, J. Sanz-Forcada¹², P. Thébaud¹⁵, and G.J. White^{16, 17}

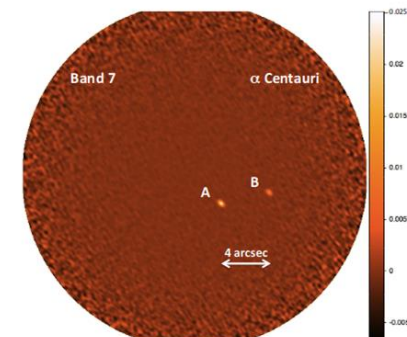


Fig. 1. ALMA observation of α Cen A and B at 870 μm (~ 344 GHz) on 7 July 2014. At 1.35 pc distance, this binary is nearest to the Sun. The primary has spectral type G2 V, and the secondary is a K1 V dwarf. The stellar disks are unresolved, so that the synthesized beam is defined by the point-like stars and beam sizes, are given in Sect. 2. Intensity units are Jy beam⁻¹. North is up and east to the left.

<https://arxiv.org/pdf/1412.3923.pdf>

Data reduction conducted by Dr. Richard Russel on 11/30/19

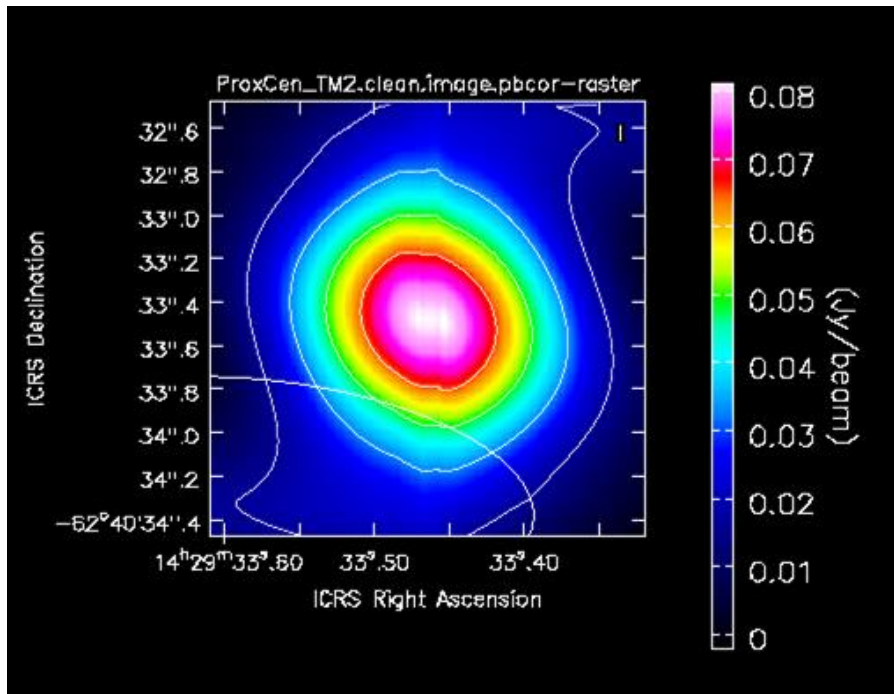
"This paper makes use of the following ALMA data: ADS/JAO.ALMA#2013.1.00170.S. ALMA is a partnership of ESO (representing its member states), NSF (USA) and NINS (Japan), together with NRC (Canada) and NSC and ASIAA (Taiwan), and KASI (Republic of Korea), in cooperation with the Republic of Chile. The Joint ALMA Observatory is operated by ESO, AUI/NRAO and NAOJ."

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Alpha Centauri C (Proxima Centauri) (ALMA Archive)

2016.A.00013.S - use for pub reference
#Observer: guillem Project: uid://A001/X8a9/X177
#Observation: ALMA
#Data records: 60590333 Total elapsed time = 4487.86 seconds
#Observed from 25-Apr-2017/04:16:28.4 to 25-Apr-2017/05:31:16.3 (UTC)
#scan 1-32
#field 0 J1427-4206 wvr bandpass
#field 1 J1427-5848 flux
#field 2 J1424-6807 phase
#fields 3-10 Proxima_Centauri mosaic
#SPW 0-24 221-242 GHz
#Antennas 0-40

Data Reduction Results



Data reduction conducted by Dr. Richard Russel on 12/6/19

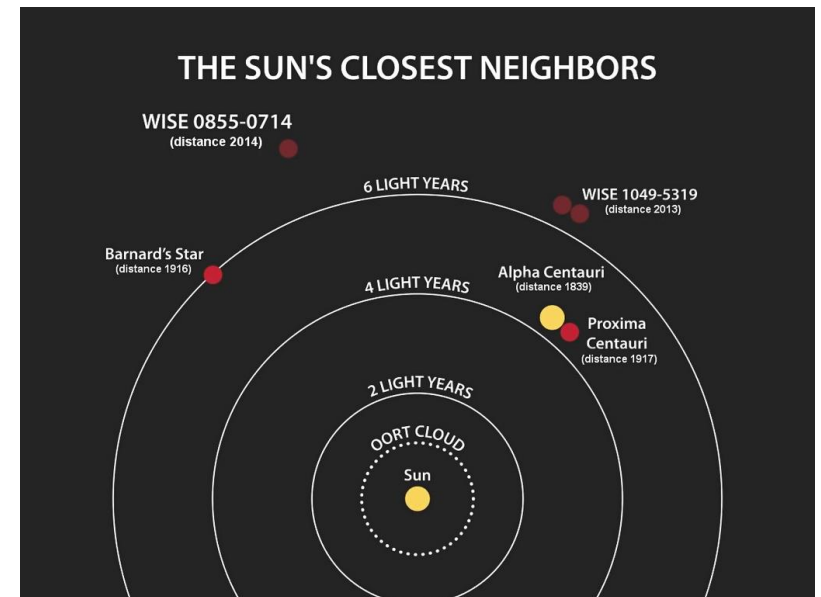
"This paper makes use of the following ALMA data: ADS/JAO.ALMA#2016.A.00013.S. ALMA is a partnership of ESO (representing its member states), NSF (USA) and NINS (Japan), together with NRC (Canada) and NSC and ASIAA (Taiwan), and KASI (Republic of Korea), in cooperation with the Republic of Chile. The Joint ALMA Observatory is operated by ESO, AUI/NRAO and NAOJ."

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Background Information Wikipedia

"Proxima Centauri is a small, low-mass [star](#) located 4.244 [light-years](#) (1.301 [pc](#)) away from the [Sun](#) in the southern [constellation](#) of [Centaurus](#). Proxima Centauri is a [red dwarf](#) star with a mass about an eighth of the Sun's mass ([M_☉](#)), and average [density](#) about 33 times that of the Sun.

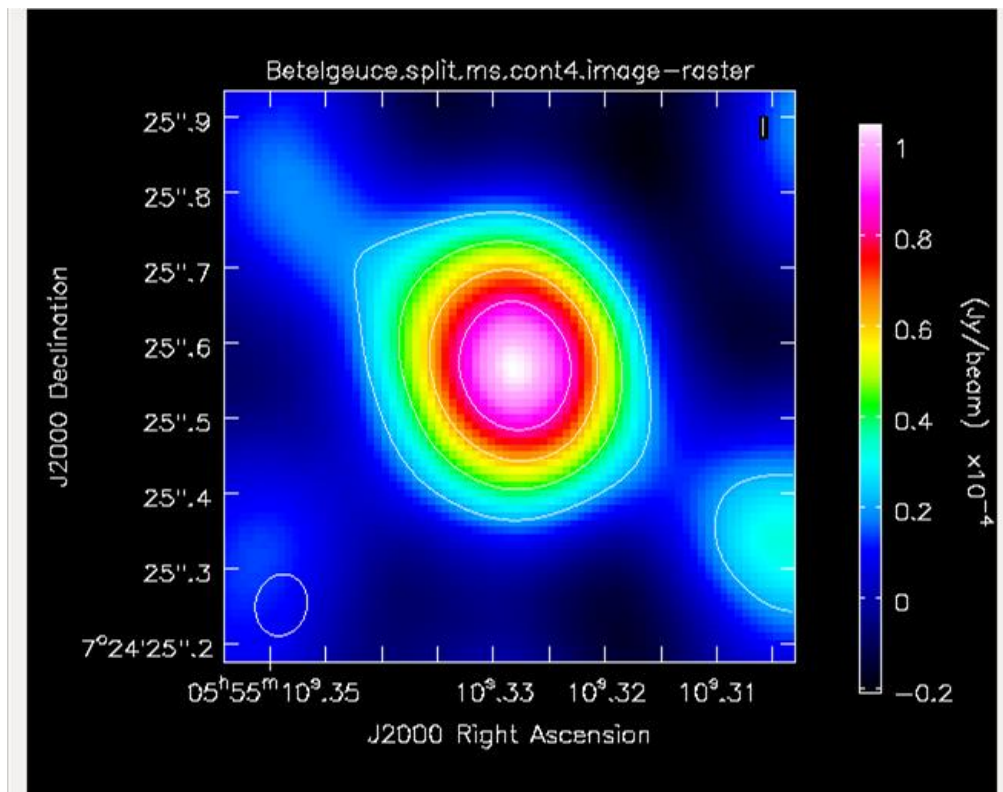
In 2016, the [European Southern Observatory](#) announced the discovery of [Proxima Centauri b](#), a [planet](#) orbiting the star at a distance of roughly 0.05 AU (7.5 million km) with an orbital period of approximately 11.2 Earth days. Its estimated mass is at least 1.3 times that of the Earth "



Betelgeuse (Alpha Orionis) (VLA Archive)

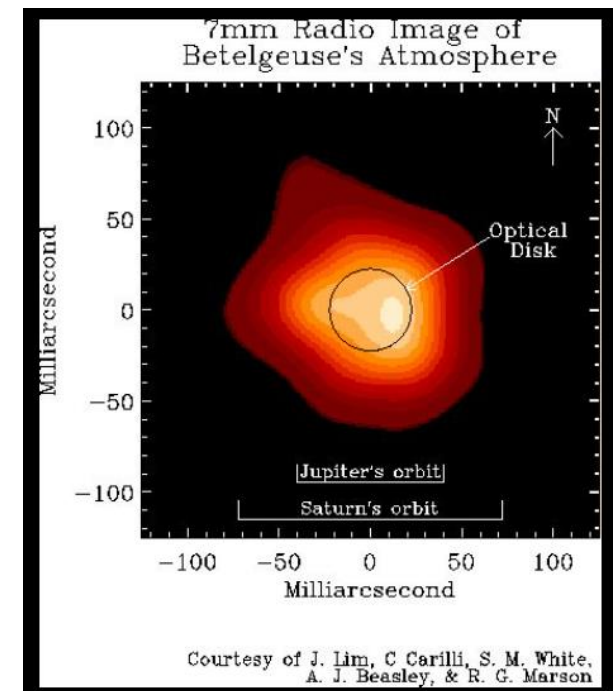
```
Observer: Prof. Ian T. Durham    Project: uid://evla/pdb/28661765
Observation: EVLA
Computing scan and subscan properties...
Data records: 12524382          Total elapsed time = 4004 seconds
Observed from 27-Feb-2014/01:08:21.0 to 27-Feb-2014/02:15:05.0 (UTC)
```

Data Reduction Results



Background Information Wikipedia

"**Betelgeuse** is generally the [ninth-brightest star](#) in the [night sky](#) and second-brightest in the [constellation](#) of [Orion](#) (after [Rigel](#)). It is a distinctly reddish, [semiregular variable star](#) whose [apparent magnitude](#) varies between +0.0 and +1.3, the widest range of any [first-magnitude star](#). At [near-infrared wavelengths](#), Betelgeuse is the brightest star in the night sky. It has the [Bayer designation](#) α [Orionis](#), which is [Latinised](#) to **Alpha Orionis** and abbreviated **Alpha Ori** or α Ori."



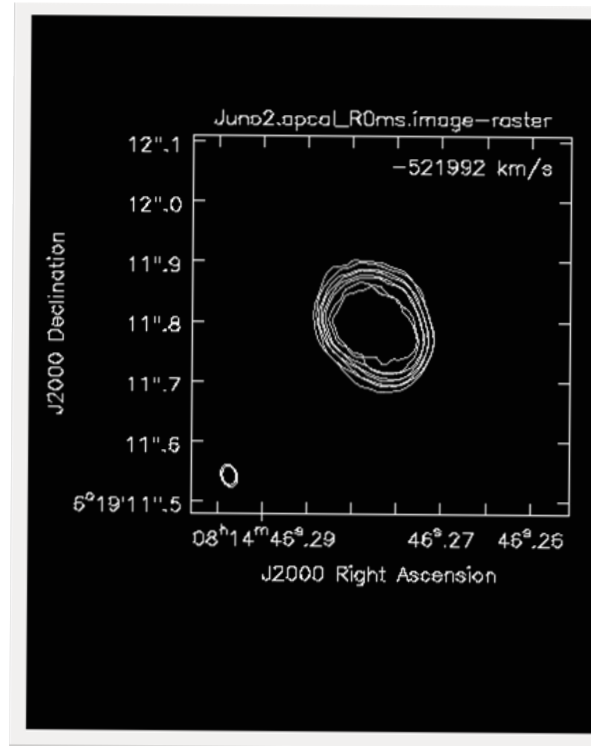
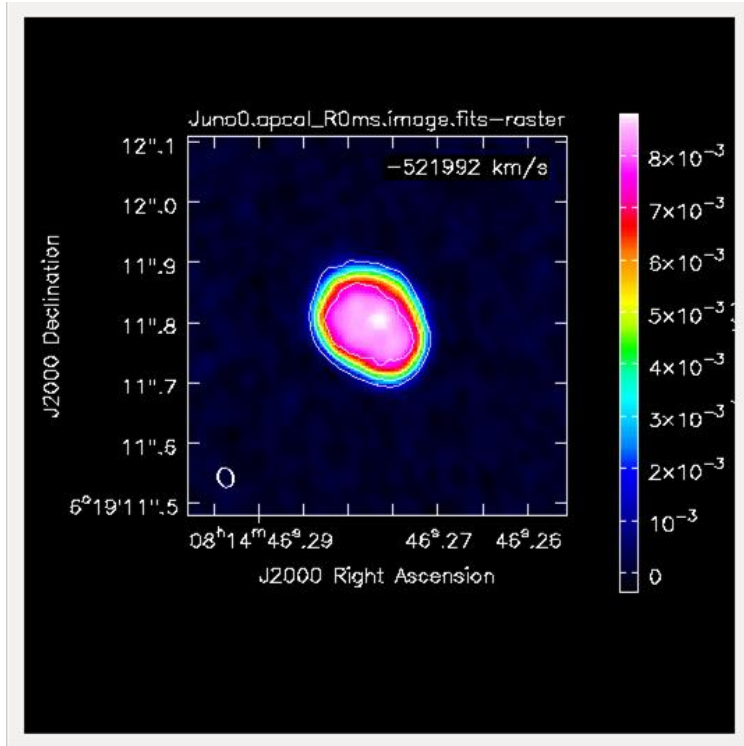
Data reduction completed by Dr. Richard Russel 11-18-2019 using download from NRAO VLA archive.

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

Juno Asteroid (ALMA Archive)

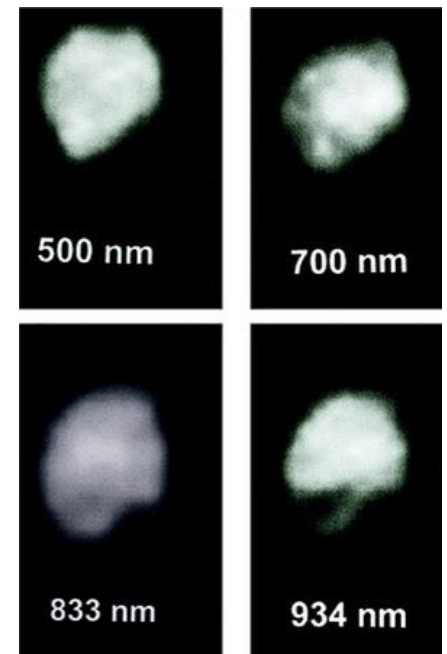
```
=====
Observer: hirotaaak   Project: uid://A002/X8d0549/x17
Observation: ALMA
Computing scan and subscan properties...
Data records: 830280   Total elapsed time = 1162.32 seconds
Observed from 19-Oct-2014/09:32:23.0 to 19-Oct-2014/09:51:45.4 (UTC)
=====
```

Data Reduction Results



Background Information Wikipedia

?Juno is one of the larger asteroids, perhaps tenth by size and containing approximately 1% the mass of the entire [asteroid belt](#).^[17] It is the second-most-massive S-type asteroid after 15 Eunomia.^[4] Even so, Juno has only 3% the mass of [Ceres](#).^[4]



Data reduction conducted by Dr. Richard Russel on 11-1-19 using the ALMA Tutorial located at:

https://casaguides.nrao.edu/index.php/ALMA2014_LBC_SVDATA

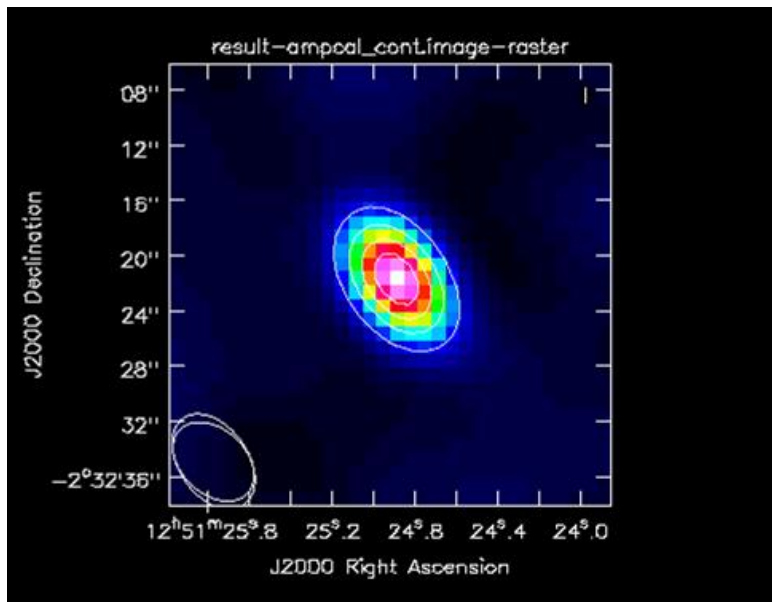
"This paper makes use of the following ALMA data: ADS/JAO.ALMA project code: 2011.0.00013.SV. ALMA is a partnership of ESO (representing its member states), NSF (USA) and NINS (Japan), together with NRC (Canada), MOST and ASIAA (Taiwan), and KASI (Republic of Korea), in cooperation with the Republic of Chile. The Joint ALMA Observatory is operated by ESO, AUI/NRAO and NAOJ."

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Saturn's moon of Titan (ALMA Archive)

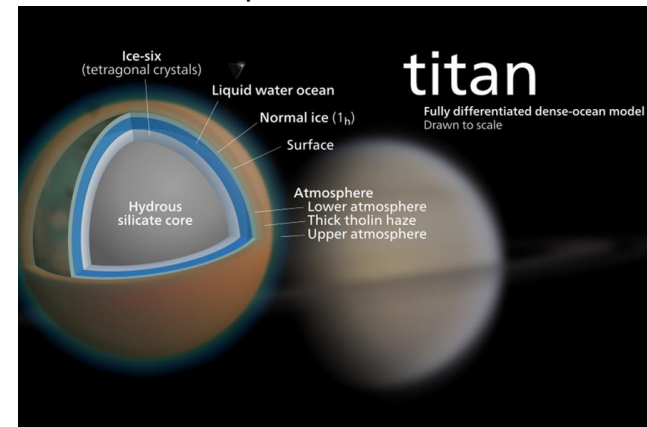
```
Computing scan and subscan properties...  
Data records: 326400      Total elapsed time = 90574.4 seconds  
Observed from 16-Apr-2011/02:59:18.2 to 17-Apr-2011/04:08:52.6 (UTC)
```

Data Reduction Results



Background Information Wikipedia

"Titan is the largest [moon of Saturn](#) and [the second-largest](#) natural satellite in the [Solar System](#). It is the only [moon](#) known to have a dense [atmosphere](#), and the only known body in space, other than Earth, where clear evidence of stable bodies of surface liquid has been found."



Used as calibrator for NGC3256

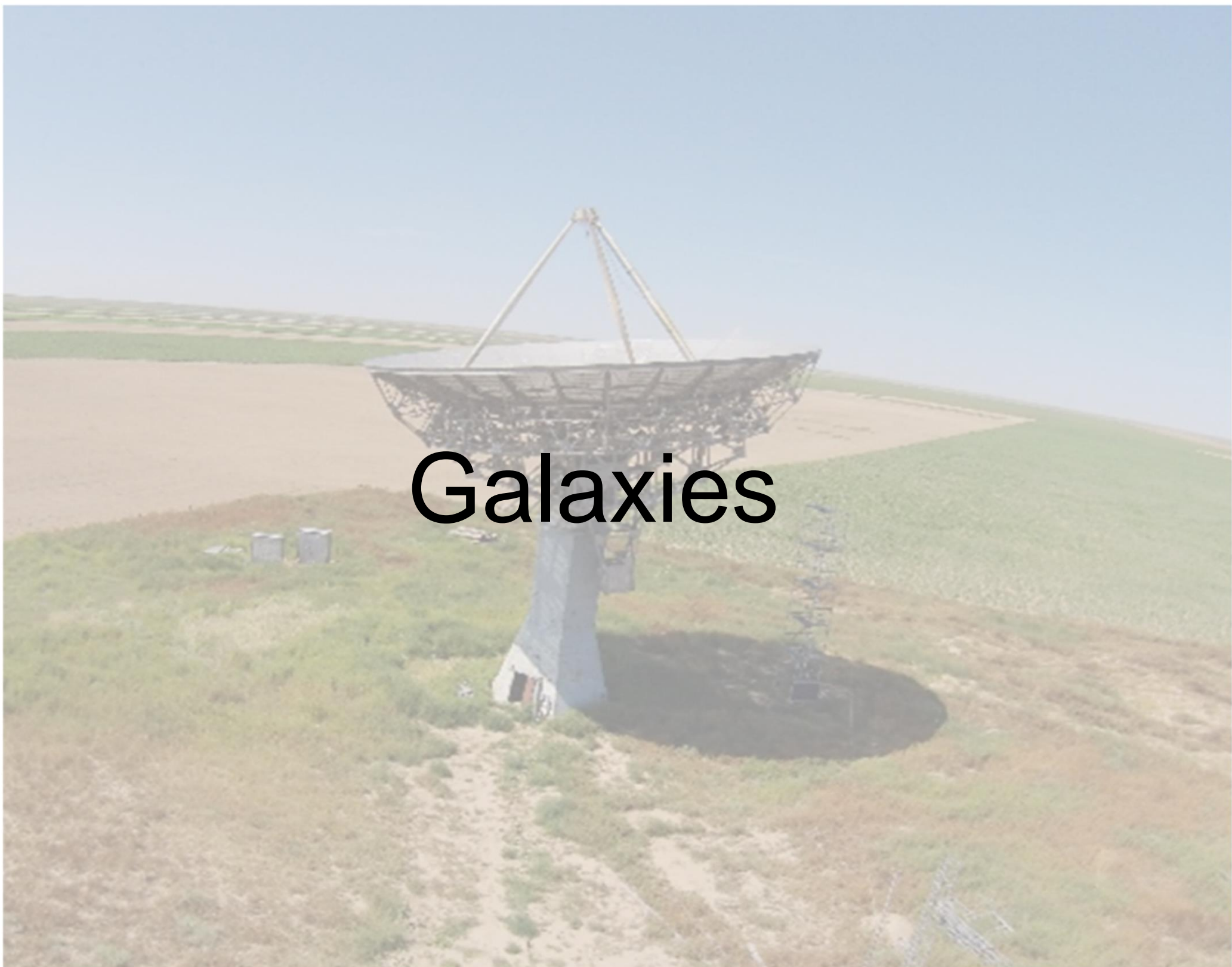
Data reduction conducted by Dr. Richard Russel on 10-22-19 using the ALMA Tutorial located at:

https://casaguides.nrao.edu/index.php/NGC3256_Band3_Imaging_for_CASA_4.2

This paper makes use of the following ALMA data: ADS/JAO.ALMA project code: 2011.0.00002.SV. ALMA is a partnership of ESO (representing its member states), NSF (USA) and NINS (Japan), together with NRC (Canada), MOST and ASIAA (Taiwan), and KASI (Republic of Korea), in cooperation with the Republic of Chile. The Joint ALMA Observatory is operated by ESO, AUI/NRAO and NAOJ."

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Galaxies



M100 Spiral Galaxy (ALMA Archive)

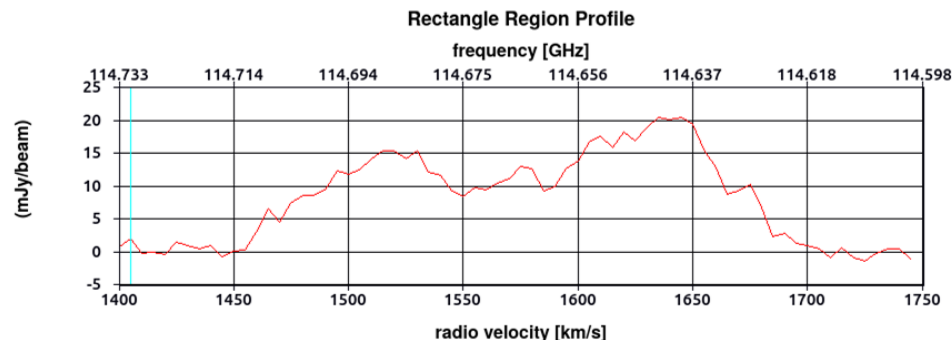
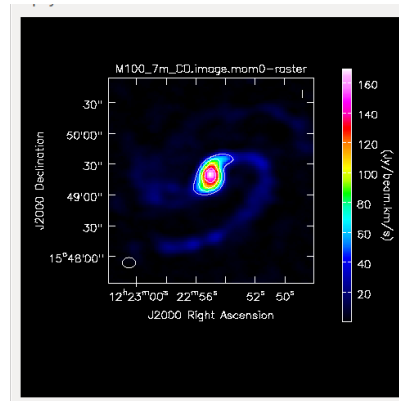
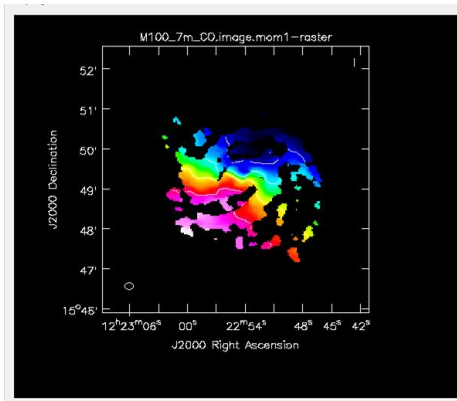
Background Information Wikipedia

“Messier 100 (also known as [NGC 4321](#)) is an example of a [grand design](#)[\[4\]](#) [intermediate spiral galaxy](#) located within the southern part of [constellation Coma Berenices](#). It is one of the brightest and largest galaxies in the [Virgo Cluster](#), located approximately 55 million [light-years](#)[\[3\]](#) distant from [Earth](#) and has a diameter of 107,000 light years, roughly 60% the size of the [Milky Way](#). It was discovered by [Pierre Méchain](#) on March 15, 1781 and was subsequently entered in [Messier's catalogue](#) of nebulae and star clusters[\[5\]](#) after [Charles Messier](#)[\[6\]](#) made observations of his own on April 13, 1781. The galaxy was one of the first spiral galaxies[\[6\]](#) to be discovered, and was listed as one of fourteen [spiral nebulae](#) by [Lord William Parsons of Rosse](#) in 1850.”



Observer: cvlahakis Project: uid://A002/X5d9e5c/X5d				
Observation: ALMA				
Telescope	Observation Date	Observer	Project	
ALMA	[	4.87021e+09, 4.87022e+09]	cvlahakis	uid://A002/X5d9e5c/X5d
ALMA	[	4.87022e+09, 4.87022e+09]	cvlahakis	uid://A002/X5d9e5c/X5d
ALMA	[	4.8703e+09, 4.87031e+09]	cvlahakis	uid://A002/X5d9e5c/Xb1
ALMA	[	4.87031e+09, 4.87031e+09]	cvlahakis	uid://A002/X5d9e5c/Xb1
ALMA	[	4.87263e+09, 4.87263e+09]	cvlahakis	uid://A002/X5d9e5c/X3e5
ALMA	[	4.87496e+09, 4.87496e+09]	cvlahakis	uid://A002/X5d9e5c/X5d
Computing scan and subscan properties...				
Data records: 177120 Total elapsed time = 4.74969e+06 seconds				
observed from 17-Mar-2013/04:44:04.3 to 11-May-2013/04:05:39.2 (UTC)				

Data Reduction Results



Data reduction conducted by Dr. Richard Russel on 11-3-19 using the ALMA Tutorial located at: <https://almascience.nrao.edu/alma-data/science-verification/overview>

"This paper makes use of the following ALMA data: ADS/JAO.ALMA#2011.0.00004.SV. ALMA is a partnership of ESO (representing its member states), NSF (USA) and NINS (Japan), together with NRC (Canada) and NSC and ASIAA (Taiwan), and KASI (Republic of Korea), in cooperation with the Republic of Chile. The Joint ALMA Observatory is operated by ESO, AUI/NRAO and NAOJ."

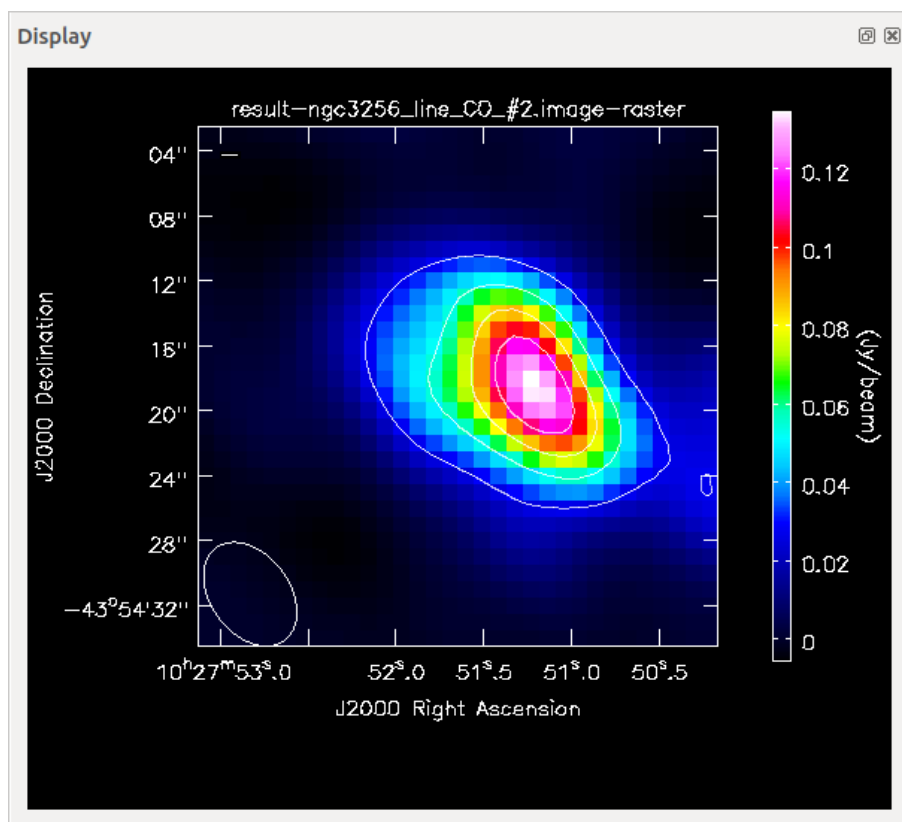
"The National Radio Astronomy Observatory is a facility of the National Science Foundation operated under cooperative agreement by Associated Universities, Inc."

NGC 3256 (ALMA Archive)

```
Computing scan and subscan properties...  
Data records: 326400      Total elapsed time = 90574.4 seconds  
Observed from 16-Apr-2011/02:59:18.2 to 17-Apr-2011/04:08:52.6 (UTC)
```

Background Information Wikipedia

Data Reduction Results



“NGC 3256 is a [peculiar galaxy](#) formed from the [collision of two separate galaxies](#) in the constellation of [Vela](#). NGC 3256 is located about 100 million [light years](#) away and belongs to the [Hydra-Centaurus supercluster](#) complex.”



NGC 3256 Hubble Image

Data reduction conducted by Dr. Richard Russel on 10-22-19 using the ALMA Tutorial located at: https://casaguides.nrao.edu/index.php/NGC3256_Band3_Imaging_for_CASA_4.2

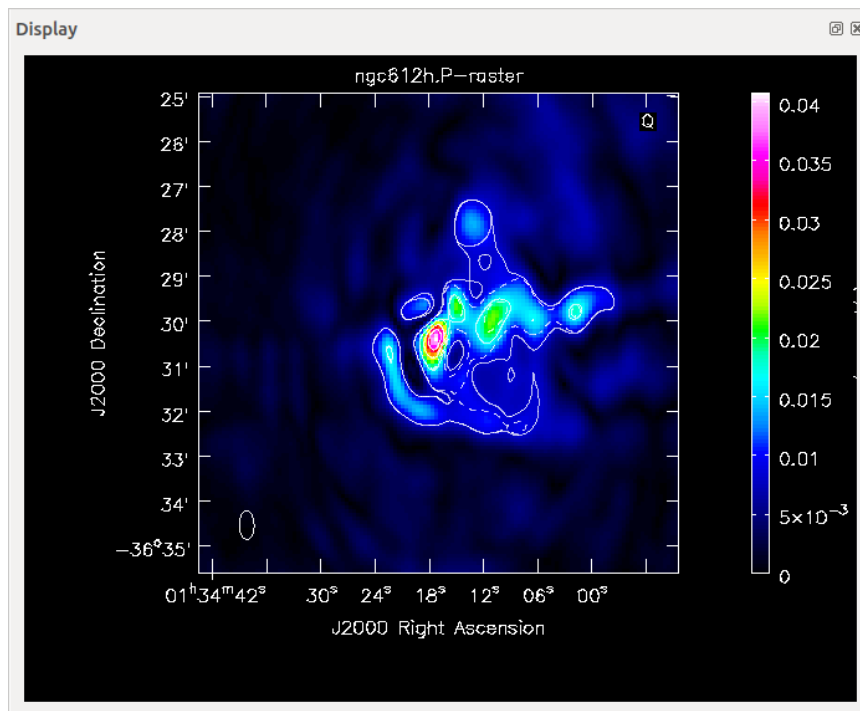
This paper makes use of the following ALMA data: ADS/JAO.ALMA project code: 2011.0.00013.SV. ALMA is a partnership of ESO (representing its member states), NSF (USA) and NINS (Japan), together with NRC (Canada), MOST and ASIAA (Taiwan), and KASI (Republic of Korea), in cooperation with the Republic of Chile. The Joint ALMA Observatory is operated by ESO, AUI/NRAO and NAOJ.

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NGC-612 using the Australian Telescope Compact Array (ATCA Archive)

```
-----
MeasurementSet Name: /home/dses/Imaging/NGC612_ATCA/ngc612.ms.0
-----
Observer: obs      Project: C2728
Observation: ATCA
Computing scan and subscan properties...
Data records: 60465      Total elapsed time = 43730 seconds
Observed from 25-Oct-2012/07:07:39.9 to 25-Oct-2012/19:16:29.9 (UTC)
-----
```

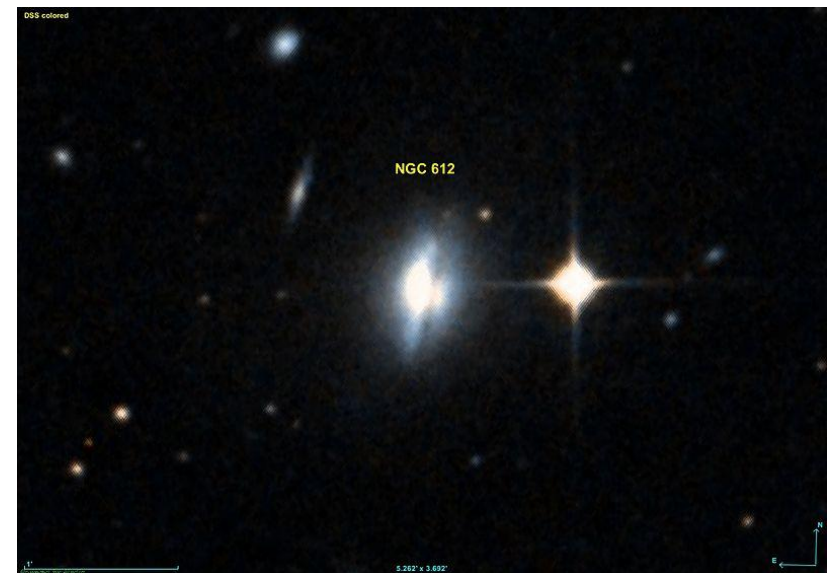
Data Reduction Results



Total polarized flux density: 1.942 Jy
Pol. Angles in western lobe: -57.5 and 23.7 degrees

Background Information Wikipedia

“NGC 612 is a [lenticular galaxy](#) in the [constellation](#) of [Sculptor](#) located approximately 388 million [light-years](#) from Earth. It is a type II [Seyfert galaxy](#) and thus has an [active galactic nucleus](#).^{[1][3]} NGC 612 has been identified as an extremely rare example of a non-[elliptical radio galaxy](#), hosting one of the nearest powerful [FR-II](#) radio sources.^[4]Coordinates: [01h33m57.74s, -36° 29' 35.7″](#)^[5] “



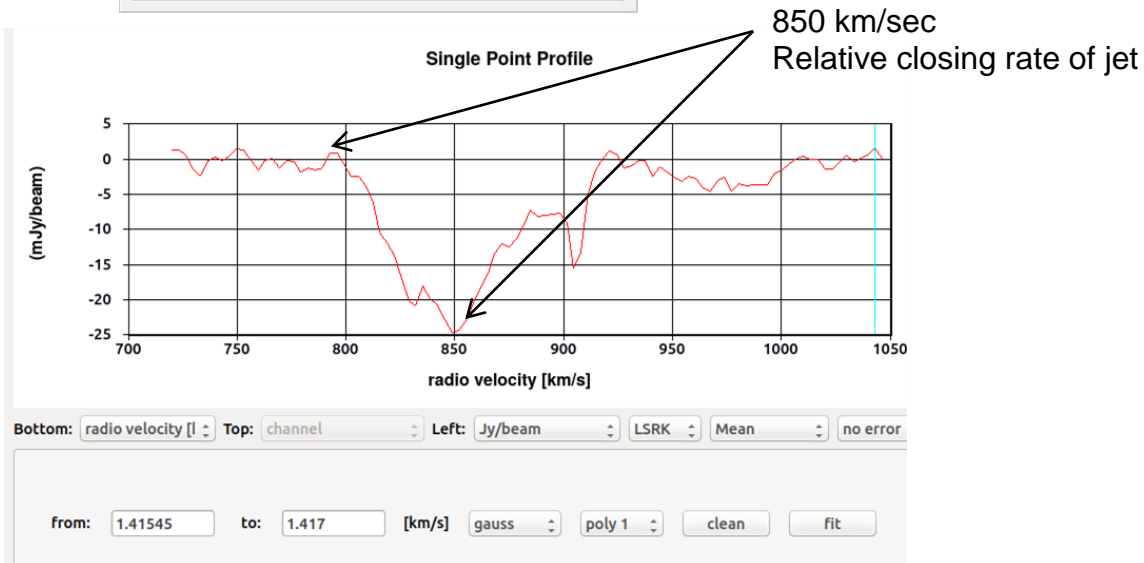
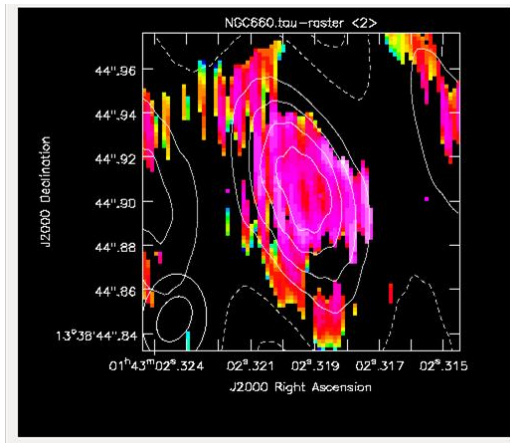
NGC-660 Galaxy

Velocity of Jet Measured using Spectral Line Technique using the European Very Long Baseline Interferometer (EVLBI Archive)

```
=====
Observer: EA054   Project:
Observation: EVN
Computing scan and subscan properties...
Data records: 49159   Total elapsed time = 41950 seconds
Observed from 30-Oct-2013/15:50:40.0 to 31-Oct-2013/03:29:50.0 (UTC)
=====
```

```
ObservationID = 0   ArrayID = 0
Date   Timerange (UTC)   Scan   FldId   FieldName   nRows
30-Oct-2013/15:50:40.0 - 19:16:00.0   1   0   NGC660   16
19:38:42.0 - 23:04:58.0   2   0   NGC660   15
23:26:26.0 - 02:52:38.0   3   0   NGC660   12
31-Oct-2013/03:12:36.0 - 03:29:50.0   4   0   NGC660   12
(nRows = Total number of rows per scan)
```

```
Fields: 1
ID   Code Name   RA   Decl   Epoch   SrcId
0   NGC660   01:43:02.291000 +13.38:44.30000 J2000   0
```



Background Information Wikipedia

“NGC 660 is a [peculiar](#) and unique [polar-ring galaxy](#) located approximately 45 million light years from Earth in the [Pisces constellation](#).^[3] It is the only such galaxy having, as its host, a "late-type lenticular galaxy".^[4] It was probably formed when two galaxies collided a billion years ago.^[5] However, it may have first started as a disk galaxy that captured matter from a passing galaxy. This material could have, over time, become "strung out" to form a rotating ring.”

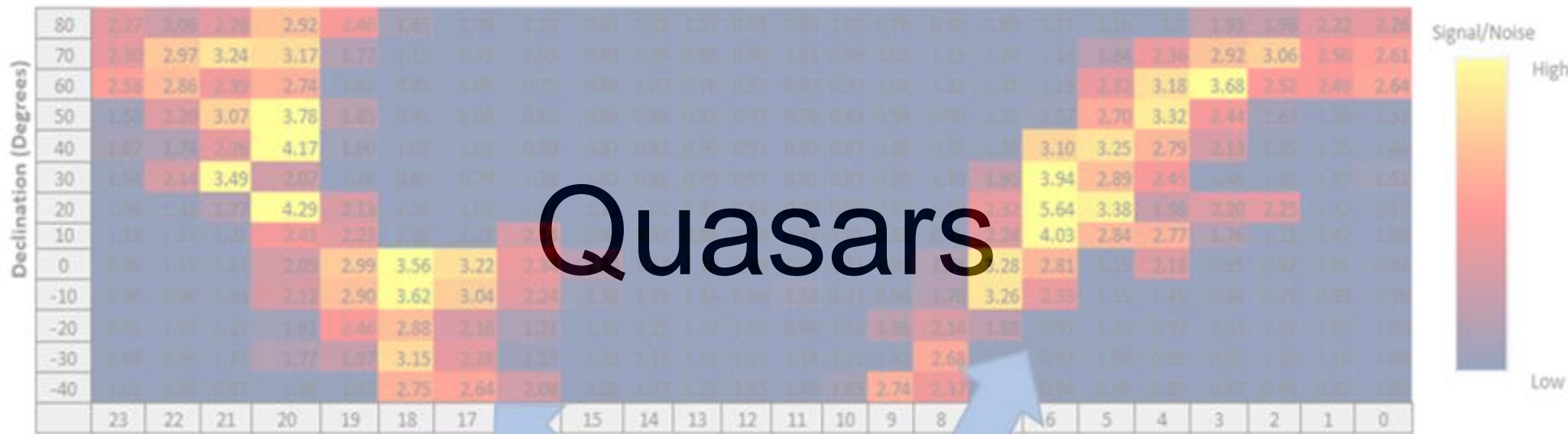
“Late in 2012, this polar-ring galaxy produced an enormous outburst having a magnitude of approximately ten times brighter than a supernova explosion. The cause is not certain, but this event may have resulted from a tremendous jet being emanating from galaxy's central black” hole.^[5]”



NGC 660 showing Polar-Galaxy Structure



HI Spectrum Peak Map Survey

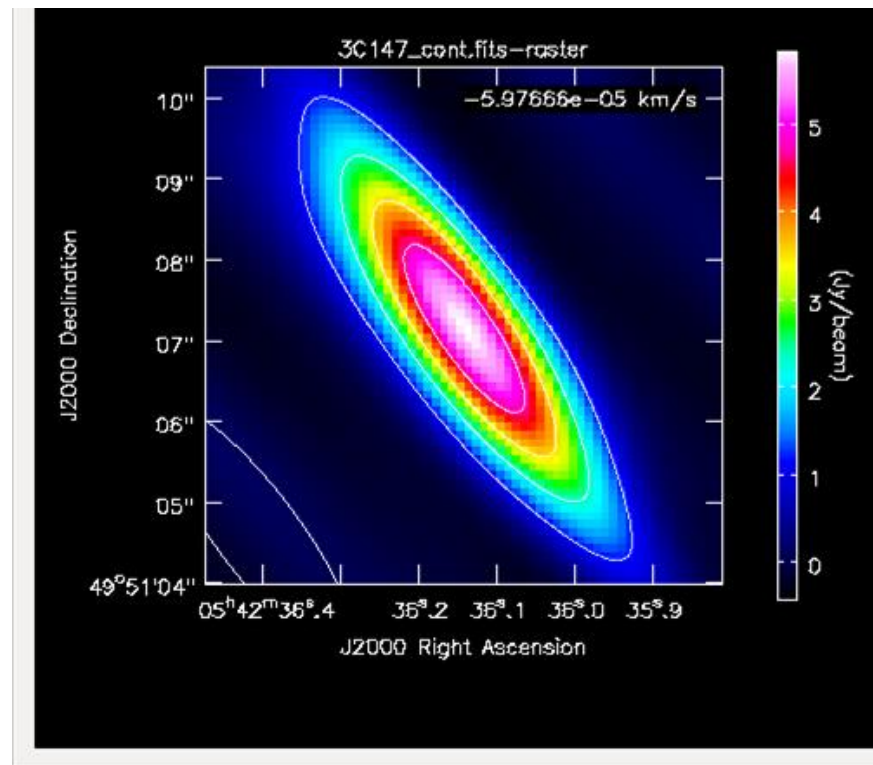


3C147 Quasar and EVLA Calibrator

VLA Archive

#obs date: 03 Jun 2016
#Project: uid://evla/pdb/31987083
#Observer Enrique Macias
#field 0: 0542+498=3C147 FLux/Bandpass (3C147)
#field 1: J0438+3004 Phase
#field 2: GM_Aur Target RA 04:55:10.97 DEC+30.21.59
#scans:0-17
#SPWID(0~47) freq 4488-7959 (C Band)
#Antennas (27)

Data Reduction Results



Background Information

VLBA polarimetric observations of the CSS quasar 3C 147

A. Rossetti¹, F. Mantovani¹, D. Dallacasa^{1,2}, W. Junor³, C.J. Salter⁴, and D.J. Saikia⁵

¹ Istituto di Radioastronomia – INAF, via Gobetti 101, I-40129, Bologna, Italy

² Dipartimento di Astronomia, Università degli Studi, via Ranzani 1, I-40127 Bologna, Italy

³ Los Alamos National Laboratory, Los Alamos, NM 87545, USA

⁴ Arecibo Observatory, HC3 Box 53995, Arecibo, Puerto Rico 00612

⁵ National Centre for Astrophysics, TIFR, Post Bag 3, Ganeshkhind, Pune 411 007, India

Received June 4, 2018; accepted ???

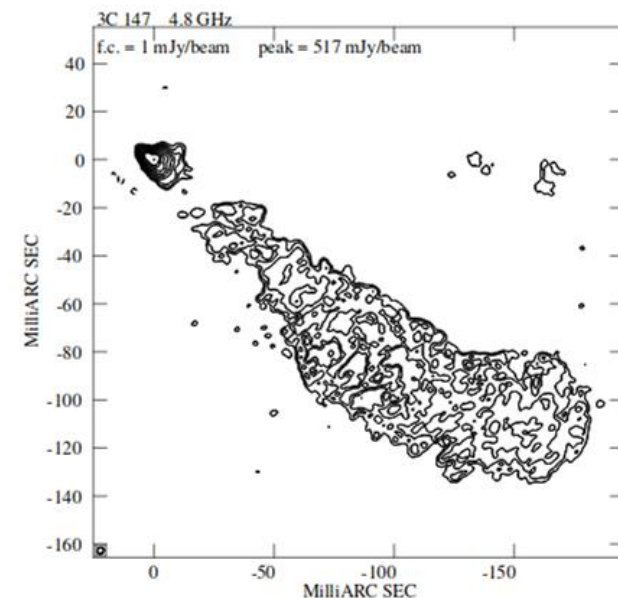


Fig. 1. The total intensity 4.8-GHz image of 3C 147 using all four C-band IFs and a restoring beam of 2.8×2.5 mas at -40° . Contour levels increase by a factor of 2 from 1 mJy/beam.

<https://arxiv.org/pdf/0910.2146.pdf>

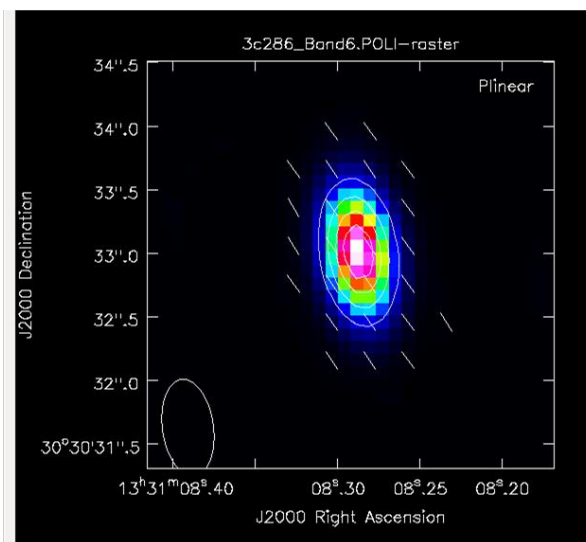
Data reduction completed by Dr. Richard Russel 11-27-2019 using download from VLA database.

3C286 Quasar Full Polarization (ALMA Archive)

```
=====
Observer: knakanishi   Project: uid://A002/X845868/X11
Observation: ALMA
Data records: 10125065   Total elapsed time = 3858.05 seconds
Observed from 01-Jul-2014/21:18:10.9 to 01-Jul-2014/22:22:29.0 (UTC)
```

Background Information Wikipedia

Data Reduction Results



Measured Statistics

3C286	Flux	Err
I(Jy)	0.369024458019	0.000533920312708
Q(Jy)	0.0120461752389	4.28833878305e-05
U(Jy)	0.0590976963663	0.00010008727778
Pol int (mJy)	60.3129178011	0.0984439608693
P(%)	0.163438808704	0.000356487589209
X (deg)	39.2394747207	0.0221021634448

"3C 286, also known by its position as 1328+307 ([B1950](#) coordinates) is a [quasar](#)^[3] at [redshift](#) 0.8493 with a [radial velocity](#) of 164,137 km/s.^[4] It is part of the [Third Cambridge Catalogue of Radio Sources](#)."

"3C 286 is one of four primary calibrators used by the [Very Large Array](#) (along with [3C 48](#), [3C 138](#), and [3C 147](#)). Visibilities of all other sources are calibrated using observed visibilities of one of these four calibrators.^[5]"

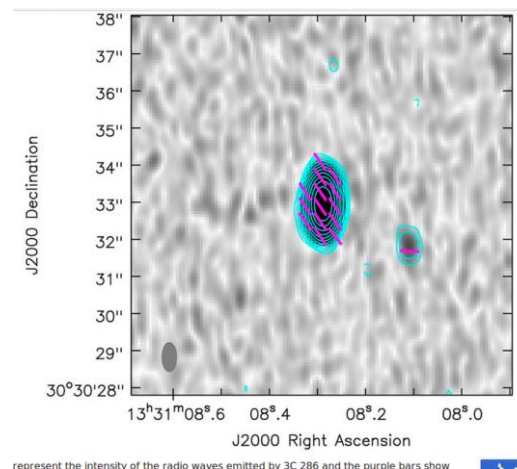


Image and statistics reduced by Dr. Richard A. Russel 10-29-19, using ALMA tutorial located at:

https://casaguides.nrao.edu/index.php/3C286_Polarization

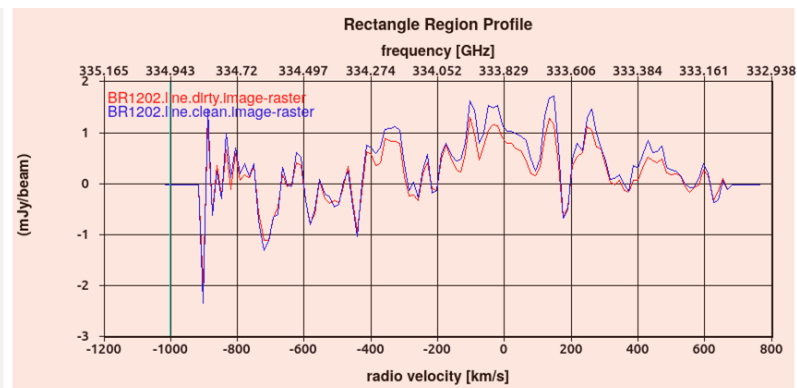
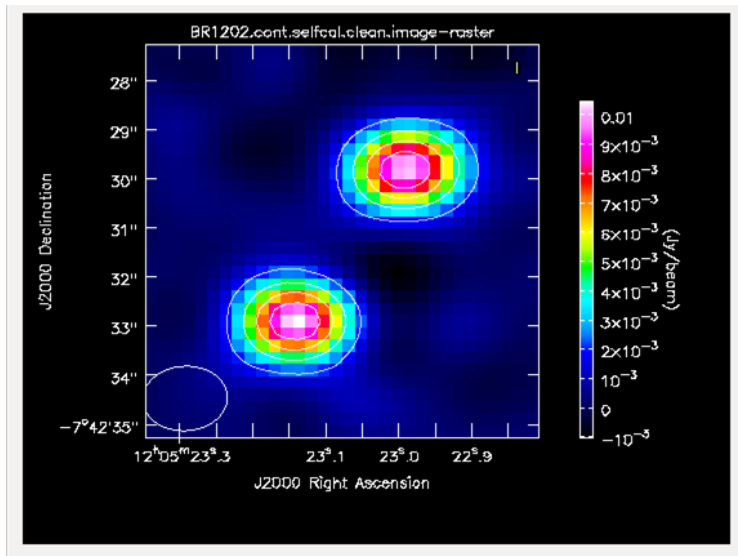
Using the data for publication: The following statement should be included in the acknowledgment of papers using the datasets listed above: "This paper makes use of the following ALMA data: ADS/JAO.ALMA#2011.0.00017.SV. ALMA is a partnership of ESO (representing its member states), NSF (USA) and NINS (Japan), together with NRC (Canada) and NSC and ASIAA (Taiwan), and KASI (Republic of Korea), in cooperation with the Republic of Chile. The Joint ALMA Observatory is operated by ESO, AUI/NRAO and NAOJ."

BR1202-0725 Quasar at $z=4.69$ (ALMA Archive)

Observer: Unknown Project: T.B.D.
Observation: ALMA
Data records: 53516 Total elapsed time = 2507.23 seconds
Observed from 14-Jan-2012/12:39:19.7 to 14-Jan-2012/13:21:07.0 (UTC)

Background Information

Data Reduction Results

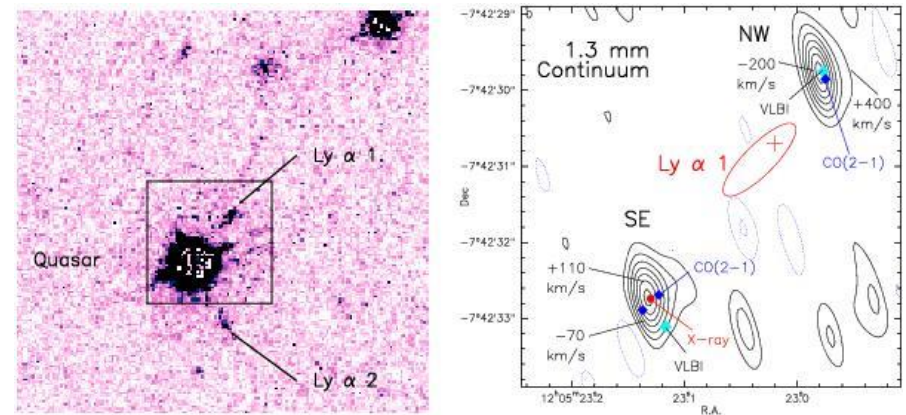


BR1202-0725: an extreme multiple merger at $z = 4.7$ ★

P. Salomé¹, M. Guélin², D. Downes², P. Cox², S. Guilloteau³, A. Omont⁴, R. Gavazzi⁴ and R. Neri²

Received: 5 July 2012 Accepted: 27 July 2012

Abstract: <excerpt>The radio-quiet quasar BR1202-0725 ($z = 4.695$) is a remarkable source with a bright northwest (NW) companion detected at submillimeter and radio wavelengths but invisible in the optical.



https://www.aanda.org/articles/aa/full_html/2012/09/aa19955-12/aa19955-12.html

Data reduction conducted by Dr. Richard Russel on 11-4-19 using the ALMA Tutorial located at: <https://almascience.nrao.edu/alma-data/science-verification/overview>

"This paper makes use of the following ALMA project code: 2011.0.0006.SV. ALMA is a partnership of ESO (representing its member states), NSF (USA) and NINS (Japan), together with NRC (Canada) and NSC and ASIAA (Taiwan), and KASI (Republic of Korea), in cooperation with the Republic of Chile. The Joint ALMA Observatory is operated by ESO, AUI/NRAO and NAOJ."

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J0438+3004 Quasar and EVLA Phase Calibrator (VLA Archive)

#obs date: 03 Jun 2016
#Project: uid://evla/pdb/31987083
#Observer Enrique Macias
#field 0: 0542+498=3C147 FLux/Bandpass (3C147)
#field 1: J0438+3004 Phase
#field 2: GM_Aur Target RA 04:55:10.97 DEC+30.21.59
#scans:0-17
#SPWID(0~47) freq 4488-7959 (C Band)
#Antennas (27)

Mon. Not. R. Astron. Soc. **300**, 790–816 (1998)

Interferometer phase calibration sources – III. The regions $+20^\circ \leq \delta_{B1950} \leq +35^\circ$ and $+75^\circ \leq \delta_{B1950} \leq +90^\circ$

P. N. Wilkinson,^{1*} I. W. A. Browne,¹ A. R. Patnaik,^{1,2} J. M. Wrobel³ and B. Sorathia^{1,4}

¹University of Manchester, Nuffield Radio Astronomy Laboratories, Jodrell Bank, Macclesfield, Cheshire SK11 9DL

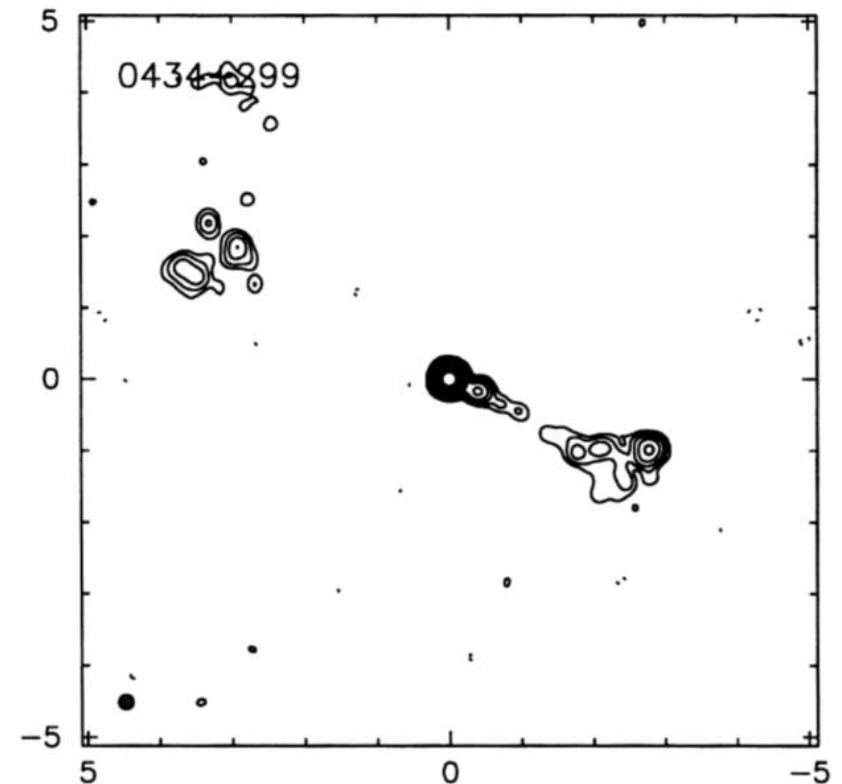
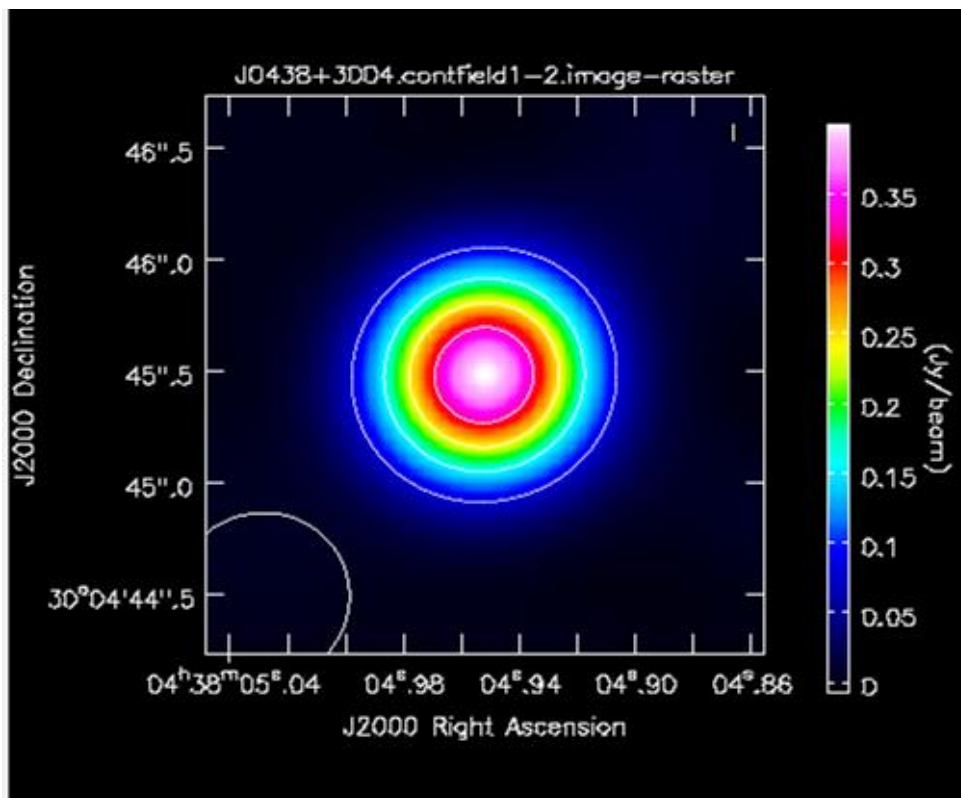
²Max Planck Institute für Radioastronomie, Auf dem Hügel 69, D-53121 Bonn, Germany

³National Radio Astronomy Observatory, PO Box O, Socorro, New Mexico 87801, USA

⁴York University, Ontario, Canada

Accepted 1998 June 25. Received 1998 June 25; in original form 1998 April 28

Data Reduction Results



Data reduction completed by Dr. Richard Russel 11-27-2019 using download from VLA database.

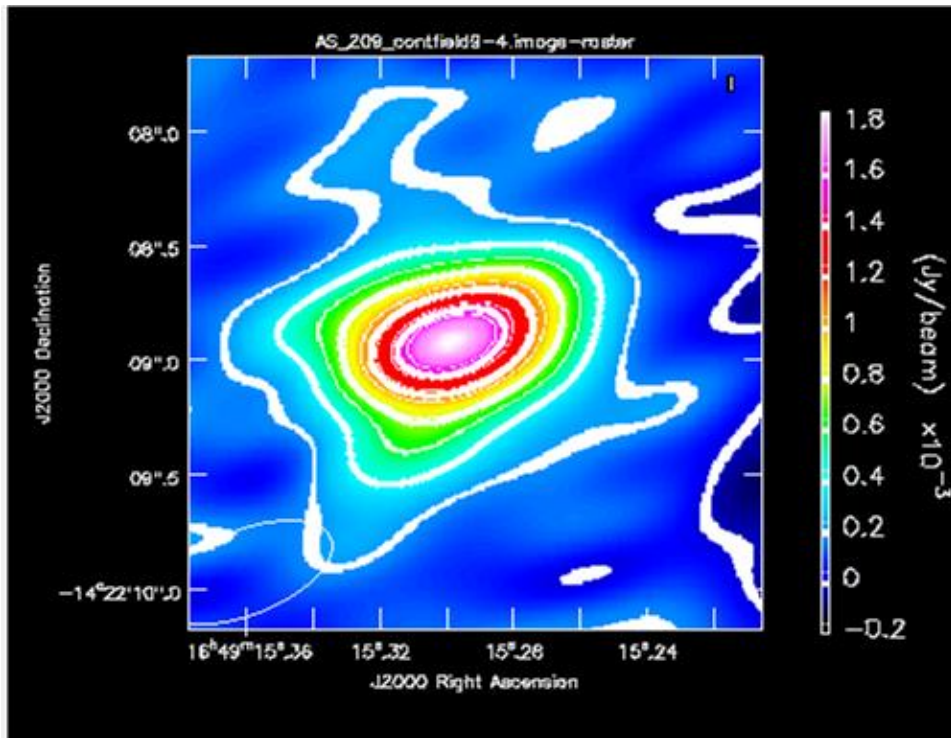
An aerial photograph of a large, white, parabolic radio telescope dish situated in a grassy field. The dish is mounted on a complex metal support structure. In the background, there are some small buildings and a dirt road. The entire image is framed within a circular border.

Protoplanetary Systems

AS 209 Protoplanetary Disk (VLA Archive)

#Project: uid://evla/pdb/2408028
 #obs date: 29 Jan 2011
 #Observer Dr. Claire J. Chandler
 #field 0-1: J1246-0730 Target and Pointing
 #field 2-3: J1256-0547 Target and Bandpass
 #field 4-5: J1554-2704 Target pointing
 #field 6-7: J1625-2527 Target phase
 #field 8: J1638-1415 Phase
 #field 9: AS209-Kaoff Target RA:16:49:15.446 DEC:-14.22.06.53
 #field 10-12: J1331+3030 (3C286_K.im) Gain
 #scans:0-93
 #SPWID(0-17)
 #SPWID(0-1) freq 4832-5023 (C Band)
 #SPWID(2-17) 30884-37947 (K Band)
 #Antennas (27)

Data Reduction Results



Background Information

A multi-wavelength analysis for interferometric (sub-)mm observations of protoplanetary disks

Radial constraints on the dust properties and the disk structure

M. Tazzari^{1,2}, L. Testi^{1,2,3}, B. Ercolano^{2,4}, A. Natta^{3,5}, A. Isella⁶, C. J. Chandler⁷, L. M. Pérez⁷, S. Andrews⁸, D. J. Wilner⁸, L. Ricci⁸, T. Henning⁹, H. Linz⁹, W. Kwon¹⁰, S. A. Corder¹¹, C. P. Dullemond¹², J. M. Carpenter¹³, A. I. Sargent¹³, L. Mundy¹⁴, S. Storm¹⁴, N. Calvet¹⁵, J. A. Greaves¹⁶, J. Lazio¹⁷, A. T. Deller¹⁸

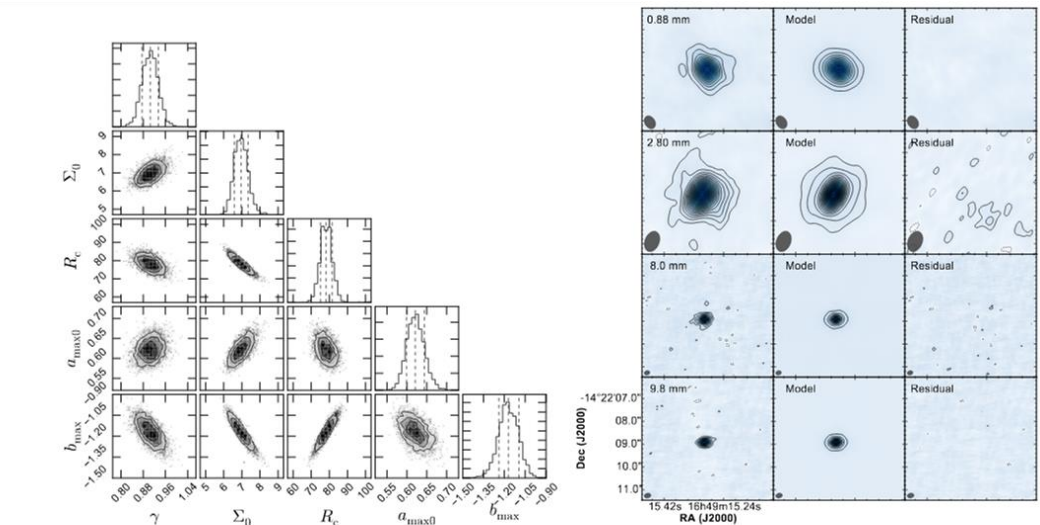


Fig. C.2. Left panel: Staircase plot showing the marginalized and bi-variate probability distributions resulting from the fit for AS 209. Right panel: AS 209 maps of the residuals at the fitted wavelengths.

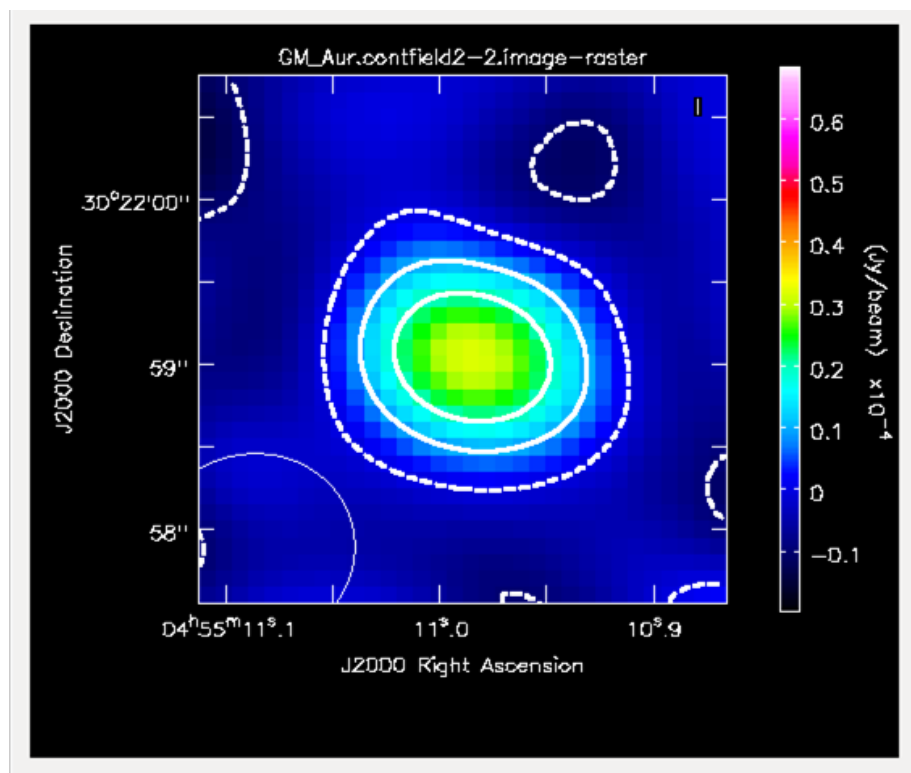
<https://arxiv.org/pdf/1512.05679.pdf>

Data reduction completed by Dr. Richard Russel 11-28-2019 using download from VLA database.

GM Aurigae – Protoplanetary Disk (VLA Archive)

#obs date: 03 Jun 2016
#Project: uid://evla/pdb/31987083
#Observer Enrique Macias
#field 0: 0542+498=3C147 FLux/Bandpass (3C147)
#field 1: J0438+3004 Phase
#field 2: GM_Aur Target RA 04:55:10.97 DEC+30.21.59
#scans:0-17
#SPWID(0~47) freq 4488-7959 (C Band)
#Antennas (27)

Data Reduction Results



Background Information

MULTIPLE RINGS IN THE TRANSITIONAL DISK OF GM AURIGAE REVEALED BY VLA AND ALMA

ENRIQUE MACÍAS, CATHERINE C. ESPAILLAT, ÁLVARO RIBAS

Department of Astronomy, Boston University, 725 Commonwealth Avenue, Boston, MA 02215, USA emacias@bu.edu

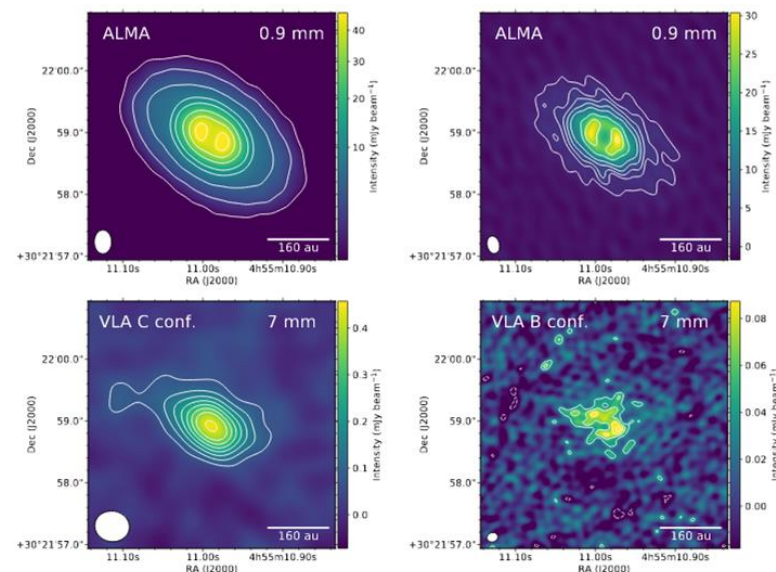


Figure 1. Observed images of the mm emission of GM Aur. *Top-left:* ALMA image at 0.9 mm, obtained using Briggs weighting with robust=0.5 (synthesized beam= $0''.39 \times 0''.28$, PA= 0°). Contour levels are 5, 20, 50, 100, 150, 250, 350, and 450 times the rms of the map, $0.10 \text{ mJy beam}^{-1}$. *Top-right:* ALMA image at 0.9 mm, obtained using uniform weighting (synthesized beam= $0''.29 \times 0''.20$, PA= 14°). Contour levels are 5, 9, 13, 20, 30, 50, 70, and 90 times the rms of the map, $0.35 \text{ mJy beam}^{-1}$. *Bottom-left:* Image at 7 mm, obtained using the C configuration of the VLA and natural weighting (synthesized beam= $0''.58 \times 0''.50$, PA= 81°), adapted from Macías et al. (2016). Contour levels are 3, 5, 7, 9, 11, 13, 15, and 18 times the rms of the map, $24 \mu\text{Jy beam}^{-1}$. *Bottom-right:* Image at 7 mm, obtained using the B configuration of the VLA and natural weighting (synthesized beam= $0''.18 \times 0''.15$, PA= -72°). Contour levels are -3, 3, 5, 7, 9, and 11 times the rms of the map, $12 \mu\text{Jy beam}^{-1}$.

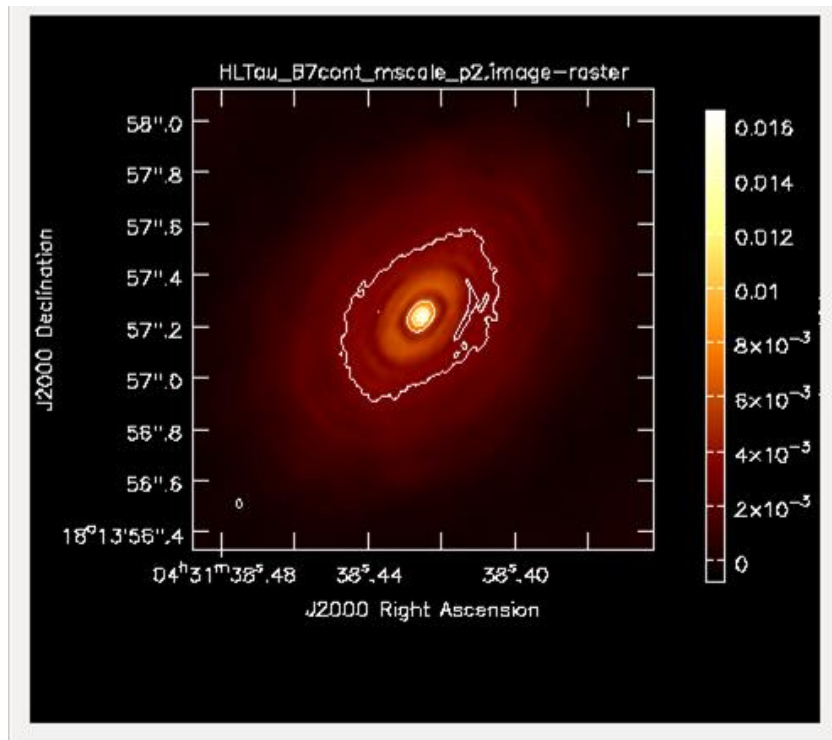
<https://arxiv.org/pdf/1808.01920.pdf>

Data reduction completed by Dr. Richard Russel 11-27-2019 using download from VLA database.

HL Tauri Protoplanetary System (ALMA Archive)

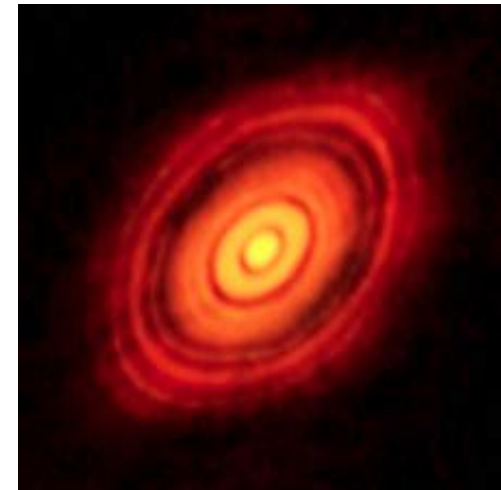
Observer: violette	Project: uid://A002/X8d0549/X5f			
Observation: ALMA				
Telescope	Observation Date	Observer	Project	
ALMA	[	4.92136e+09,	4.92136e+09]violette	uid://A002/X8d0549/X5f
ALMA	[	4.92136e+09,	4.92137e+09]violette	uid://A002/X8d0549/X5f
ALMA	[	4.92137e+09,	4.92137e+09]violette	uid://A002/X8d0549/X5f
ALMA	[	4.92154e+09,	4.92154e+09]violette	uid://A002/X8d0549/X5f
ALMA	[	4.92154e+09,	4.92154e+09]violette	uid://A002/X8d0549/X5f
ALMA	[	4.92155e+09,	4.92155e+09]violette	uid://A002/X8d0549/X5f
ALMA	[	4.92179e+09,	4.92179e+09]violette	uid://A002/X8d0549/X5f
ALMA	[	4.92179e+09,	4.9218e+09]violette	uid://A002/X8d0549/X5f
ALMA	[	4.92196e+09,	4.92197e+09]violette	uid://A002/X8d0549/X5f
ALMA	[	4.92197e+09,	4.92197e+09]violette	uid://A002/X8d0549/X5f
Computing scan and subscan properties...				
Data records: 25005708 Total elapsed time = 609437 seconds				
Observed from 30-Oct-2014/04:24:27.5 to 06-Nov-2014/05:41:44.1 (UTC)				

Data Reduction Results



Background Information Wikipedia

“HL Tauri (abbreviated HL Tau) is a very young [T Tauri star](#)^[5] in the constellation [Taurus](#), approximately 450 light-years (140 pc) from Earth^[1] in the [Taurus Molecular Cloud](#).^[6] The luminosity and effective temperature of HL Tauri imply that its age is less than 100,000 years.^[7] At [apparent magnitude](#) 15.1,^[3] it is too faint to be seen with the unaided eye. It is surrounded by a [protoplanetary disk](#) marked by dark bands visible in [submillimeter radiation](#) that may indicate a number of planets in the process of formation.^[2] It is accompanied by the [Herbig–Haro object](#) HH 150, a jet of gas emitted along the rotational axis of the disk that is colliding with nearby interstellar dust and gas.^[8]”



Data reduction conducted by Dr. Richard Russel on 11-1-19 using the ALMA Tutorial located at:

https://casaguides.nrao.edu/index.php/ALMA2014_LBC_SVDATA

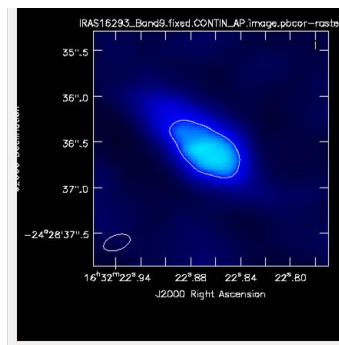
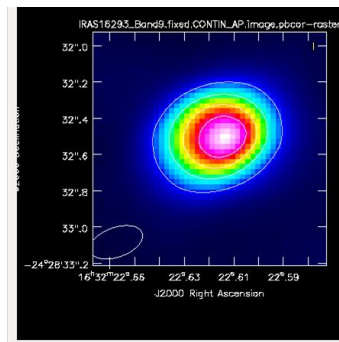
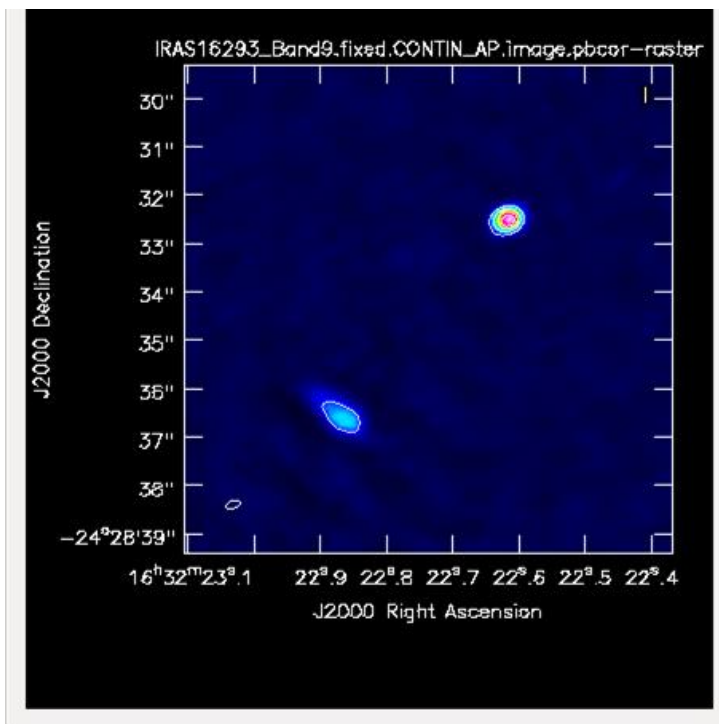
“This paper makes use of the following ALMA data: ADS/JAO.ALMA project code:2011.0.00015.SV. ALMA is a partnership of ESO (representing its member states), NSF (USA) and NINS (Japan), together with NRC (Canada), MOST and ASIAA (Taiwan), and KASI (Republic of Korea), in cooperation with the Republic of Chile. The Joint ALMA Observatory is operated by ESO, AUI/NRAO and NAOJ.”

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

IRAS16293 Band 9 (ALMA Archive)

Observer: dgarcia		Project: uid://A002/X3cd6b2/X53	
Observation: ALMA			
Telescope	Observation Date	Observer	Project
ALMA	[	4.84128e+09, 4.84129e+09]	dgarcia uid://A002/X3cd6b2/X53
ALMA	[	4.84135e+09, 4.84136e+09]	dgarcia uid://A002/X3cd6b2/X53
ALMA	[	4.84137e+09, 4.84137e+09]	dgarcia uid://A002/X3cd6b2/X53
ALMA	[	4.84137e+09, 4.84138e+09]	dgarcia uid://A002/X3cd6b2/X53
Computing scan and subscan properties...			
Data records: 52996		Total elapsed time = 98524.9 seconds	
Observed from 16-Apr-2012/08:27:40.4 to 17-Apr-2012/11:49:45.3 (UTC)			

Data Reduction Results



Background Information Wikipedia

"RAS 16293–2422 is a binary system consisting of at least two forming [protostars](#) A and B, separated by a distance of 700 [astronomical units](#) (au), all having masses similar to that of the [Sun](#).^{[1][2]} Astronomers using the [ALMA array](#) found [glycolaldehyde](#) — a simple form of sugar — in the gas surrounding the star.^{[3][4]} This discovery was the first time sugar has been found in space around a solar-type star on scales corresponding to the distance between Sun and Uranus - i.e., the scales where a planet-forming disk is expected to arise. The discovery shows that the building blocks of [life](#) may in the right place, at the right time, to be included in planets forming around the star."

"[Chloromethane](#), also known as methyl chloride, was detected for the first time in the [interstellar medium](#) in IRAS 16293–2422. Chloromethane is an important biomarker but its discovery in a protostellar system showed that it can be formed through abiotic processes in space.^[5]"



Data reduction conducted by Dr. Richard Russel on 10-31-19 using the ALMA Tutorial located at:[https://casaguides.nrao.edu/index.php/IRAS16293_Band9 - Imaging for CASA 5.4](https://casaguides.nrao.edu/index.php/IRAS16293_Band9_-_Imaging_for_CASA_5.4)

This paper makes use of the following ALMA data: ADS/JAO.ALMA project code:2011.0.00007.SV. ALMA is a partnership of ESO (representing its member states), NSF (USA) and NINS (Japan), together with NRC (Canada), MOST and ASIAA (Taiwan), and KASI (Republic of Korea), in cooperation with the Republic of Chile. The Joint ALMA Observatory is operated by ESO, AUI/NRAO and NAOJ."

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TW Hydrae Band 7 (ALMA Archive)

Observer:	Unknown	Project:	T.B.D.
Observation:	ALMA		
Telescope	Observation Date	Observer	Project
ALMA	[	4.81015e+09, 4.81015e+09]	Unknown T.B.D.
ALMA	[	4.81015e+09, 4.81016e+09]	Unknown T.B.D.
ALMA	[	4.81016e+09, 4.81017e+09]	Unknown T.B.D.
Computing scan and subscan properties...			
Data records:	126900	Total elapsed time =	16902.1 seconds
observed from	22-Apr-2011/00:15:36.7	to	22-Apr-2011/04:57:18.8 (UTC)

Background Information
Wikipedia

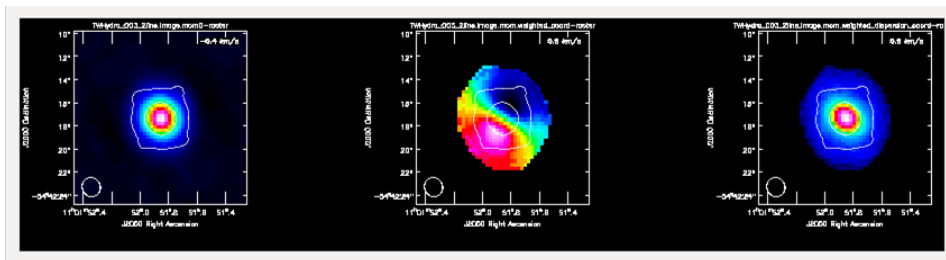
Data Reduction Results

CO(3-2) moment maps

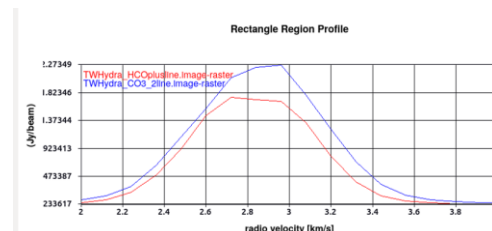
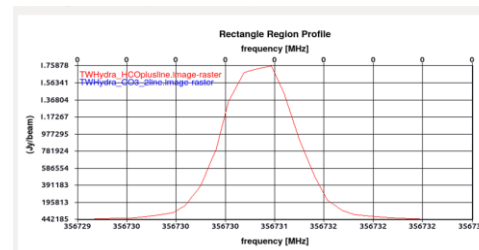
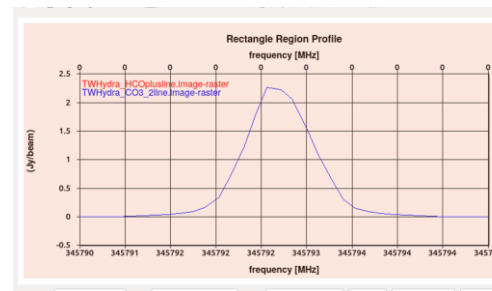
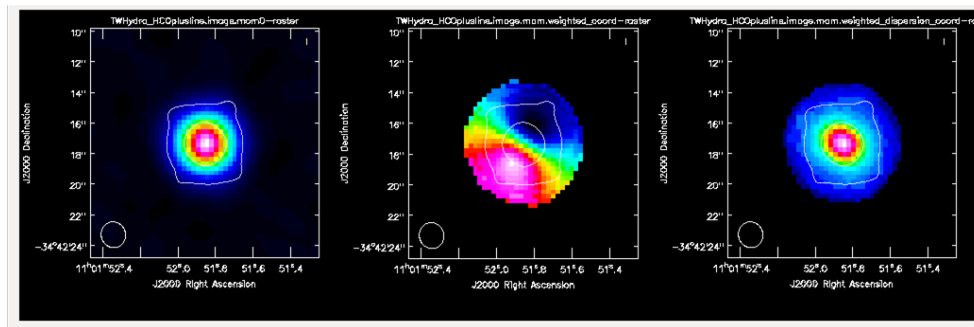
Integrated Intensity

Intensity Weighted
Velocity Field

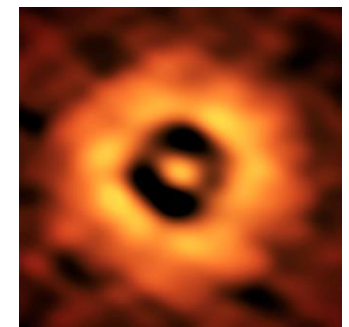
Intensity Weighted
Velocity Dispersion



HCO+(4-3) moment maps



"TW Hydrae is a [T Tauri star](#) approximately 196 [light-years](#) away^[1] in the [constellation](#) of [Hydra](#) (the [Sea Serpent](#)). The star is the closest such star to the [Solar System](#). TW Hydrae is about 80% of the [mass](#) of the Sun, but is only about 5-10 million years old. The star appears to be accreting from a face-on [protoplanetary disk](#) of dust and gas, which has been resolved in images from the [ALMA observatory](#)."



Data reduction conducted by Dr. Richard Russel on 11-2-19 using the ALMA Tutorial located at:
<https://casaguides.nrao.edu/index.php?title=TWHydraBand7>

This paper makes use of the following ALMA data: ADS/JAO.ALMA project code:2011.0.00001.SV ALMA is a partnership of ESO (representing its member states), NSF (USA) and NINS (Japan), together with NRC (Canada), MOST and ASIAA (Taiwan), and KASI (Republic of Korea), in cooperation with the Republic of Chile. The Joint ALMA Observatory is operated by ESO, AUI/NRAO and NAOJ.
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Future Work

- Derive Scientific data
- Chemical signals
- Distance measurements
- Moment Measurements
- Polarization and Magnetic Fields

A photograph of a man wearing an orange hard hat with "VLA VISITOR" printed on it, and colorful safety glasses. He is smiling and standing in front of a large, white, curved radio telescope dish. In the background, another person in a hard hat is visible, holding a camera. The scene is set in a desert landscape under a clear blue sky with a bright sun flare in the upper left.

Questions?