Reproducible Queries to the ALMA archive & making finder charts with python

https://almascience.eso.org/aq/

ALMA Science Archive Query

Query Form | Results Table

Search | Reset

Query Help

Position

Source name (Resolver)
Source name (ALMA)
RA Dec

Energy

Frequency
Bandwidth
Spectral resolution
Band

Time

Observation date
Integration time

Polarisation

Polarisation type

Observation

Water vapour

Project

Project code
Project title
PI name

Options

View: (•) raw data ( ) project
[x] public data only
[x] science observations only

ALMA Science Archive Query

Query Form | Results Table

Search | Reset

Query Help

Position

Source name (Resolver)
M83
Source name (ALMA)
RA Dec

Energy

Frequency
Bandwidth
Spectral resolution
Band

Time

Observation date
Integration time

Polarisation

Polarisation type

Observation

Water vapour

Project

Project code
Project title
PI name

Options

View: raw data project
public data only
science observations only

Query Form | Results Table

Submit download request

Results Bookmark | Export Table | Results Help

Showing 225 rows (225 before filtering). More columns

Project code	Source name	RA	Dec	Band	Integration	*Release date* ▲	Velocity resolution	Frequency support
Filter:							m/s	
2011.0.00772.S	M83	13:36:59.27	-29:51:15.0	3	40.035	2013-09-28	1354.73	100.63..115.38GHz
2011.0.00772.S	M83	13:36:59.27	-29:51:15.0	3	40.035	2013-09-28	1354.73	100.63..115.38GHz
2011.0.00772.S	M83	13:36:59.27	-29:51:15.0	3	40.173	2013-09-28	1354.73	100.63..115.38GHz
2011.0.00772.S	M83	13:36:59.64	-29:51:53.5	3	46.731	2013-09-28	1354.73	100.63..115.38GHz
2011.0.00772.S	M83	13:36:59.64	-29:51:53.5	3	46.75	2013-09-28	1354.73	100.63..115.38GHz
2011.0.00772.S	M83	13:36:59.64	-29:51:53.5	3	46.91	2013-09-28	1354.73	100.63..115.38GHz
2011.0.00772.S	M83	13:36:59.95	-29:50:54.4	3	40.031	2013-09-28	1354.73	100.63..115.38GHz
2011.0.00772.S	M83	13:36:59.95	-29:50:54.4	3	40.036	2013-09-28	1354.73	100.63..115.38GHz
2011.0.00772.S	M83	13:36:59.95	-29:50:54.4	3	40.179	2013-09-28	1354.73	100.63..115.38GHz
2011.0.00772.S	M83	13:37:00.00	-29:52:32.0	3	60.047	2013-09-28	1354.73	100.63..115.38GHz
2011.0.00772.S	M83	13:37:00.00	-29:52:32.0	3	60.055	2013-09-28	1354.73	100.63..115.38GHz
2011.0.00772.S	M83	13:37:00.00	-29:52:32.0	3	60.265	2013-09-28	1354.73	100.63..115.38GHz
2011.0.00772.S	M83	13:37:00.31	-29:51:32.9	3	40.035	2013-09-28	1354.73	100.63..115.38GHz
2011.0.00772.S	M83	13:37:00.31	-29:51:32.9	3	40.035	2013-09-28	1354.73	100.63..115.38GHz
2011.0.00772.S	M83	13:37:00.31	-29:51:32.9	3	40.173	2013-09-28	1354.73	100.63..115.38GHz
2011.0.00772.S	M83	13:37:00.67	-29:52:11.4	3	46.731	2013-09-28	1354.73	100.63..115.38GHz
2011.0.00772.S	M83	13:37:00.67	-29:52:11.4	3	46.75	2013-09-28	1354.73	100.63..115.38GHz
2011.0.00772.S	M83	13:37:00.67	-29:52:11.4	3	46.91	2013-09-28	1354.73	100.63..115.38GHz

```
from astroquery.alma import Alma
tbl = Alma.query_object('M83')
tbl.show_in_browser()
```

Astropy tables:
http://astropy.readthedocs.org/en/latest/table/

Project code	Source name	RA	Dec	Band	Frequency resolution	Integration	Release date	Frequency support	Velocity resolution	Pol products	Observation date	PI name	PWV
2011.0.00772.S	M83	204.24697661723459	-29.854173214826339	3	488.28125	40.034999999999997	2013-09-28	[100.63..101.57GHz,488.28kHz, XX YY] U [102.43..103.37GHz,488.28kHz, XX YY] U [112.74..113.68GHz,488.28kHz, XX YY] U [114.45..115.38GHz,488.28kHz, XX YY]	1354.7258237091098	XX YY	2012-03-27 07:12:59	Hirota, Akihiko	1.3226013
2011.0.00772.S	M83	204.24697661723459	-29.854173214826339	3	488.28125	40.034999999999997	2013-09-28	[100.63..101.57GHz,488.28kHz, XX YY] U [102.43..103.37GHz,488.28kHz, XX YY] U [112.74..113.68GHz,488.28kHz, XX YY] U [114.45..115.38GHz,488.28kHz, XX YY]	1354.7258237091098	XX YY	2012-03-27 08:41:25	Hirota, Akihiko	1.2252344
2011.0.00772.S	M83	204.24697661723459	-29.854173214826339	3	488.28125	40.173000000000002	2013-09-28	[100.63..101.57GHz,488.28kHz, XX YY] U [102.43..103.37GHz,488.28kHz, XX YY] U [112.74..113.68GHz,488.28kHz, XX YY] U [114.45..115.38GHz,488.28kHz, XX YY]	1354.7258237091098	XX YY	2012-05-07 02:48:00	Hirota, Akihiko	1.8213283
2011.0.00772.S	M83	204.24848880184393	-29.864865672087014	3	488.28125	46.731000000000002	2013-09-28	[100.63..101.57GHz,488.28kHz, XX YY] U [102.43..103.37GHz,488.28kHz, XX YY] U [112.74..113.68GHz,488.28kHz, XX YY] U [114.45..115.38GHz,488.28kHz, XX YY]	1354.7258237091098	XX YY	2012-03-27 07:12:59	Hirota, Akihiko	1.3226013

```
tbl.write?
tbl.write('M83.csv',
    format='ascii.csv')
```

```
The available built-in formats are:

============================== ==== ===== ============== ==
                        Format Read Write Auto-identify De
============================== ==== ===== ============== ==
                         ascii  Yes   Yes             No
                   ascii.aastex  Yes   Yes             No
                   ascii.basic  Yes   Yes             No
       ascii.commented_header  Yes   Yes             No
                     ascii.csv  Yes   Yes             No
                    ascii.ecsv  Yes   Yes             No
              ascii.fast_basic  Yes   Yes             No
  ascii.fast_commented_header  Yes   Yes             No
               ascii.fast_csv  Yes   Yes             No
         ascii.fast_no_header  Yes   Yes             No
               ascii.fast_rdb  Yes   Yes             No
               ascii.fast_tab  Yes   Yes             No
             ascii.fixed_width  Yes   Yes             No
  ascii.fixed_width_no_header  Yes   Yes             No
   ascii.fixed_width_two_line  Yes   Yes             No
                  ascii.html  Yes   Yes            Yes
                  ascii.ipac  Yes   Yes             No
                 ascii.latex  Yes   Yes            Yes
              ascii.no_header  Yes   Yes             No
                   ascii.rdb  Yes   Yes            Yes
                   ascii.tab  Yes   Yes             No
                        fits  Yes   Yes            Yes
                        hdf5  Yes   Yes            Yes
                    jsviewer   No   Yes             No
                     votable  Yes   Yes            Yes
                      aastex  Yes   Yes             No
                         csv  Yes   Yes            Yes
                        html  Yes   Yes             No
                        ipac  Yes   Yes             No
                       latex  Yes   Yes             No
                         rdb  Yes   Yes             No
============================== ==== ===== ============== ==
```

```
tbl = Alma.query_region('M104', 0.3*u.deg)
```

```
from astropy import units as u
```

```
In [13]: Alma.query_region('M104', 0.3*u.deg)
Out[13]:
<Table masked=True length=9>
 Project code  Source name      RA       ...                           Project title                           Project type Scan intent
                                deg      ...
  string128     string2048    float64    ...                             string2048                              string128   string2048
-------------- ---------- ------------ ... -------------------------------------------------------------------- ------------ -----------
2011.0.00754.S    Sombrero 189.99763271 ... The Sombrero galaxy with a very massive black hole at extreme sub-Eddington rate            S      TARGET
2011.0.00754.S    Sombrero 189.99763271 ... The Sombrero galaxy with a very massive black hole at extreme sub-Eddington rate            S      TARGET
2011.0.00754.S    Sombrero 189.99763271 ... The Sombrero galaxy with a very massive black hole at extreme sub-Eddington rate            S      TARGET
2011.0.00754.S    Sombrero 189.99763271 ... The Sombrero galaxy with a very massive black hole at extreme sub-Eddington rate            S      TARGET
2011.0.00754.S    Sombrero 189.99763271 ... The Sombrero galaxy with a very massive black hole at extreme sub-Eddington rate            S      TARGET
2011.0.00754.S    Sombrero 189.99763271 ... The Sombrero galaxy with a very massive black hole at extreme sub-Eddington rate            S      TARGET
2011.0.00754.S    Sombrero 189.99763271 ... The Sombrero galaxy with a very massive black hole at extreme sub-Eddington rate            S      TARGET
2011.0.00754.S    Sombrero 189.99763271 ... The Sombrero galaxy with a very massive black hole at extreme sub-Eddington rate            S      TARGET
2011.0.00754.S    Sombrero 189.99763271 ... The Sombrero galaxy with a very massive black hole at extreme sub-Eddington rate            S      TARGET
```

ALMA Science Archive Query

Query Form | Results Table

Submit download request

Results Bookmark Export Table Results Help

Showing 9 rows (9 before filtering). More columns

	Project code	Source name	RA	Dec	Band	Integration	Release date ▲	Velocity resolution	Frequency support
Filter:								m/s	
	2011.0.00754.S	Sombrero	12:39:59.43	-11:37:23.0	3	4.59	2013-10-30	100023.24	85.70..101.69GHz
	2011.0.00754.S	Sombrero	12:39:59.43	-11:37:23.0	3	4.605	2013-10-30	86774.93	100.00..115.99GHz
	2011.0.00754.S	Sombrero	12:39:59.43	-11:37:23.0	6	4.55	2013-10-30	37176.64	242.01..261.99GHz
	2011.0.00754.S	Sombrero	12:39:59.43	-11:37:23.0	6	4.552	2013-10-30	42391.47	211.01..230.99GHz
	2011.0.00754.S	Sombrero	12:39:59.43	-11:37:23.0	7	4.596	2013-10-30	32761.24	278.00..293.99GHz
	2011.0.00754.S	Sombrero	12:39:59.43	-11:37:23.0	7	4.67	2013-10-30	26769.99	342.00..357.99GHz
	2011.0.00754.S	Sombrero	12:39:59.43	-11:37:23.0	9	8.652	2013-10-30	14753.69	631.00..638.92GHz
	2011.0.00754.S	Sombrero	12:39:59.43	-11:37:23.0	9	8.653	2013-10-30	13777.34	676.00..683.92GHz
	2011.0.00754.S	Sombrero	12:39:59.43	-11:37:23.0	9	16.973	2013-10-30	13269.95	702.00..709.92GHz

Examining cycle 0 data

`tbl['Asdm uid']` (use `'Member ous id'` for cycle 1+)

`uid://A002/X41d520/X5c`

```
Alma.get_cycle0_uid_contents('uid://A002/X41d520/X5c')
```

```
u'2011.0.00754.S/sg_ouss_id/group_ouss_id/member_ouss_2012-10-25_id3/README',
u'2011.0.00754.S/sg_ouss_id/group_ouss_id/member_ouss_2012-10-25_id3/calibration/',
u'2011.0.00754.S/sg_ouss_id/group_ouss_id/member_ouss_2012-10-25_id3/log/',
u'2011.0.00754.S/sg_ouss_id/group_ouss_id/member_ouss_2012-10-25_id3/qa/',
u'2011.0.00754.S/sg_ouss_id/group_ouss_id/member_ouss_2012-10-25_id3/raw/uid___A002_X41d520_X2cd.ms.split',
u'2011.0.00754.S/sg_ouss_id/group_ouss_id/member_ouss_2012-10-25_id3/script/',
u'2011.0.00754.S/sg_ouss_id/group_ouss_id/member_ouss_2012-10-25_id3/calibrated/uid___A002_X41d520_X2cd.ms.split',
u'2011.0.00754.S/sg_ouss_id/group_ouss_id/member_ouss_2012-10-25_id3/calibration/',
u'2011.0.00754.S/sg_ouss_id/group_ouss_id/member_ouss_2012-10-25_id3/product/uid___A002_X41d520_X2cd.ms.split.image.continuum.source4.image.fits',
u'2011.0.00754.S/sg_ouss_id/group_ouss_id/member_ouss_2012-10-25_id4/README',
u'2011.0.00754.S/sg_ouss_id/group_ouss_id/member_ouss_2012-10-25_id4/calibration/',
u'2011.0.00754.S/sg_ouss_id/group_ouss_id/member_ouss_2012-10-25_id4/log/',
u'2011.0.00754.S/sg_ouss_id/group_ouss_id/member_ouss_2012-10-25_id4/qa/',
u'2011.0.00754.S/sg_ouss_id/group_ouss_id/member_ouss_2012-10-25_id4/raw/uid___A002_X41d520_X36d.ms.split',
u'2011.0.00754.S/sg_ouss_id/group_ouss_id/member_ouss_2012-10-25_id4/script/',
u'2011.0.00754.S/sg_ouss_id/group_ouss_id/member_ouss_2012-10-25_id2/README',
u'2011.0.00754.S/sg_ouss_id/group_ouss_id/member_ouss_2012-10-25_id2/calibration/',
u'2011.0.00754.S/sg_ouss_id/group_ouss_id/member_ouss_2012-10-25_id2/log/',
u'2011.0.00754.S/sg_ouss_id/group_ouss_id/member_ouss_2012-10-25_id2/qa/',
u'2011.0.00754.S/sg_ouss_id/group_ouss_id/member_ouss_2012-10-25_id2/raw/uid___A002_X41d520_X21d.ms.split',
u'2011.0.00754.S/sg_ouss_id/group_ouss_id/member_ouss_2012-10-25_id2/script/',
u'2011.0.00754.S/sg_ouss_id/group_ouss_id/member_ouss_2012-10-25_id4/calibrated/uid___A002_X41d520_X36d.ms.split',
u'2011.0.00754.S/sg_ouss_id/group_ouss_id/member_ouss_2012-10-25_id4/calibration/',
u'2011.0.00754.S/sg_ouss_id/group_ouss_id/member_ouss_2012-10-25_id4/product/uid___A002_X41d520_X36d.ms.split.image.continuum.source4.image.fits',
u'2011.0.00754.S/sg_ouss_id/group_ouss_id/member_ouss_2012-10-25_id/README',
u'2011.0.00754.S/sg_ouss_id/group_ouss_id/member_ouss_2012-10-25_id/calibration/',
u'2011.0.00754.S/sg_ouss_id/group_ouss_id/member_ouss_2012-10-25_id/log/',
u'2011.0.00754.S/sg_ouss_id/group_ouss_id/member_ouss_2012-10-25_id/qa/',
u'2011.0.00754.S/sg_ouss_id/group_ouss_id/member_ouss_2012-10-25_id/raw/uid___A002_X41d520_X18c.ms.split',
u'2011.0.00754.S/sg_ouss_id/group_ouss_id/member_ouss_2012-10-25_id/script/',
u'2011.0.00754.S/sg_ouss_id/group_ouss_id/member_ouss_2012-10-25_id2/calibrated/uid___A002_X41d520_X21d.ms.split',
u'2011.0.00754.S/sg_ouss_id/group_ouss_id/member_ouss_2012-10-25_id2/calibration/'
```

Examining cycle 1 data

```
tbl = Alma.query_region('Cartwheel',
                        1*u.arcmin, public=True)
data_info = Alma().stage_data(
                       tbl[0]['Member ous id'])
```

Another table

```
In [27]: data_info['uid','size']
Out[27]:
<Table masked=False length=6>
                      uid                        size
                                                 Gbyte
                    unicode1664                 float64
------------------------------------------------ -------
2012.1.00720.S_uid___A002_X6444ba_Xd5_001_of_001.tar  0.9147
2012.1.00720.S_uid___A002_X6a533e_X1b1e.asdm.sdm.tar     7.3
2012.1.00720.S_uid___A002_X6a533e_X1c87.asdm.sdm.tar     7.3
 2012.1.00720.S_uid___A002_X75ab74_X2d4.asdm.sdm.tar    11.0
 2012.1.00720.S_uid___A002_X75bfbf_X465.asdm.sdm.tar     9.7
  2012.1.00720.S_uid___A002_X75bfbf_X79.asdm.sdm.tar     9.7
```

Data retrieval for *any* cycle

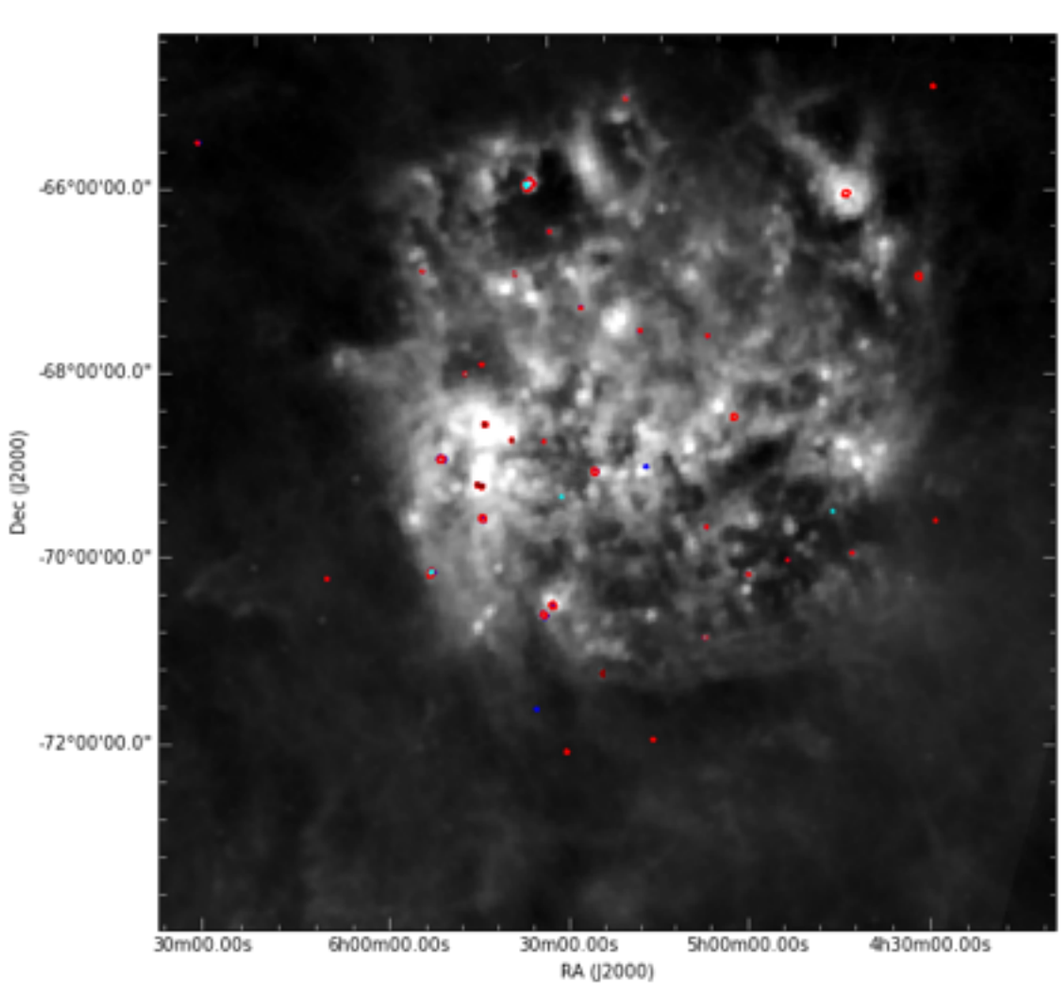
```
n [1]: from astroquery.alma import Alma

n [2]: tbl = Alma.query_region('M104', 0.3*u.deg)

n [3]: Alma.retrieve_data_from_uid(tbl['Member ous id'][0])
NFO: Staging files... [astroquery.alma.core]
INFO: Downloading files of size 23.958 Gbyte... [astroquery.alma.core]
NFO: Downloading 2011.0.00754.S_2012-10-25_001_of_013.tar... [astroquery.query]
```

```
from astroquery.alma import Alma
tbl = Alma.query_region('Cartwheel', 1*u.arcmin, public=True)
data_info = Alma().stage_data(tbl[0]['Member ous id'])
data = Alma.download_and_extract_files(data_info[0]['URL'])
```

```
In [7]: data = Alma.download_and_extract_files(data_info[0]['URL'])
INFO: Downloading 2012.1.00720.S_uid___A002_X6444ba_Xd5_001_of_001.tar... [astroquery.query]
Downloading URL https://almascience.eso.org/dataPortal/requests/anonymous/846252394/ALMA/201
2.1.00720.S_uid___A002_X6444ba_Xd5_001_of_001.tar/2012.1.00720.S_uid___A002_X6444ba_Xd5_001_
of_001.tar ...
|==========================================================| 959M/959M (100.00%)         14s
INFO: Extracting 2012.1.00720.S/science_goal.uid___A002_X6444ba_Xd3/group.uid___A002_X6444ba
_Xd4/member.uid___A002_X6444ba_Xd5/product/Cartwheel_cont.fits to /Users/adam/.astropy/cache
/astroquery/Alma [astroquery.alma.core]
INFO: Extracting 2012.1.00720.S/science_goal.uid___A002_X6444ba_Xd3/group.uid___A002_X6444ba
_Xd4/member.uid___A002_X6444ba_Xd5/product/Cartwheel_CO.fits to /Users/adam/.astropy/cache/a
stroquery/Alma [astroquery.alma.core]
INFO: Deleting /Users/adam/.astropy/cache/astroquery/Alma/2012.1.00720.S_uid___A002_X6444ba_
Xd5_001_of_001.tar [astroquery.alma.core]
```

Quick-look finder charts using ALMA + SkyView

```
from astroquery.alma import Alma,utils
r = utils.make_finder_chart('LMC',
                            10*u.deg,
                            'LMC_10deg_IRAS',
        service_kwargs={'survey':['IRIS 100'],
                        'pixels':1000})
```



```
utils.make_finder_chart('M83',
                        10*u.arcmin,
                        'M83_10arcmin_2MASS')
```

Red = Private

Band 3

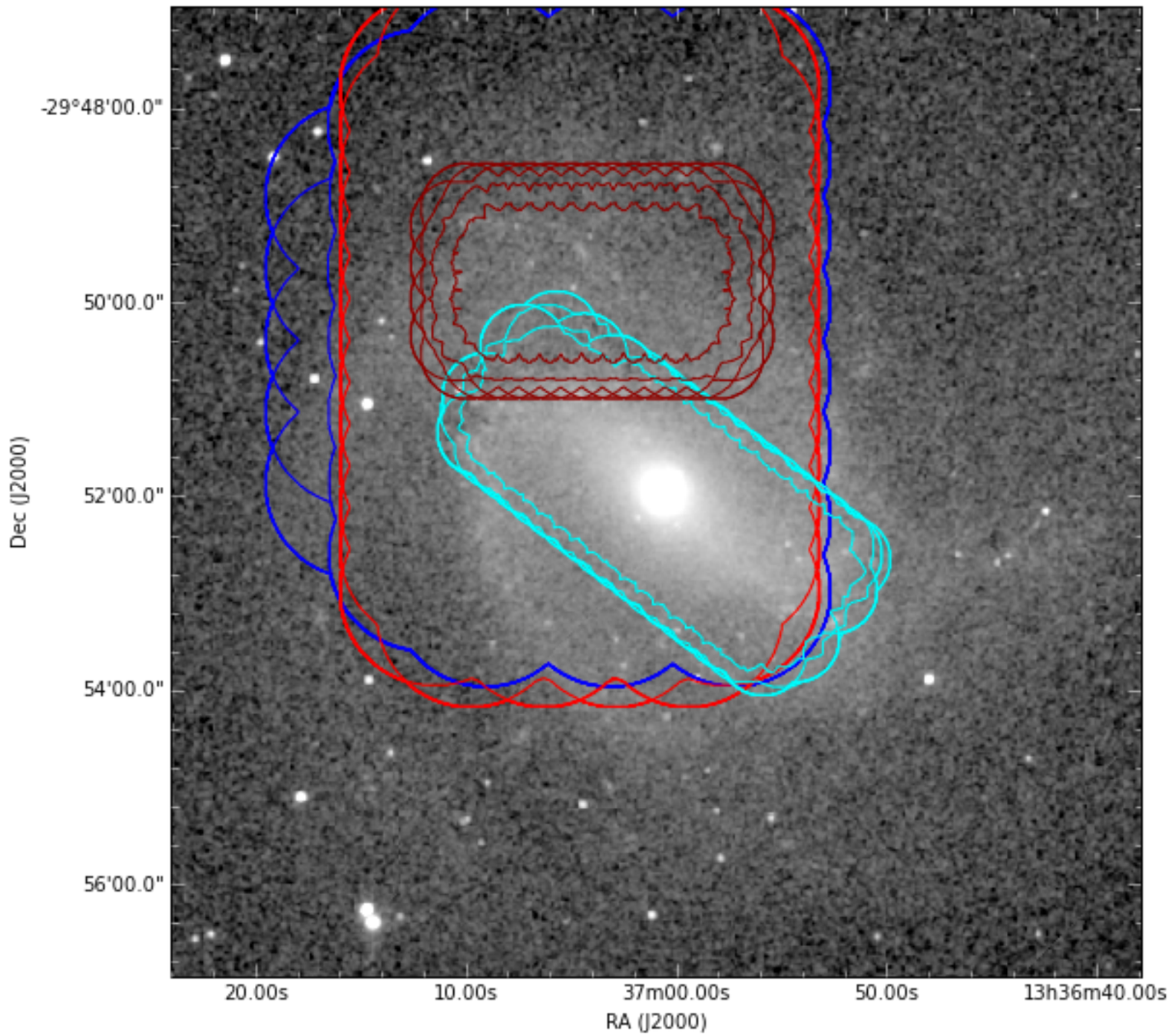
Band 6

Blue = Public

Band 3

Band 6

Configurable!



http://astroquery.readthedocs.org/en/latest/

http://astroquery.readthedocs.org/en/latest/alma/alma.html

astroquery:docs

Page Contents

Astroquery

This is the documentation for the Astroquery affiliated package of astropy.

Code and issue tracker are on GitHub.

Introduction

Astroquery is a set of tools for querying astronomical web forms and databases.

There are two other packages with complimentary functionality as Astroquery: astropy.vo is in the Astropy core and pyvo is an Astropy affiliated package. They are more oriented to general virtual observatory discovery and queries, whereas Astroquery has web service specific interfaces.

Check out the *A Gallery of Queries* for some nice examples.

- SIMBAD Queries (**`astroquery.simbad`**)
- VizieR Queries (**`astroquery.vizier`**)
- IRSA Dust Extinction Service Queries (**`astroquery.irsa_dust`**)
- NED Queries (**`astroquery.ned`**)
- Splatalogue Queries (**`astroquery.splatalogue`**)
- IRSA Queries (**`astroquery.irsa`**)
- UKIDSS Queries (**`astroquery.ukidss`**)
- MAGPIS Queries (**`astroquery.magpis`**)
- NRAO Queries (**`astroquery.nrao`**)
- Besancon Queries (**`astroquery.besancon`**)
- NIST Queries (**`astroquery.nist`**)
- NVAS Queries (**`astroquery.nvas`**)
- GAMA Queries (**`astroquery.gama`**)
- ESO Queries (**`astroquery.eso`**)
- xMatch Queries (**`astroquery.xmatch`**)
- Atomic Line List (**`astroquery.atomic`**)
- ALMA Queries (**`astroquery.alma`**)
- Skyview Queries (**`astroquery.skyview`**)

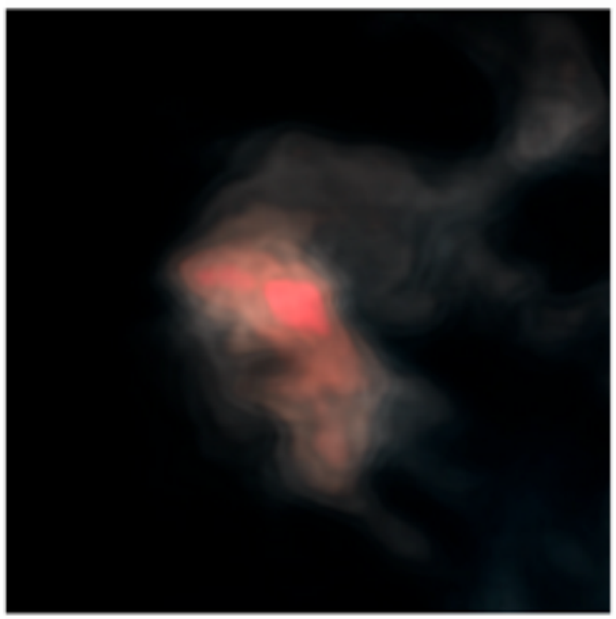
http://radio-astro-tools.github.io

Software Tools for Radio Astronomy

The radio-astro-tools organization hosts a number of community-developed codes pertinent to the analysis of long-wavelength astronomical data in the radio, millimeter, and far-infrared regime.

Python Packages

Spectral Cube

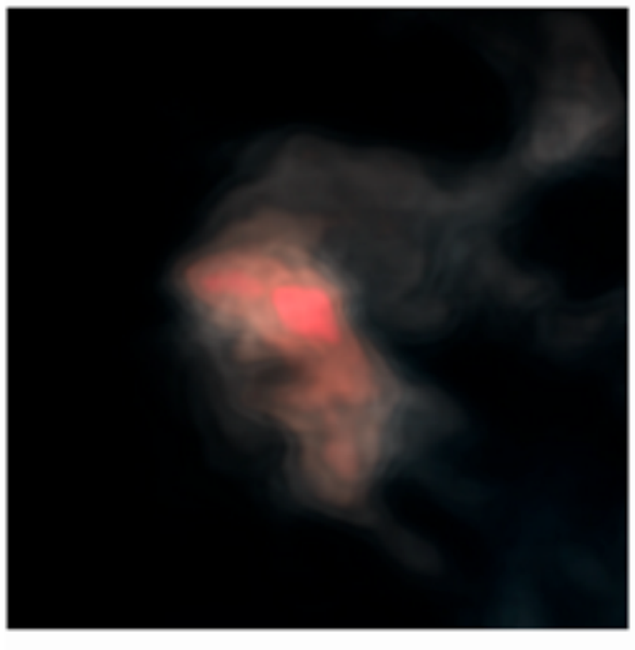


Spectral Cube: A toolkit for reading, writing, masking, and otherwise manipulating the spectral cubes that are typical products of radio interferometers and single-dish OTF maps. It includes a clean interface to yt, an analysis suite built for simulations with powerful visualization tools.

Python Packages

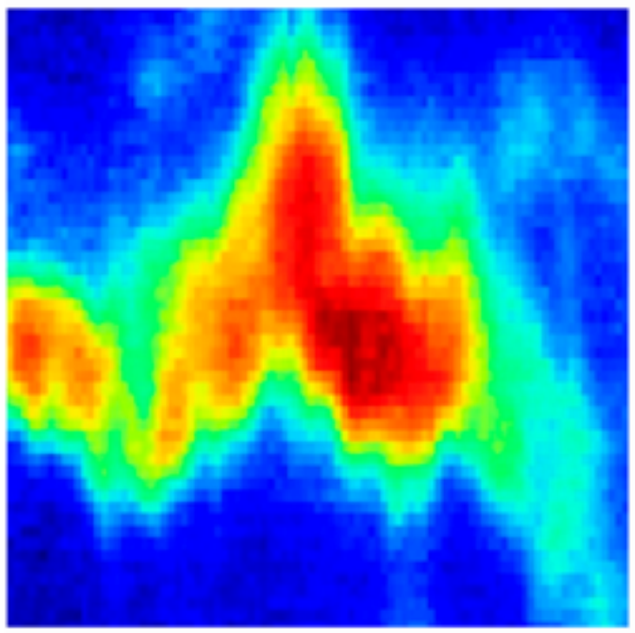
http://radio-astro-tools.github.io

Spectral Cube



Spectral Cube: A toolkit for reading, writing, masking, and otherwise manipulating the spectral cubes that are typical products of radio interferometers and single-dish OTF maps. It includes a clean interface to yt, an analysis suite built for simulations with powerful visualization tools.

PV Extractor



PV Extractor: A toolkit for the extraction of position-velocity diagrams from data cubes. Includes a matplotlib-based interactive GUI and an interface to the ds9 FITS viewer.

Quick start

Here's a simple script demonstrating `spectral-cube`:

```
>>> import astropy.units as u
>>> from spectral_cube import SpectralCube
>>> cube = SpectralCube.read('data.fits')
>>> print cube
SpectralCube with shape=(563, 640, 640) and unit=K:
n_x: 640  type_x: RA---SIN  unit_x: deg
n_y: 640  type_y: DEC--SIN  unit_y: deg
n_s: 563  type_s: FREQ      unit_s: Hz

# extract the subcube between 98 and 100 GHz
>>> slab = cube.spectral_slab(98 * u.GHz, 100 * u.GHz)

# Ignore elements fainter than 1K
>>> masked_slab = slab.with_mask(slab > 1)

# Compute the first moment and write to file
>>> m1 = masked_slab.moment(order=1)
>>> m1.write('moment_1.fits')
```

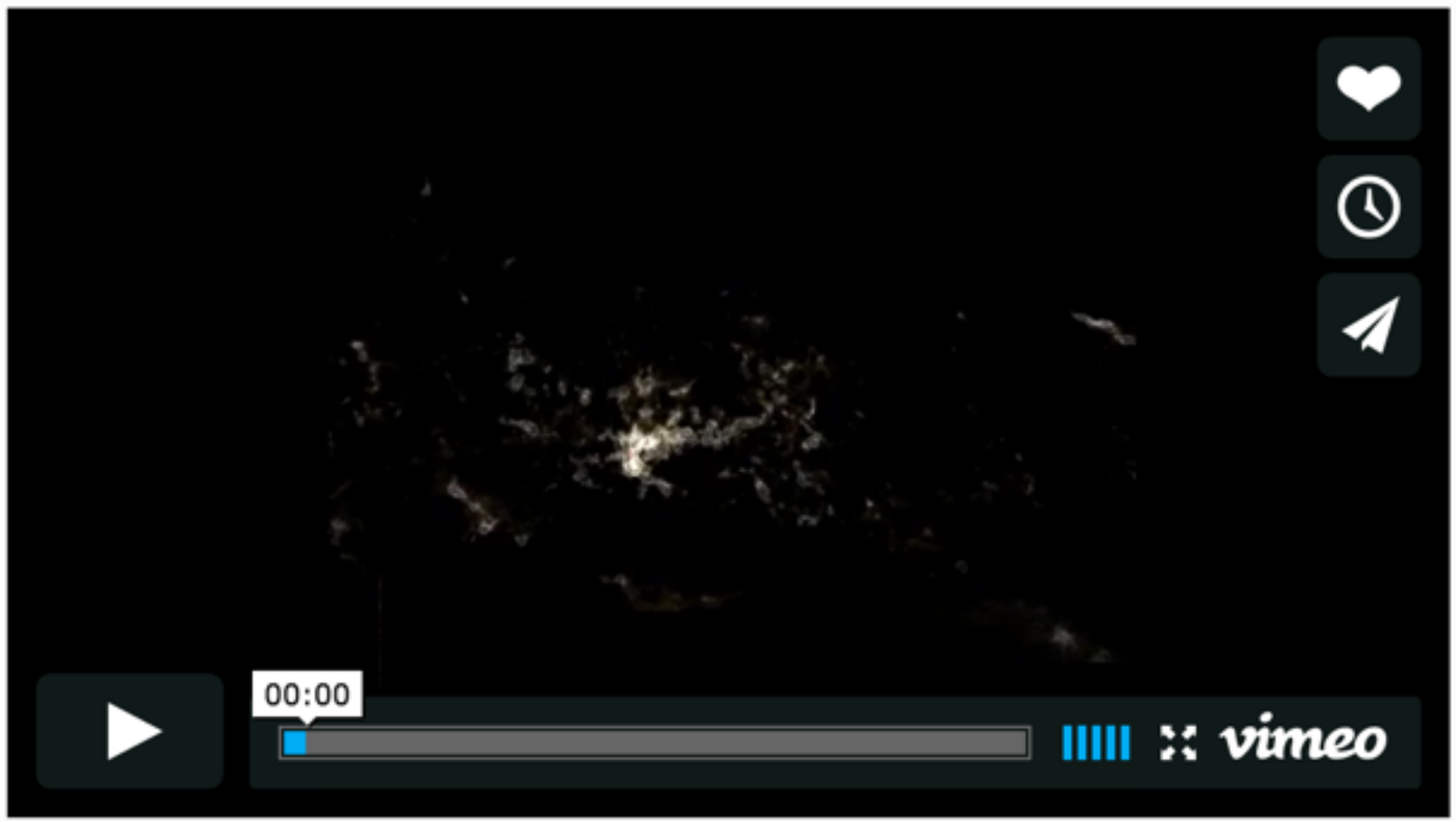
Movie Making

There is a simple utility for quick movie making. The default movie is a rotation of the cube around one of the spatial axes, going from PP -> PV space and back.:

```
>>> cube = read('cube.fits', format='fits')
>>> ytcube = cube.to_yt()
>>> images = ytcube.quick_render_movie('outdir')
```

The movie only does rotation, but it is a useful stepping-stone if you wish to learn how to use yt's rendering system.

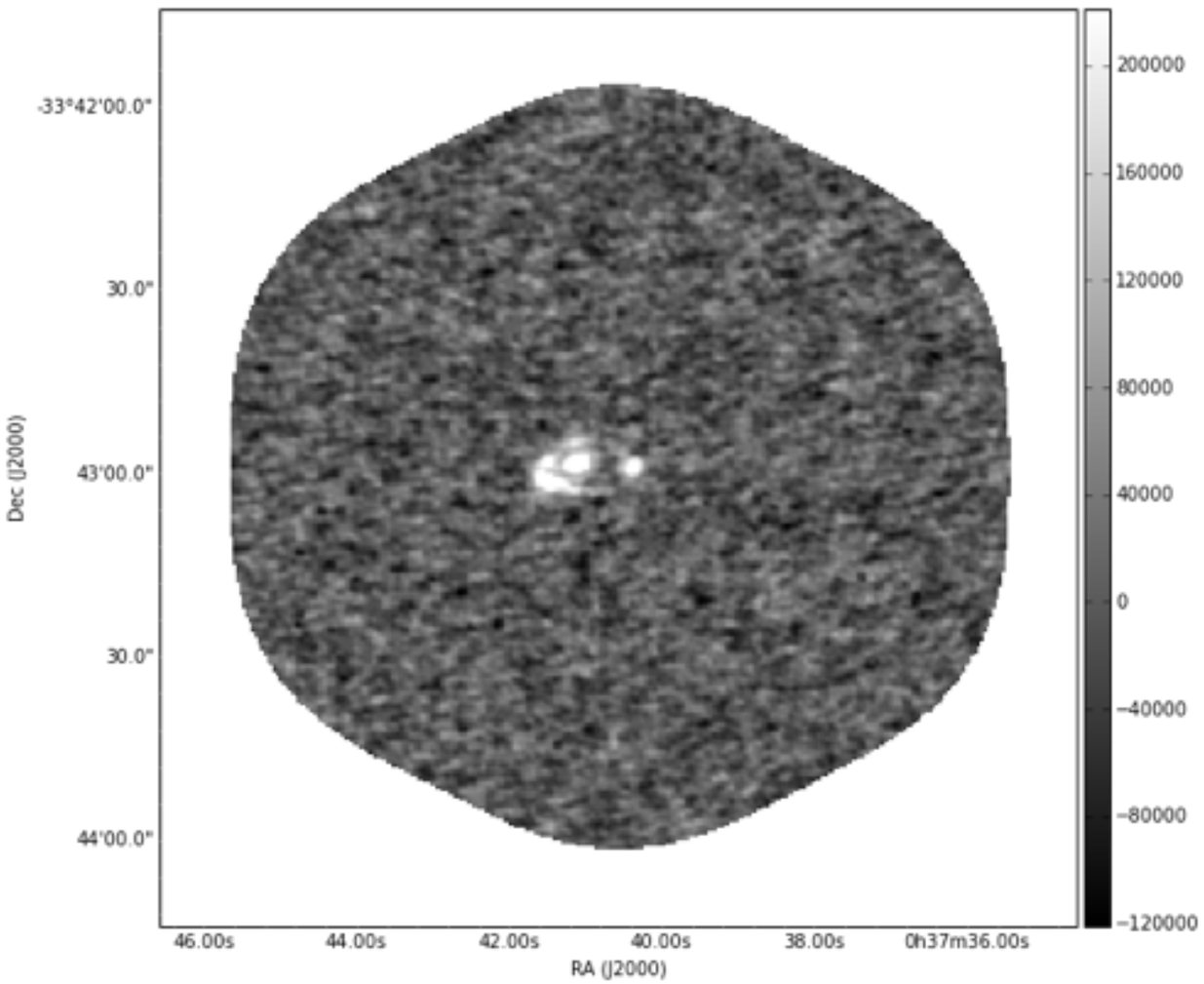
Example:

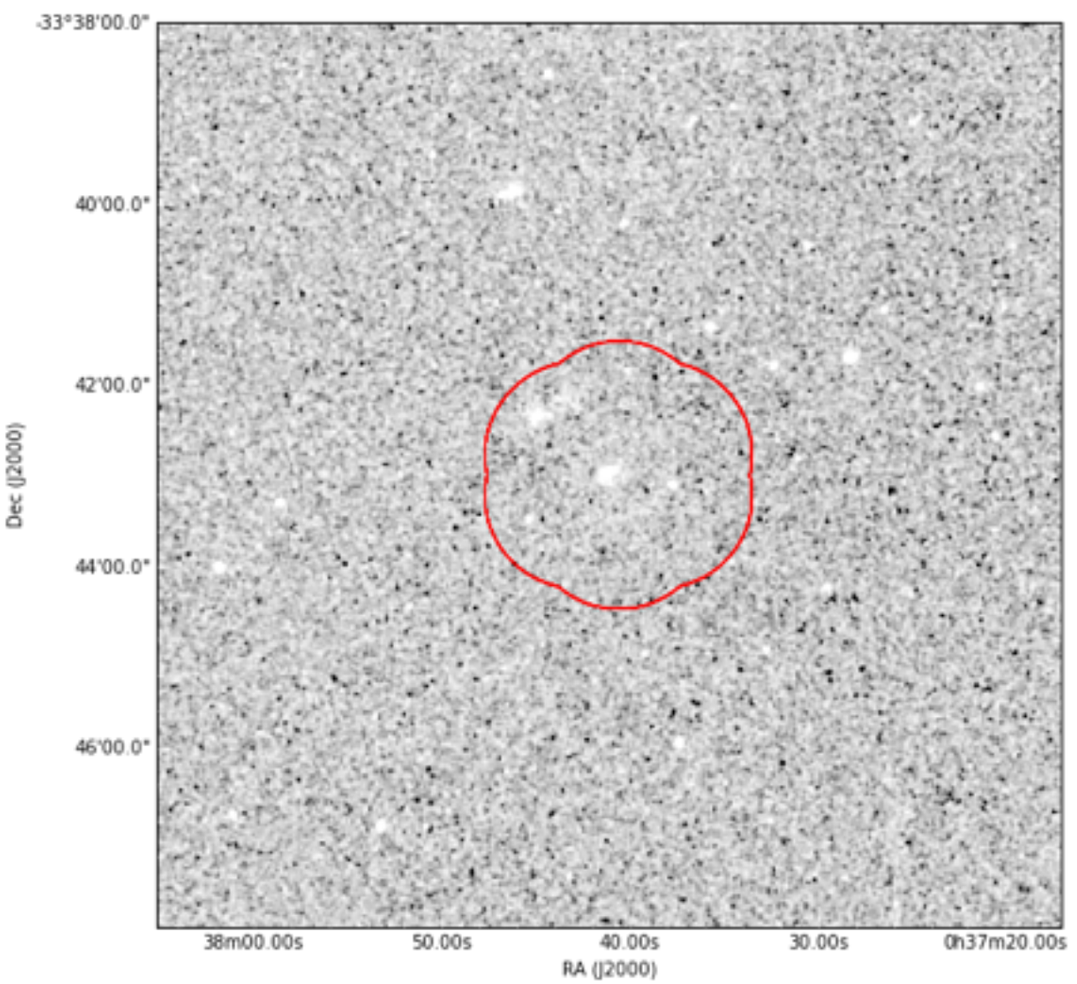


Cartwheel data revisited

http://goo.gl/13c4Ll

```
In [10]: data
Out[10]:
[u'/Users/adam/.astropy/cache/astroquery/2012.1.00720.S/science_goal.uid___A002_X6444ba_Xd3/
group.uid___A002_X6444ba_Xd4/member.uid___A002_X6444ba_Xd5/product/Cartwheel_cont.fits',
 u'/Users/adam/.astropy/cache/astroquery/2012.1.00720.S/science_goal.uid___A002_X6444ba_Xd3/
group.uid___A002_X6444ba_Xd4/member.uid___A002_X6444ba_Xd5/product/Cartwheel_CO.fits']
```





Installing astroquery into CASA

```
curl -O https://raw.githubusercontent.com/radio-
tools/casa-python/master/setup_casapy_pip.py

python setup_casapy_pip.py

export PATH=~/.casa/bin:$PATH

casa-pip install https://github.com/astropy/
astroquery/archive/master.zip
```

(astropy installation can take a minute or 5…)

Download this talk:
https://www.dropbox.com/s/ki4kyyfk8r7eib2/ALMAArchiveQuerying.pdf?dl=0

or

http://goo.gl/21QQnI