

# Use of ChARDM in an archive of velocity cubes

Data Modelling Session

Jose Enrique Ruiz  
IAA-CSIC

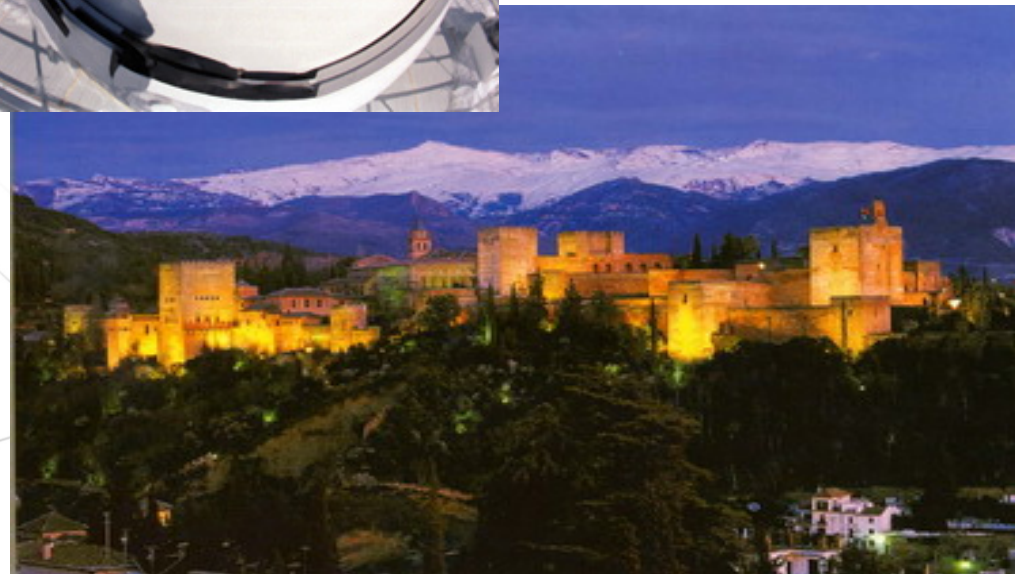
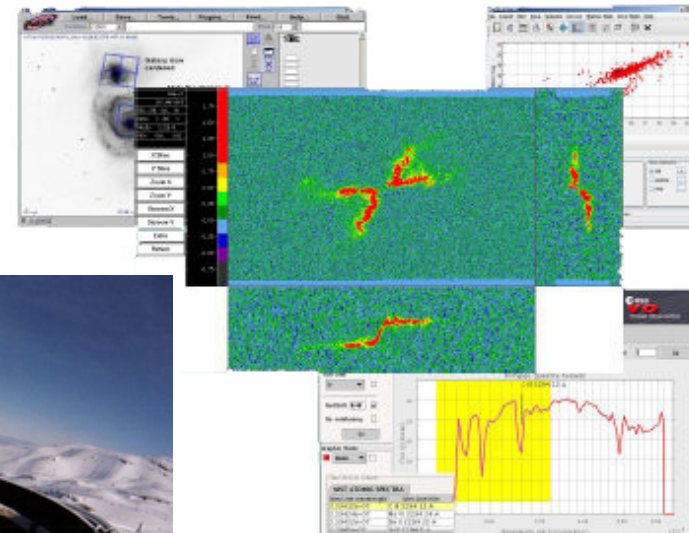
October 20<sup>th</sup> 2011  
2011 IVOA Fall Interop Meeting - Pune





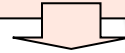
Who am I ?

Instituto Astrofísica de Andalucía - CSIC



## Analysis of the interstellar Medium of Isolated Galaxies

Statistical baseline of isolated galaxies to compare with the behaviour of galaxies in denser environments



Multi  $\lambda$  study of  $\sim 1000$  galaxies  
+

Need of intensive and complex analysis of 3D data  
2D spatial + 1 velocity

IAA-CSIC  
Univ. Granada, Obs. Marseille, Obs. Paris, NAOJ,  
FCRAO, UNAM, Univ. Edinburgh, IRAM, ESO,  
Kapteyn Astronomical Institute.

P.I. Lourdes Verdes-Montenegro  
<http://amiga.iaa.es>

## BODEGA Below 0 DEgrees GALaxies

Molecular gas properties of a survey of nearby galaxies.

30 processed and reduced datacubes of galaxies

P.I. : D. Espada

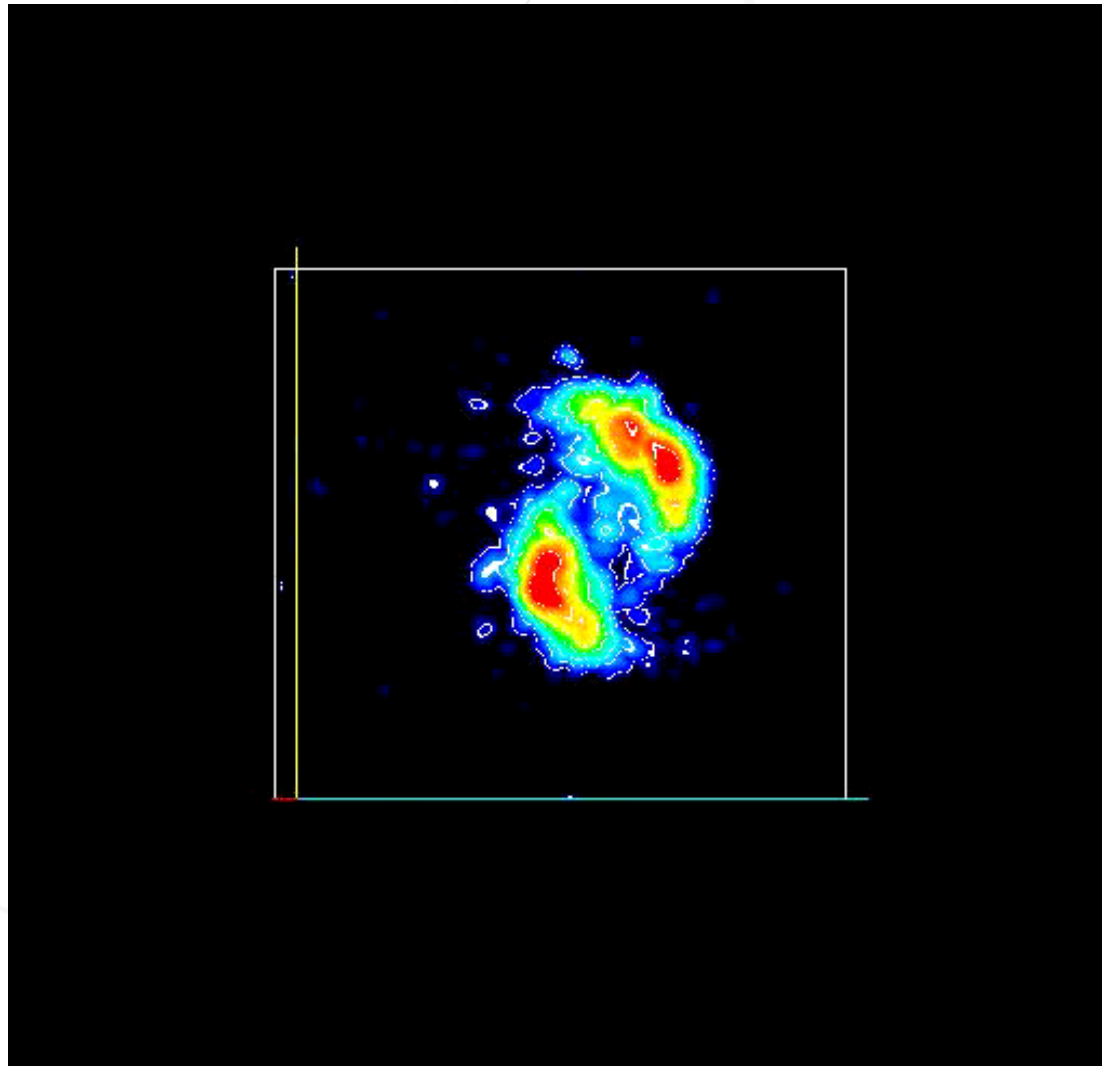
Legacy project of Submillimeter Array interferometer (SMA)

<http://bodega.iaa.es>

IAA-CSIC

CfA (Harvard-Smithsonian Center for Astrophysics)

ASIAA (Institute of Academia Sinica Astronomy and Astrophysics)



M. Kríps - ESO 3D2008 Workshop - Garching



# BODEGA VO Web Interface

## Generic Discovery Service

## Mapping SIA & SSA Input parameters with DataModels

**Target**  
Source name   
Resolved with NED, Symbad and VizieR.

**Region of interest**  
RA  (hh:mm:ss.ss)  
Dec  (dd.dd)  
Search Radius  (dd.dd)  
Width  (dd.dd)  
Height  (dd.dd)

**Spatial Coordinates Range**  
 RA  (hh:mm:ss.ss)  
 Dec  (dd.dd)

**Dates**  
Creator date  /   
M-DD. Single value or range (if second date is specified).  
 /   
M-DD. Single value or range (if second date is specified).

**Quartiles**  
range  /   
Open or closed range (specify second value to have a closed range).

**Provenance**  
Observed Band

**Class**  
Target Class

Generic Discovery Service  
Provides a list of datacubes  
full-filling search params criteria

Need search in "velocity range"

# BODEGA VO Web Interface

## BODEGA

Below zero degrees galaxies

### Generic Discovery Service Results

[« Back to Search](#)

Name	Type	RA 2000 (hh:mm:ss.ss)	DEC 2000 (deg)	Velocity (Km/s)	Redshift	Flux Min (Jy/Beam)	Flux Max (Jy/Beam)	Spectral Start (Km/s)	Spectral Stop (Km/s)
<a href="#">NGC986</a>	Cube	02:33:34.30	-39.04	1920.06	0.006405	0.02	3.65	1180.04	2180.07
<a href="#">NGC908</a>	Cube	02:23:4.60	-21.23	1460.04	0.004870	0.02	0.64	720.02	1720.05
<a href="#">NGC613</a>	Cube	01:34:18.20	-29.42	1470.08	0.004904	0.02	2.20	730.04	1730.09
<a href="#">NGC5937</a>	Cube	15:30:46.10	-2.83	2759.83	0.009206	0.03	0.42	2019.87	3019.81
<a href="#">NGC5861</a>	Cube	15:09:16.10	-11.32	1819.84	0.006070	0.02	1.02	1079.90	2079.81
<a href="#">NGC5792</a>	Cube	14:58:22.70	-1.09	1879.88	0.006271	0.02	0.90	1139.93	2139.86

### Characterization

List of properties describing the datasets

- Observable axis not needed in a first time
- Redshift as **derived** property
- Dataset Type as a **target** property

# Information from FITS Headers

```

ngc134_co21-081013LINE.fits
SIMPLE = T /
BITPIX = -32 /
NAXIS = 4 /
NAXIS1 = 400 /
NAXIS2 = 400 /
NAXIS3 = 25 /
NAXIS4 = 1 /
EXTEND = T /
BSCALE = 1.000000000000E+00 /
BZERO = 0.000000000000E+00 /
TELESCOP = 'SMA' /
CDELTA1 = -8.33333394013E-05 /
CRPIX1 = 2.01000000000E+02 /
CRVAL1 = 7.59083279706E+00 /
CTYPE1 = 'RA---SIN' /
CDELTA2 = 8.33333394013E-05 /
CRPIX2 = 2.01000000000E+02 /
CRVAL2 = -3.32441664028E+01 /
CTYPE2 = 'DEC--SIN' /
CDELTA3 = 2.00010598899E+04 /
CRPIX3 = -4.00000000000E+00 /
CRVAL3 = 1.20006446983E+06 /
CTYPE3 = 'VELO-LSR' /
CDELTA4 = 1.00000000000E+00 /
CRPIX4 = 1.00000000000E+00 /
CRVAL4 = 1.00000000000E+00 /
CTYPE4 = 'STOKES' /
DATE-OBS = '2008-10-13T10:21:31.3' /
RESTFREQ = 2.30537970000E+11 /
CELLSCAL = '1/F' /
BMAJ = 1.42183084972E-03 /
BMIN = 7.45724770240E-04 /
BPA = 1.09593591690E+01 /
RMS = 2.43862252682E-02 /
BUNIT = 'JY/BEAM' /
OBSERVER = 'despada' /
VOBS = 1.58773498535E+01 /
PCTYPE = 'GAUS(5.129E+01)' /
LSTEP = 1.00000000000E+00 /
LWIDTH = 1.00000000000E+00 /
LSTART = 1.00000000000E+00 /
LTYPE = 'channel' /
OBJECT = 'NGC134' /
NITERS = 187500 /
EPOCH = 2.00000000000E+03 /
BTYPE = 'intensity' /
DATAMIN = -1.58179461956E-01 /
DATAMAX = 5.87566614151E-01 /
HISTORY IDL/MIR to MIRIAD, Version: Beta
HISTORY based on library version xx-xx-xx
HISTORY Target Source: ngc134
    
```

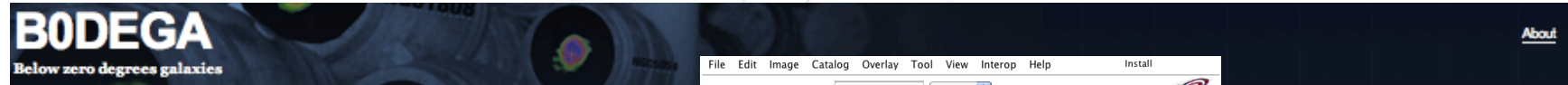
- Char
- .SpatialAxis
- .VelocityAxis
- .Coverage
- .Location
- .Bound
- Char
- .FluxAxis
- .Position
- .Coverage
- .Support

DATAMIN<0

Provenance info in Headers and HISTORY



# BODEGA VO Web Interface



## Characterization NGC986

### Basic data

#### Target

- Name: NGC986
- Class: Galaxy

#### Coordinates

- RA J2000: 02:33:34.30 hh:mm:ss.ss
- DEC J2000: -39.04 deg

#### Velocity

- V: 1920.06 Km/s
- Redshift: 0.00640462

### Extended data

#### Provenance

- Telescope: SMA
- Bandpass: Millimeter bandwidth
- Beam Major Axis: 0.00133631 deg
- Beam Minor Axis: 0.00076115 deg
- Beam Position Angle: 30.40 deg

#### Spatial

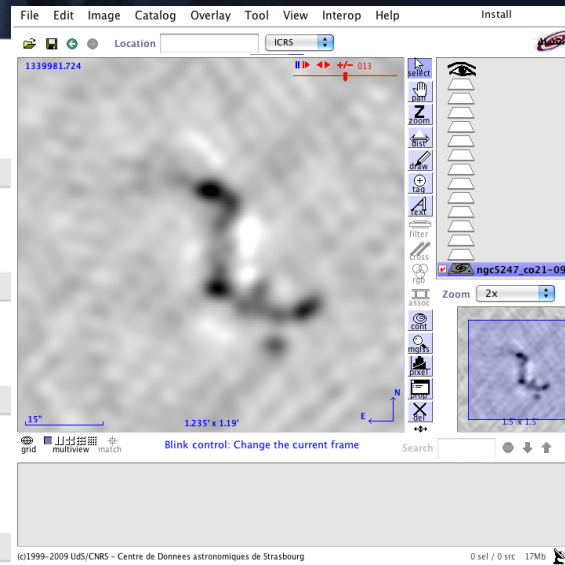
- Aperture angular size (width x height): 0.0213 x 0.0213 deg
- Spatial bin size (width x height): 8.3e-05 x 8.3e-05 deg

#### Spectral

- Spectral coord value: 1920.06 Km/s
- Width of spectrum: 1000.03 Km/s
- Start in spectral coordinate: 1180.04 Km/s
- Stop in spectral coordinate: 2180.07 Km/s

#### Flux

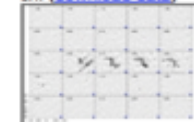
- Flux min : 0.0219 Jy/Beam
- Flux Support Extent (min): 0.0219 Jy/Beam
- Flux Support Extent (max): 3.6501 Jy/Beam



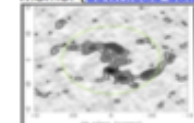
### Images

#### 12CO21

ch: [\(download data\)](#)



mom0: [\(download data\)](#)



mom1: [\(download data\)](#)



sp: [\(download data\)](#)



distrad: [\(download data\)](#)



Download Fits file



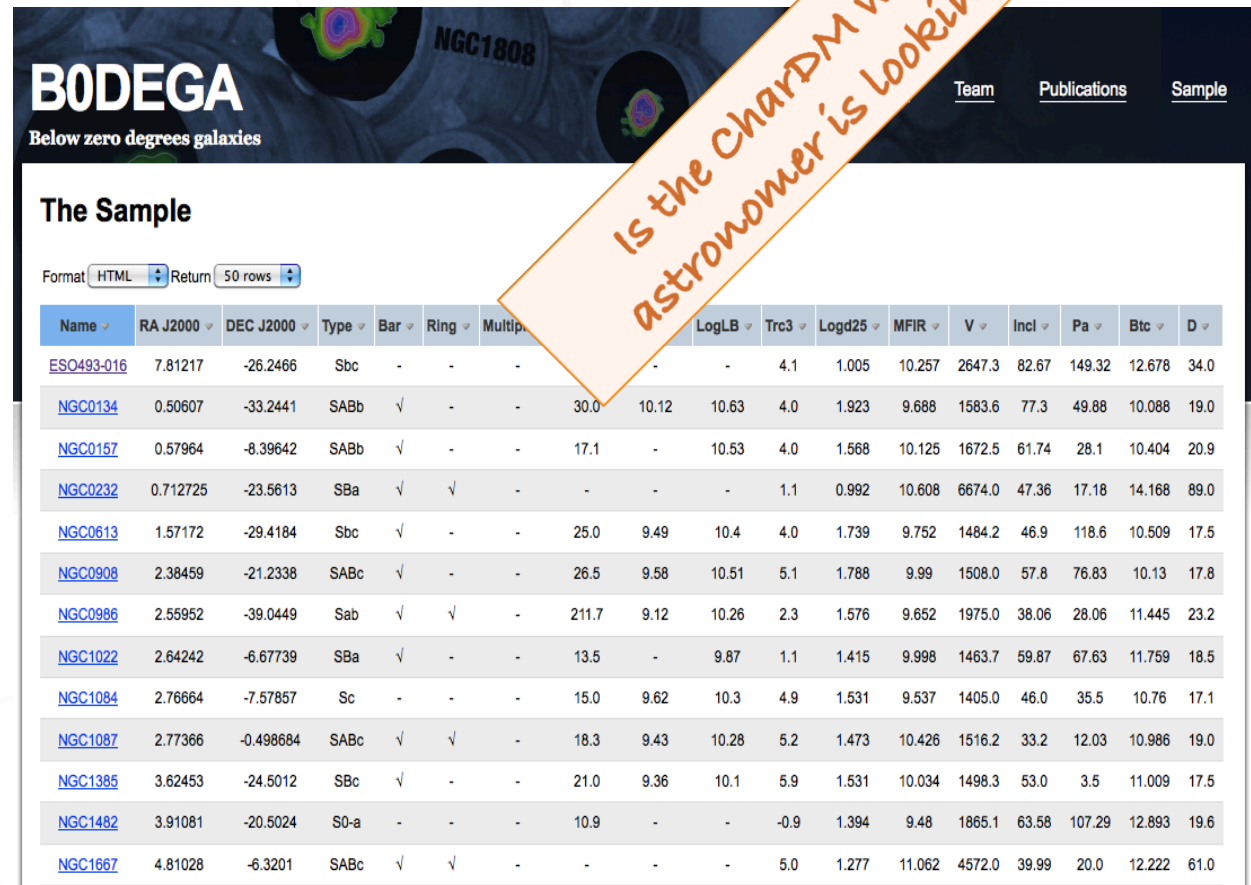
Right click and "Link As" to do

Number of points: 250000  
Size: 9011520 Kbs  
Open this with Aladdin Applet



## Data needed by the Astronomer

- Decoupled coordinates
- Distances
- Morphological Type
- Bar
- Ring
- Multiple
- Linear diameter
- Masses
- Luminosities
- Inclination
- Position Angle



**BODEGA**  
Below zero degrees galaxies

Team Publications Sample

### The Sample

Format: HTML Return: 50 rows

Name	RA J2000	DEC J2000	Type	Bar	Ring	Multi	LogLB	Trc3	Logd25	MFIR	V	Incl	Pa	Btc	D		
<a href="#">ESO493-016</a>	7.81217	-26.2466	Sbc	-	-	-	-	-	4.1	1.005	10.257	2647.3	82.67	149.32	12.678	34.0	
<a href="#">NGC0134</a>	0.50607	-33.2441	SABb	√	-	-	30.0	10.12	10.63	4.0	1.923	9.688	1583.6	77.3	49.88	10.088	19.0
<a href="#">NGC0157</a>	0.57964	-8.39642	SABb	√	-	-	17.1	-	10.53	4.0	1.568	10.125	1672.5	61.74	28.1	10.404	20.9
<a href="#">NGC0232</a>	0.712725	-23.5613	SBa	√	√	-	-	-	1.1	0.992	10.608	6674.0	47.36	17.18	14.168	89.0	
<a href="#">NGC0613</a>	1.57172	-29.4184	Sbc	√	-	-	25.0	9.49	10.4	4.0	1.739	9.752	1484.2	46.9	118.6	10.509	17.5
<a href="#">NGC0908</a>	2.38459	-21.2338	SABc	√	-	-	26.5	9.58	10.51	5.1	1.788	9.99	1508.0	57.8	76.83	10.13	17.8
<a href="#">NGC0986</a>	2.55952	-39.0449	Sab	√	√	-	211.7	9.12	10.26	2.3	1.576	9.652	1975.0	38.06	28.06	11.445	23.2
<a href="#">NGC1022</a>	2.64242	-6.67739	SBa	√	-	-	13.5	-	9.87	1.1	1.415	9.998	1463.7	59.87	67.63	11.759	18.5
<a href="#">NGC1084</a>	2.76664	-7.57857	Sc	-	-	-	15.0	9.62	10.3	4.9	1.531	9.537	1405.0	46.0	35.5	10.76	17.1
<a href="#">NGC1087</a>	2.77366	-0.498684	SABc	√	√	-	18.3	9.43	10.28	5.2	1.473	10.426	1516.2	33.2	12.03	10.986	19.0
<a href="#">NGC1385</a>	3.62453	-24.5012	SBc	√	-	-	21.0	9.36	10.1	5.9	1.531	10.034	1498.3	53.0	3.5	11.009	17.5
<a href="#">NGC1482</a>	3.91081	-20.5024	S0-a	-	-	-	10.9	-	-	-0.9	1.394	9.48	1865.1	63.58	107.29	12.893	19.6
<a href="#">NGC1667</a>	4.81028	-6.3201	SABc	√	√	-	-	-	-	5.0	1.277	11.062	4572.0	39.99	20.0	12.222	61.0

# Fitting to CharDM

AXES PROPERTIES	SPATIAL	TEMPORAL	SPECTRAL	OBSERVABLE E.G. FLUX
<b>Coverage</b>				
Location	Central position	Mid- Time	Central Frequency	Average flux
Bounds	RA,Dec [min,max] or Bounding box [center, size]	Start/stop time	Frequency [min,max]	Saturation, rms noise
Support	Primary beam FWHM (or mosaic polygons)	Time intervals (array)	Frequencies (array)	Peak, $3\sigma$ rms
Sensitivity	Smearing limits/ functions (of integ. time/ chan. width)	Gain-elevation	Bandpass function(s) or FWHM(s)	Dynamic range
Filling factor	Fraction of mosaic filled	Live time fraction	Fraction above FWHM sensitivity	
<b>Resolution</b>	Spatial scales (max and min of B <sub>Maj</sub> , B <sub>Min</sub> , B <sub>PA</sub> )	Min. imageable duration	FWHM of Hanning smoothing	RMS noise
<b>Sampling Precision</b>	Pixel scales [min, max]	Integration time	Channel width	

Array of velocities needed for generation of virtual channel maps

What if not regular sampling?

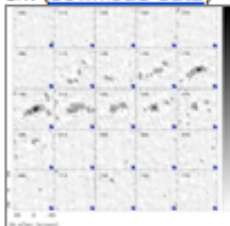
Table 5: Property versus Axis description of metadata describing a radio image service, potentially mosaiced. The Max. and Min. spatial resolu-

# Images

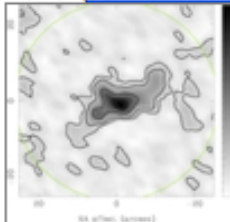
# Derived datasets from velocity cubes

12CO21

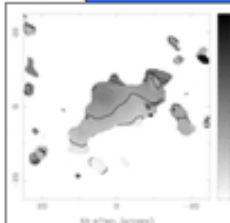
ch: [\(download data\)](#)



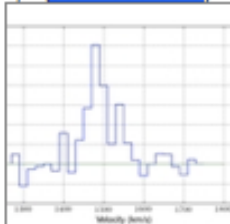
mom0: [\(download data\)](#)



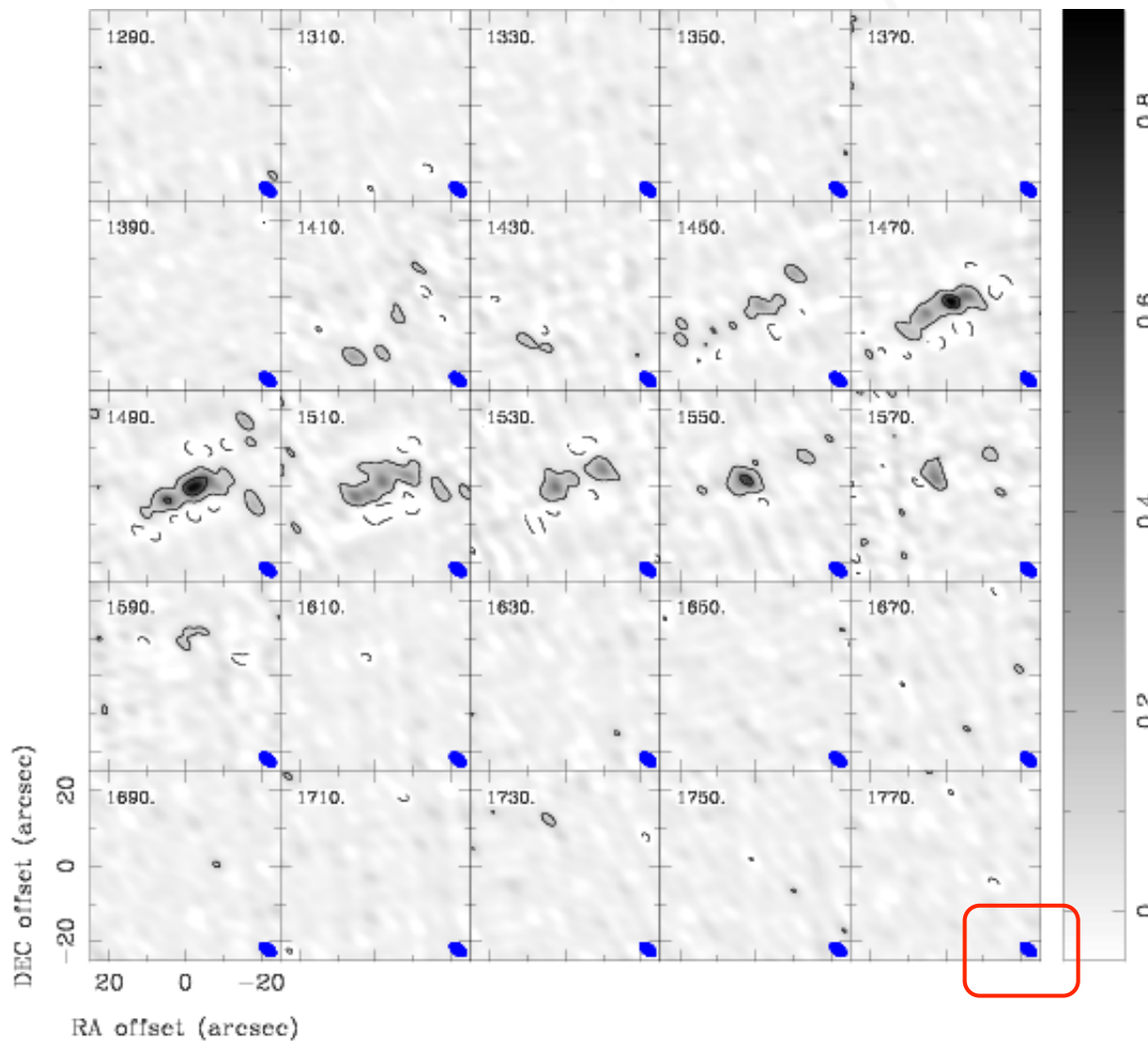
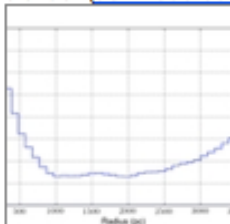
mom1: [\(download data\)](#)



sp: [\(download data\)](#)



distrad: [\(download data\)](#)



Channel Map

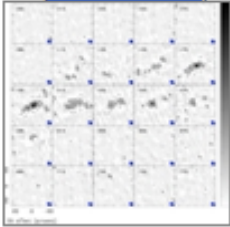
Char. velocity Axis. Coverage. Support  
Array of values

# Images

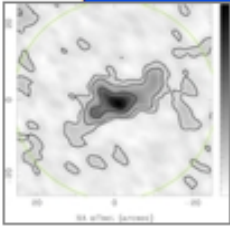
# Derived datasets from velocity cubes

12CO21

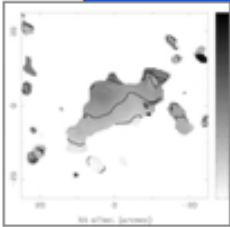
ch: [\(download data\)](#)



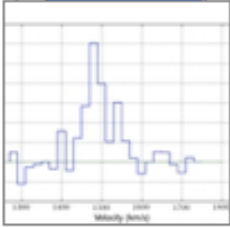
mom0: [\(download data\)](#)



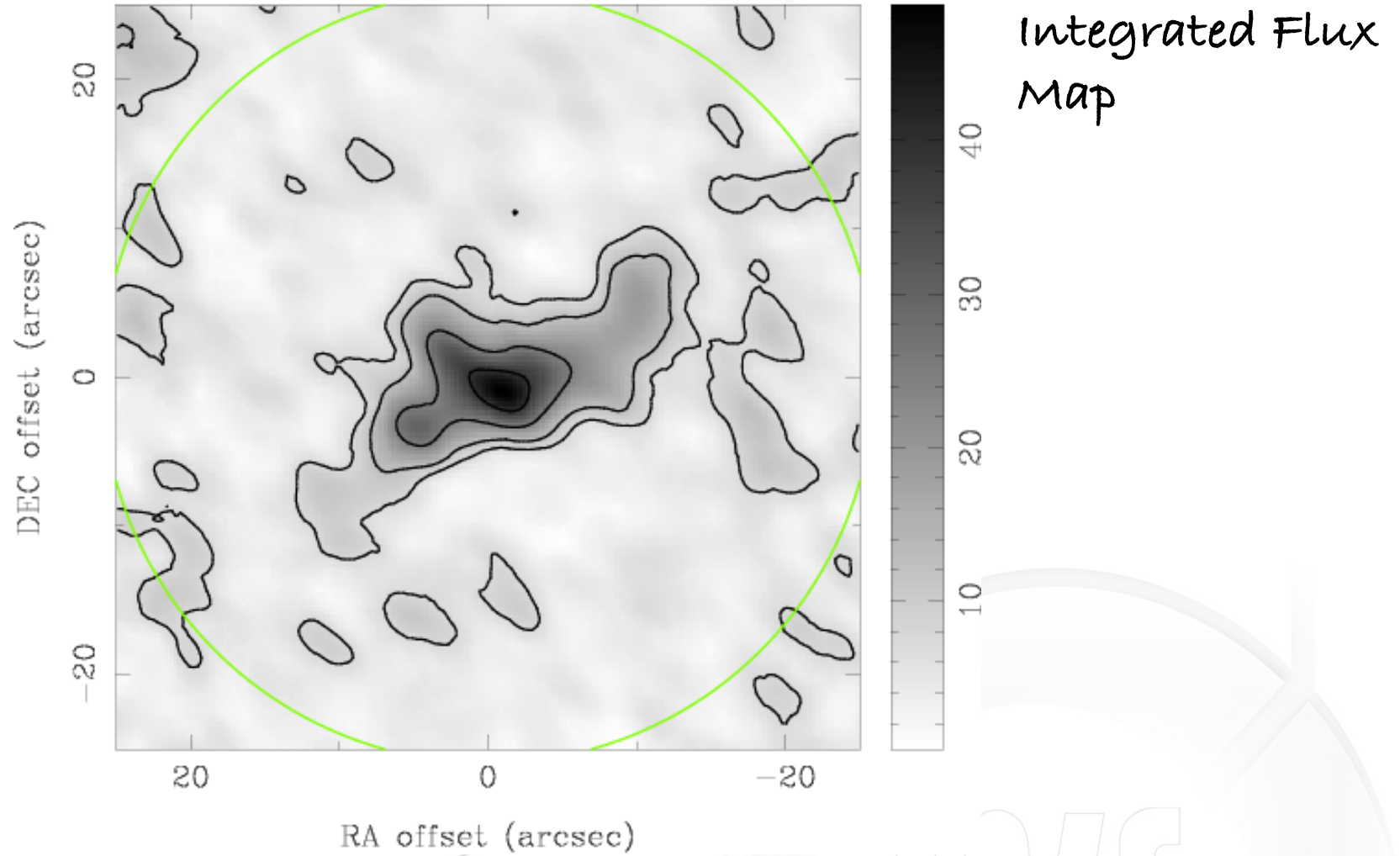
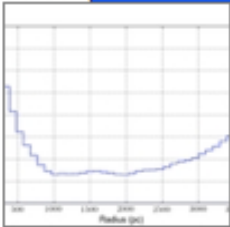
mom1: [\(download data\)](#)



sp: [\(download data\)](#)



distrad: [\(download data\)](#)



Char. Velocity Axis. Coverage. Bounds. Extent

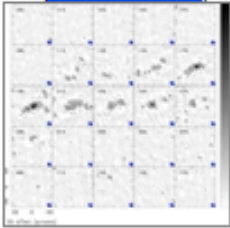


# Images

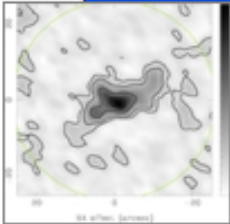
# Derived datasets from velocity cubes

12CO21

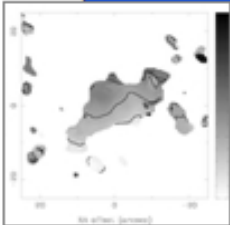
ch: [\(download data\)](#)



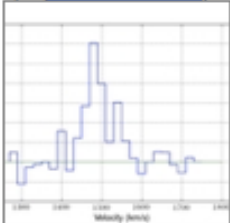
mom0: [\(download data\)](#)



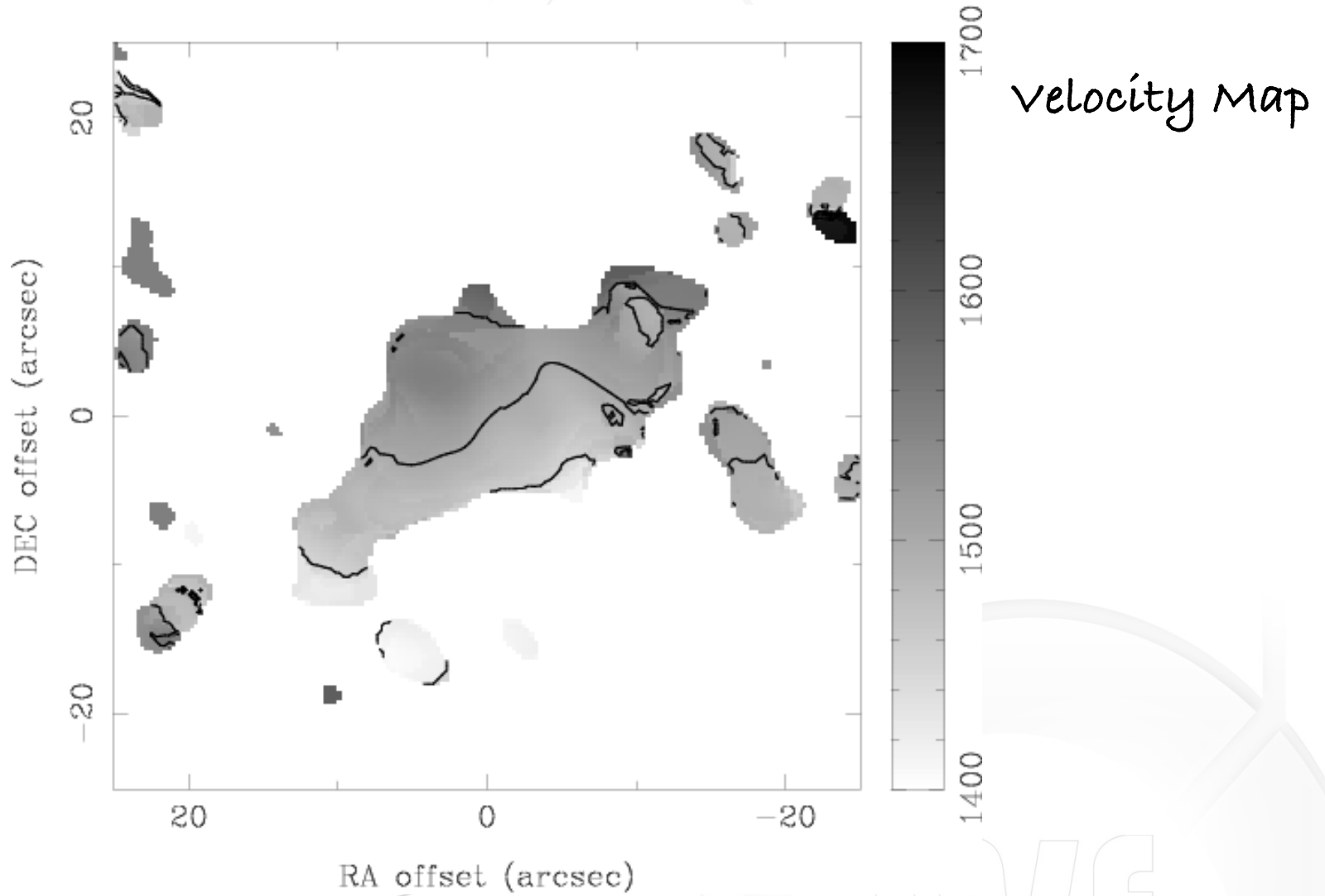
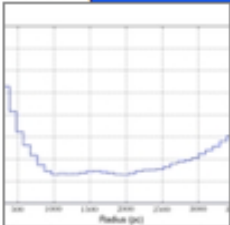
mom1: [\(download data\)](#)



sp: [\(download data\)](#)



distrad: [\(download data\)](#)

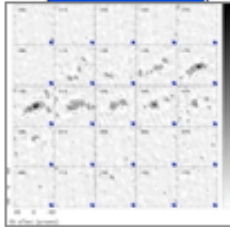


Char. Velocity Axis. Coverage. Bounds. Extent

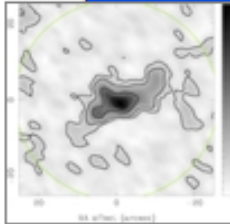
## Images

12CO21

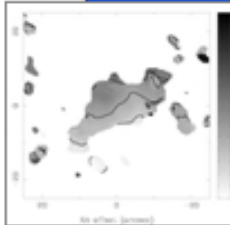
ch: [\(download data\)](#)



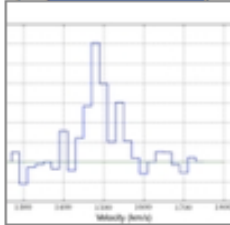
mom0: [\(download data\)](#)



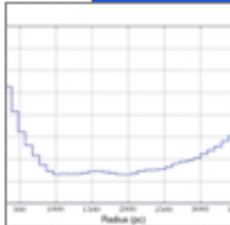
mom1: [\(download data\)](#)



sp: [\(download data\)](#)

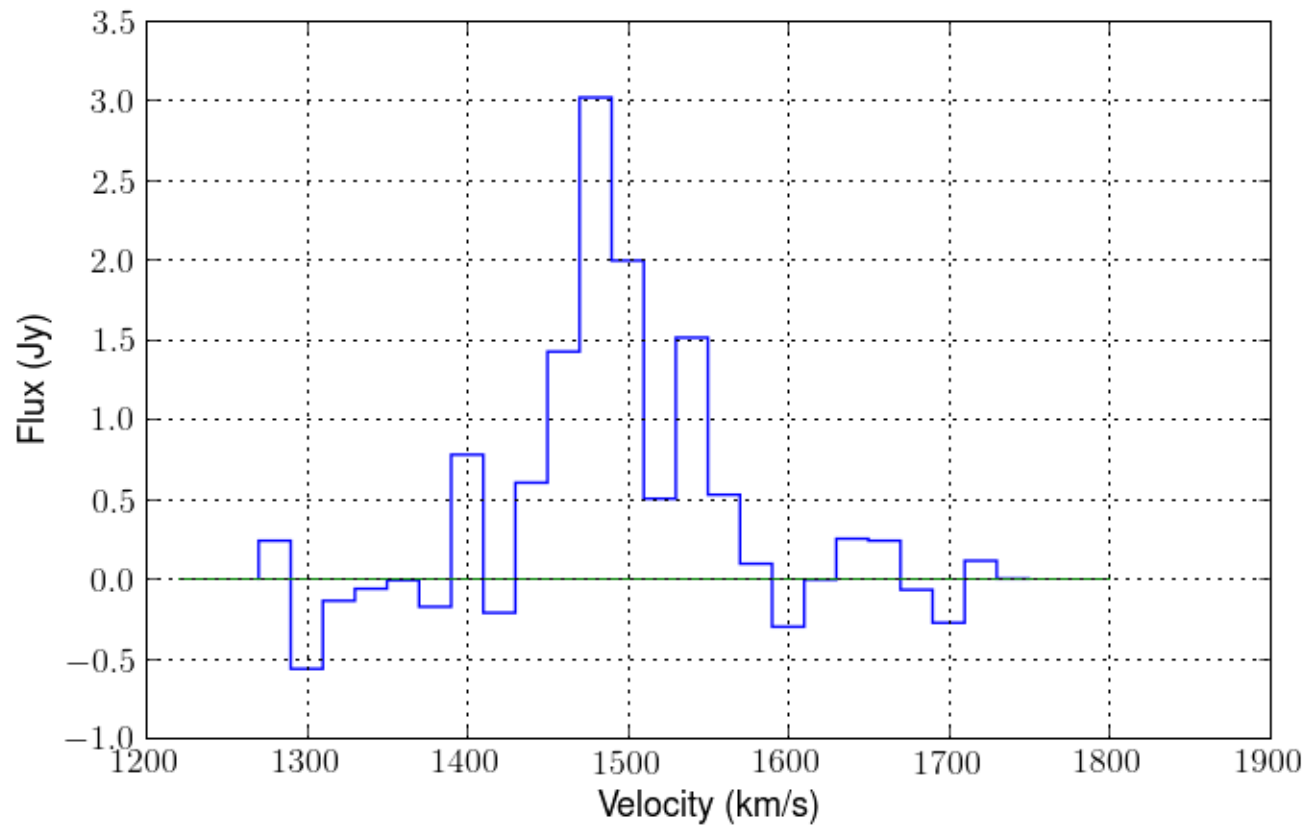


distrad: [\(download data\)](#)



# Derived datasets from velocity cubes

Spectral Profile



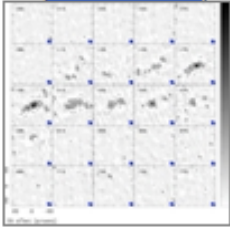
Char. Velocity Axis. Coverage. Bounds. Extent  
Char. Spatial Axis. Coverage. Support. Extent

## Images

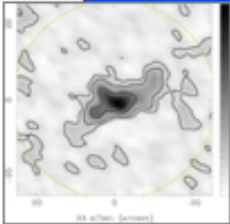
# Derived datasets from velocity cubes

12CO21

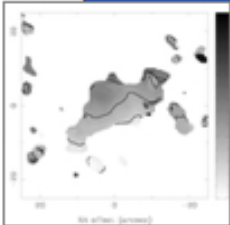
ch: [\(download data\)](#)



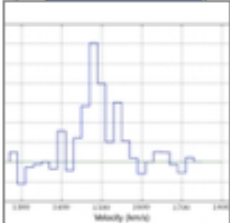
mom0: [\(download data\)](#)



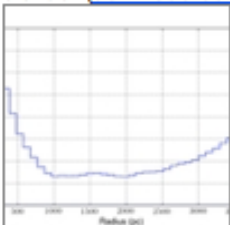
mom1: [\(download data\)](#)



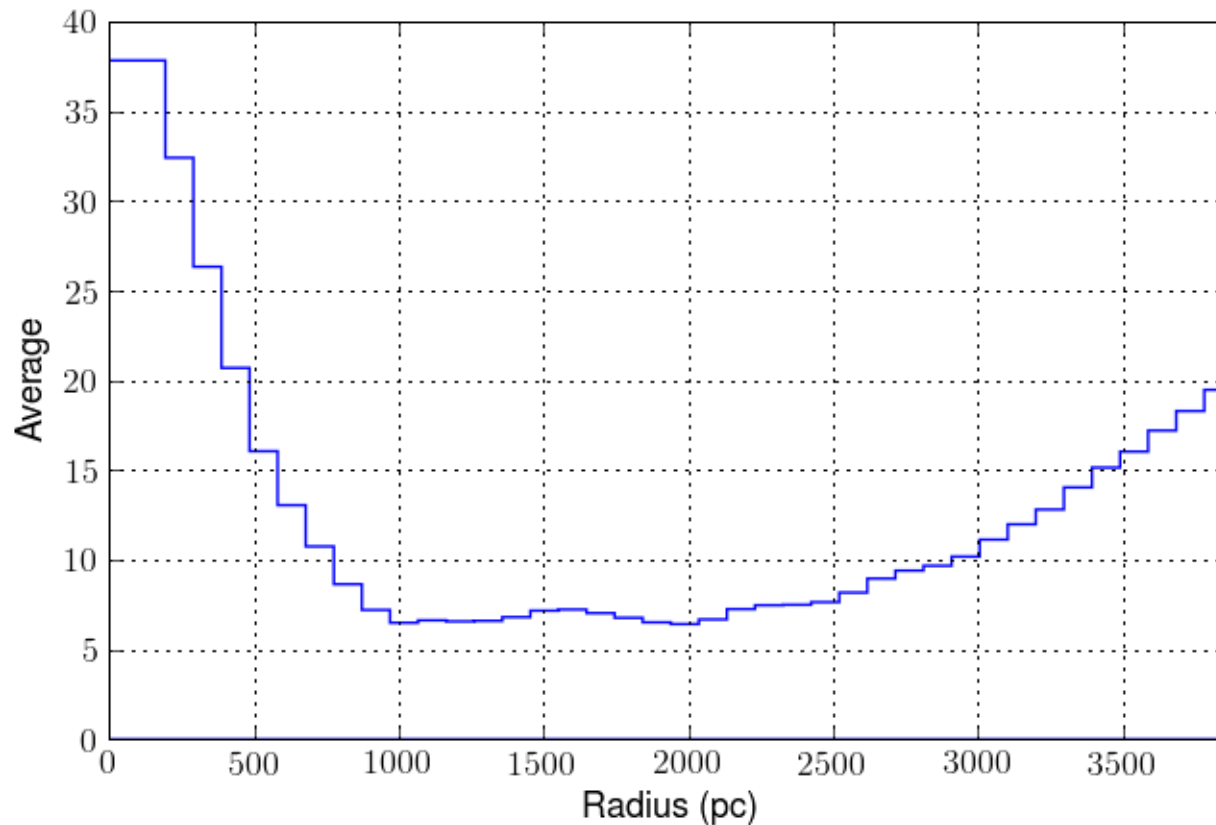
sp: [\(download data\)](#)



distrad: [\(download data\)](#)



## Radial Profile



Char. Velocity Axis. Coverage. Bounds. Extent  
Position angle, Length and Width of the  
radius of the galaxy

- Characterization of content is needed for the generation of on-the-fly virtual data subproducts

*Splinter Session  
SIA v2 Access Methods*

- Accuracy and errors should be linked to a Provenance DM
- Polarization Axis

### Char.PolarizationAxis

Char.PolarizationAxis.AxisName	meta.id	char	*
Char.PolarizationAxis.Ucd	meta.ucd	char	*
Char.PolarizationAxis.Enumeration		char	*

### Polarization Axis Characterization

Name for polarization axis
UCD for polarization
List of available polarization parameters