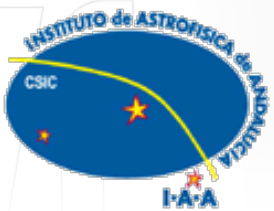
Use of CharDM in an archive of velocity cubes

Data Modelling Session

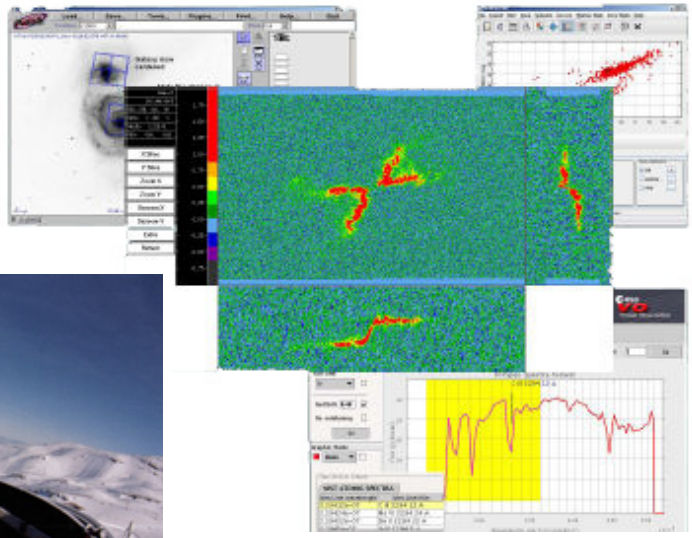
Jose Enrique Ruiz
IAA-CSIC

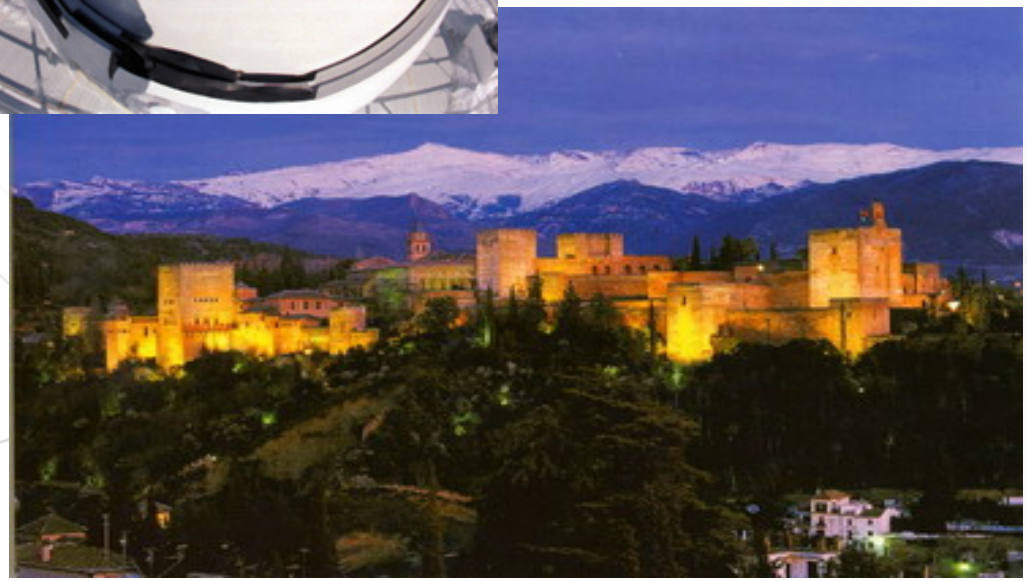
October 20th 2011
2011 IVOA Fall Interop Meeting - Pune



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 λ study of ~1000 galaxies

+

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

IAA-CSIC
Uuiv . 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

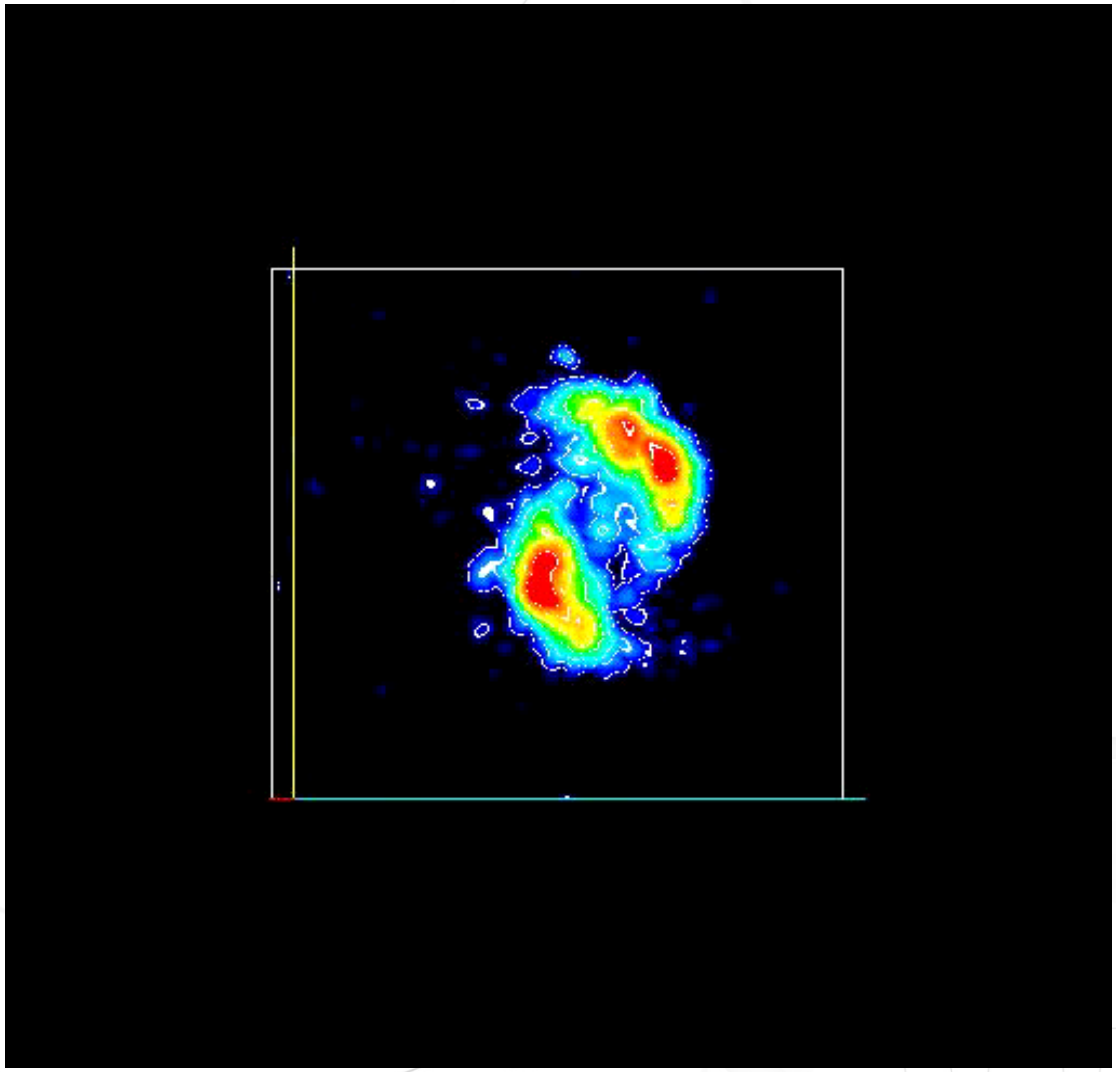
Molecular gas properties of a survey of nearby galaxies.

30 processed and reduced datacubes of galaxies

P.I. : D. Espada
Legacy project of Submillimiter Array interferometer (SMA)
http://bodega.iaa.es

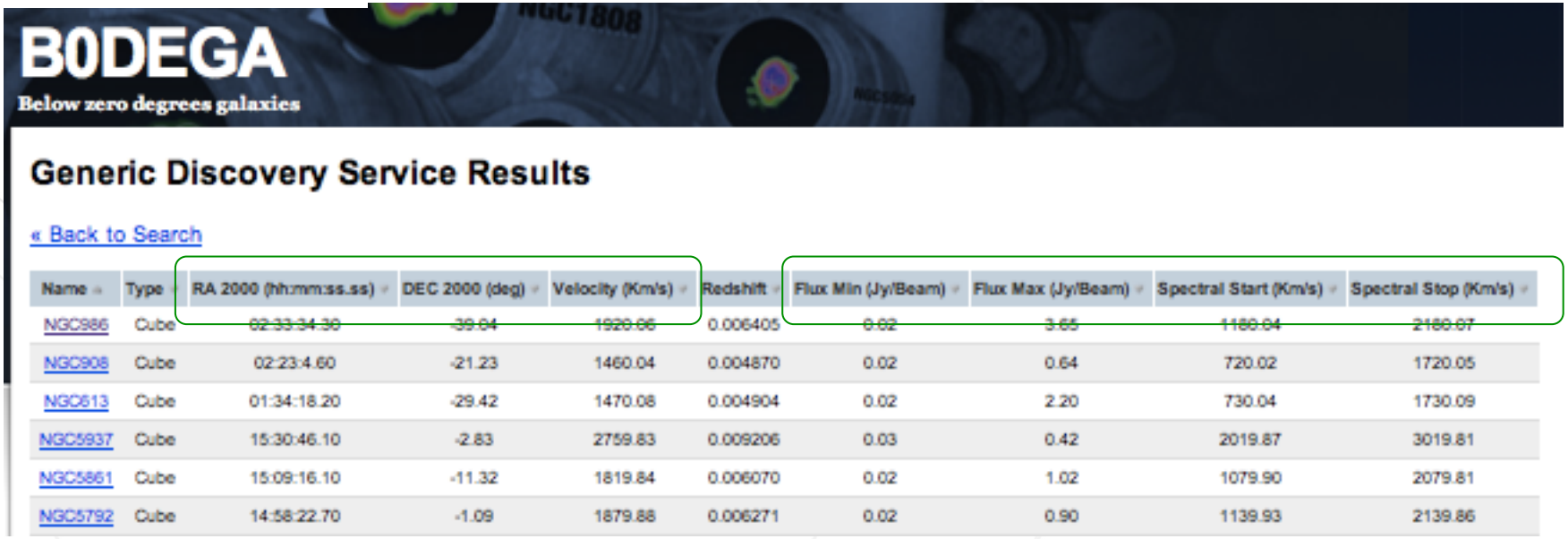
IAA-CSIC
CfA (Harvard-Smithsonian Center for Astrophysics)
ASIAA (Institute of Academia Sinica Astronomy and Astrophysics)

Velocity Cubes



BODEGA VO Web Interface

BODEGA VO Web Interface



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)
NGC986	Cube	02:33:34.30	-39.04	1920.06	0.006405	0.02	3.65	1180.04	2180.07
NGC908	Cube	02:23:4.60	-21.23	1460.04	0.004870	0.02	0.64	720.02	1720.05
NGC613	Cube	01:34:18.20	-29.42	1470.08	0.004904	0.02	2.20	730.04	1730.09
NGC5937	Cube	15:30:46.10	-2.83	2759.83	0.009206	0.03	0.42	2019.87	3019.81
NGC5861	Cube	15:09:16.10	-11.32	1819.84	0.006070	0.02	1.02	1079.90	2079.81
NGC5792	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  =    1.00000000000E+00  /
BZERO   =    0.00000000000E+00  /
TELESCOP= 'SMA     '  /
CDELT1  =   -8.33333394013E-05  /
CRPIX1  =    2.01000000000E+02  /
CRVAL1  =    7.59083279706E+00  /
CTYPE1  = 'RA---SIN'  /
CDELT2  =    8.33333394013E-05  /
CRPIX2  =    2.01000000000E+02  /
CRVAL2  =   -3.32441664028E+01  /
CTYPE2  = 'DEC--SIN'  /
CDELT3  =    2.00010598899E+04  /
CRPIX3  =   -4.00000000000E+00  /
CRVAL3  =    1.20006446983E+06  /
CTYPE3  = 'VELO-LSR'  /
CDELT4  =    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  /
PBTYPE  = '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
.FluxAxi
.R tion

overage
.Support

DATAMIN<0

Provenance info in Headers and HISTORY

BODEGA VO Web Interface

B0DEGA
Below zero degrees galaxies

About

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

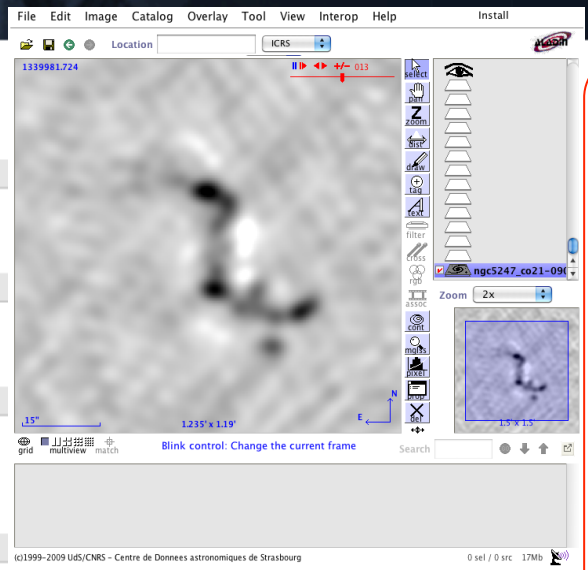
- Aperture angular size (width x height): **0.0213** x **0.0213** deg
- Spatial bin size (width x height): **8.3e-05** x **8.3e-05** deg

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

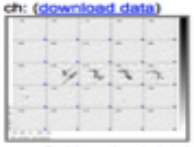
- Flux min : **0.0219** Jy/Beam
- Flux Support Extent (min): **0.0219** Jy/Beam
- Flux Support Extent (max): **3.6501** Jy/Beam



Images

12CO21

ch: (download data)



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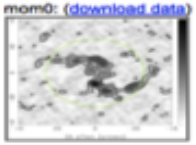
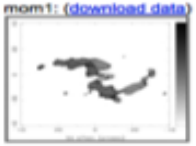


mom1: (download data)



sp: (download data)

distrad: (download data)

Download Fits file

Right click and "
Link As" to do

DataLink

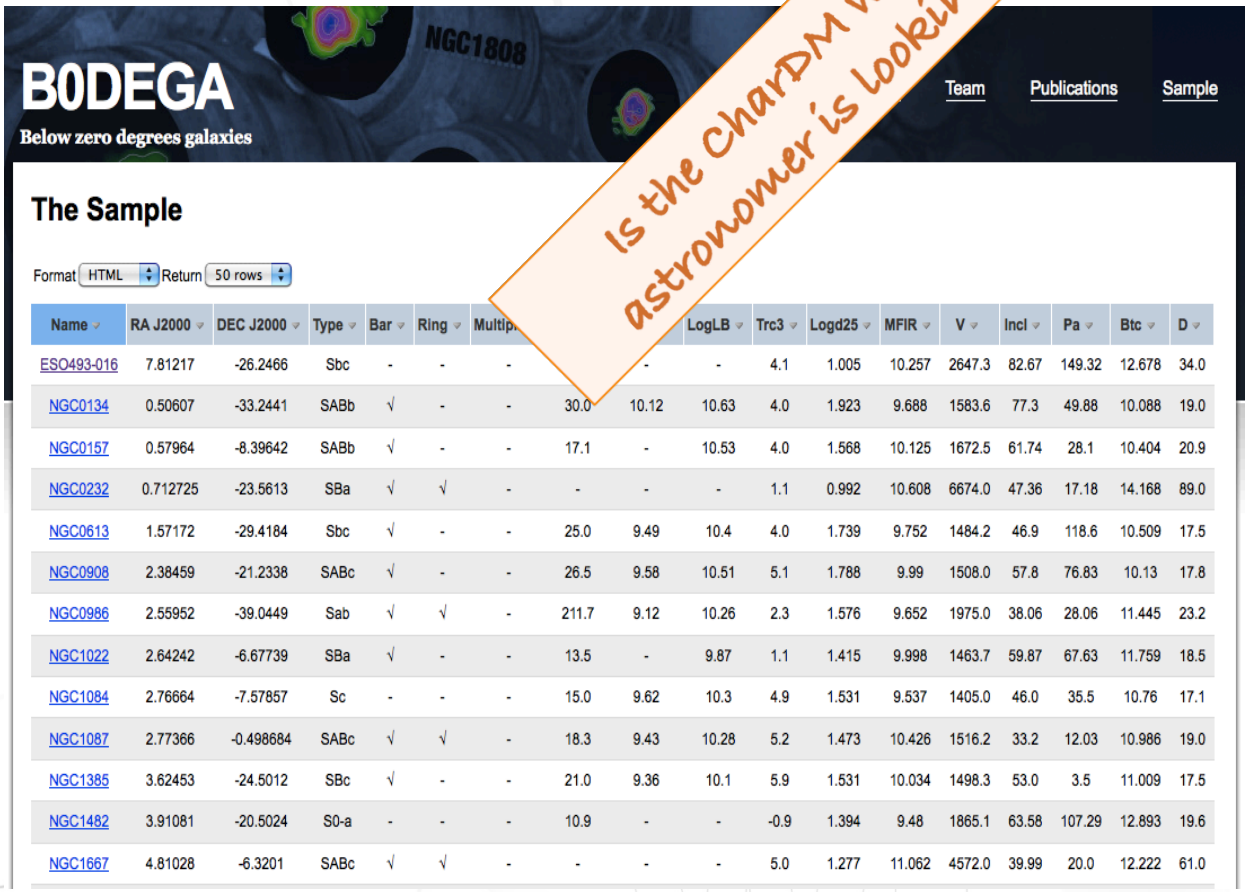
Number of points: 2[illegible]50000
Size: 9011520 Kbs
Open this with Aladdin Applet

BODEGA VO Web Interface

Data needed by the Astronomer

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

Is the CharDM what the astronomer is looking for ?



The Sample

Format HTML Return 50 rows

Name	RA J2000	DEC J2000	Type	Bar	Ring	Multip.			LogLB	Trc3	Logd25	MFIR	V	Incl	Pa	Btc	D
ESO493-016	7.81217	-26.2466	Sbc	-	-	-		-	-	4.1	1.005	10.257	2647.3	82.67	149.32	12.678	34.0
NGC0134	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
NGC0157	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
NGC0232	0.712725	-23.5613	SBa	√	√	-	-	-	-	1.1	0.992	10.608	6674.0	47.36	17.18	14.168	89.0
NGC0613	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
NGC0908	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
NGC0986	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
NGC1022	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
NGC1084	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
NGC1087	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
NGC1385	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
NGC1482	3.91081	-20.5024	S0-a	-	-	-	10.9	-	-	-0.9	1.394	9.48	1865.1	63.58	107.29	12.893	19.6
NGC1667	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
Coverage				
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, 3σ 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	
Resolution	Spatial scales (max and min of BMaj, BMin, BPA)	Min. imageable duration	FWHM of Hanning smoothing	RMS noise
Sampling Precision	Pixel scales [min, max]	Integration time	Channel width	

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

Array of velocities needed for generation of virtual channel maps

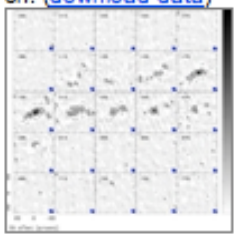
Not regular sampling ?

Derived datasets from velocity cubes

Images

12CO21

ch: (download data)



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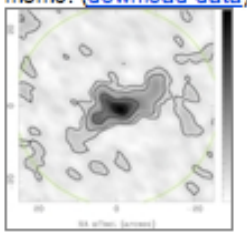

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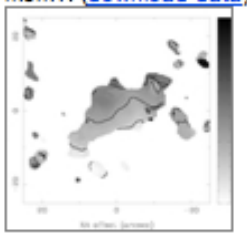

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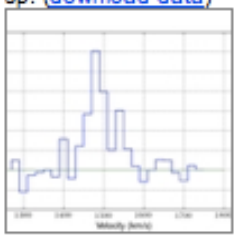
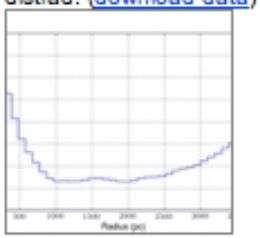
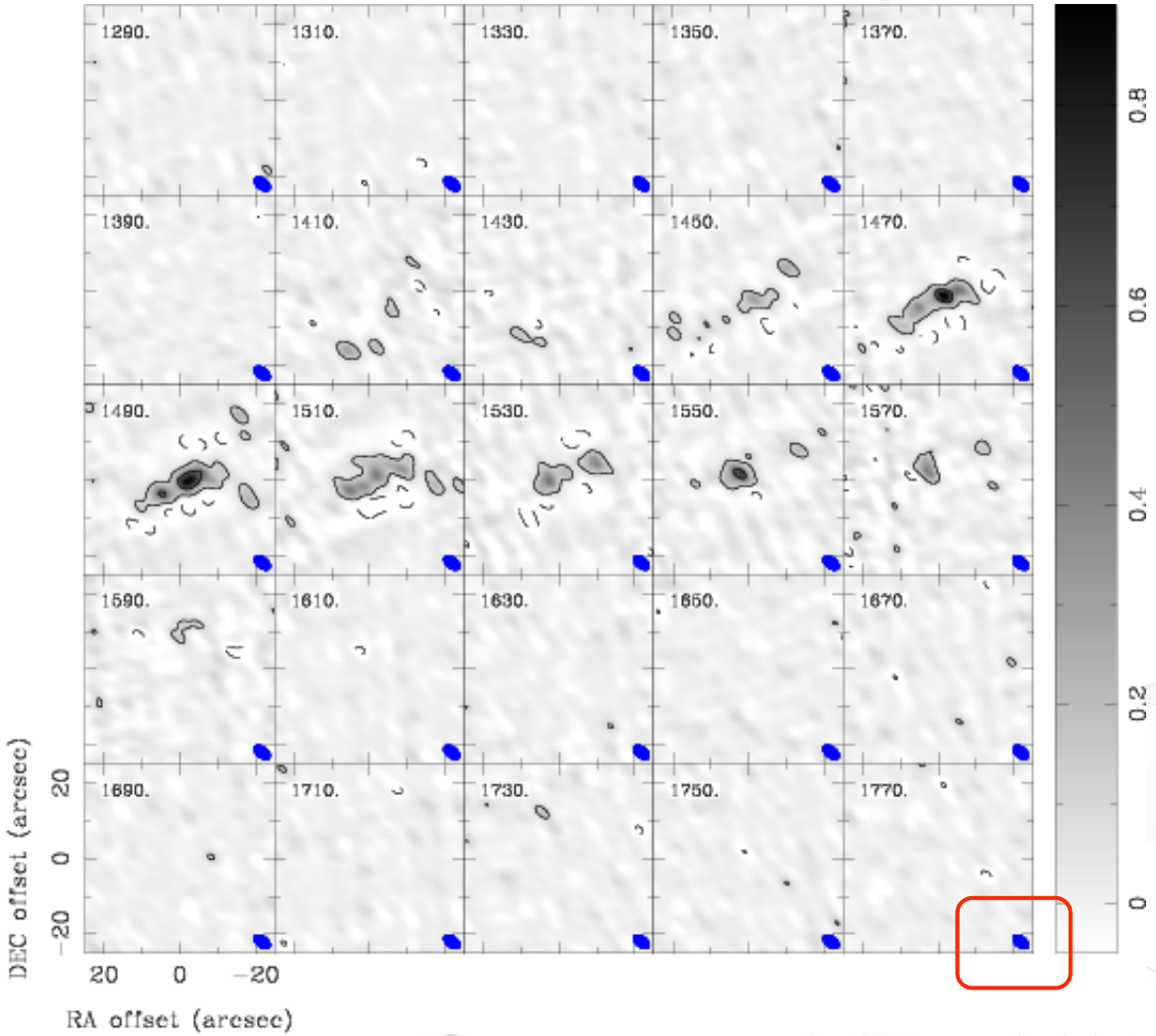


distrad: (download data)





Channel Map

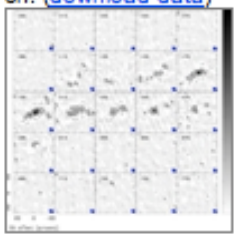
Char.VelocityAxis.Coverage.Support
Array of values

Derived datasets from velocity cubes

Images

12CO21

ch: (download data)



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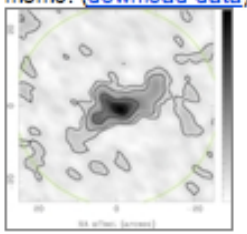

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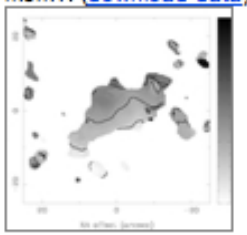

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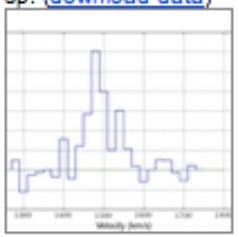

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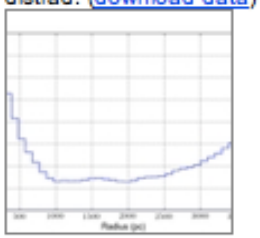
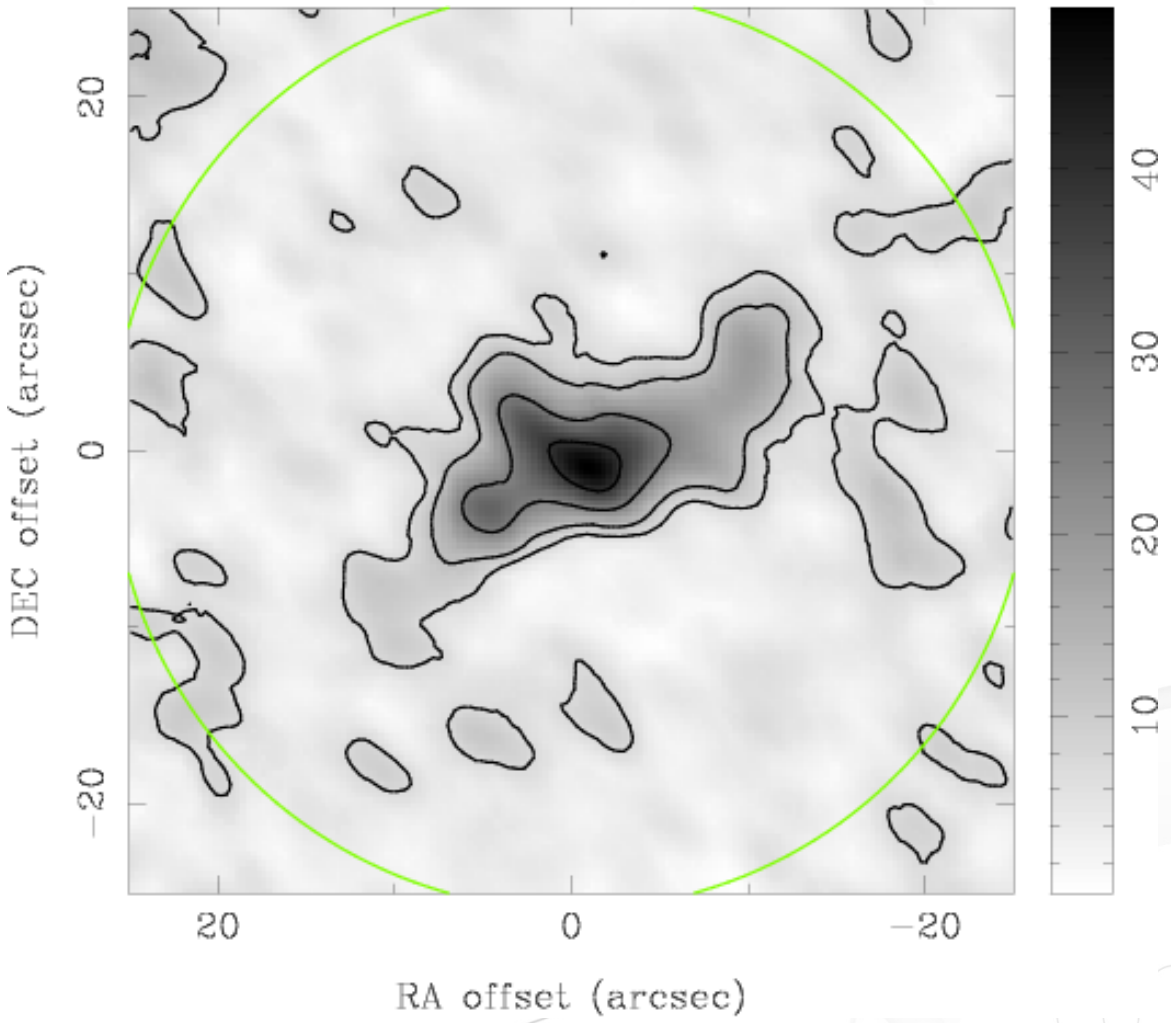




Integrated Flux Map

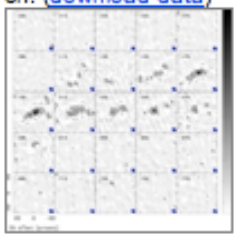
Char.VelocityAxis.Coverage.Bounds.Extent

Derived datasets from velocity cubes

Images

12CO21

ch: (download data)



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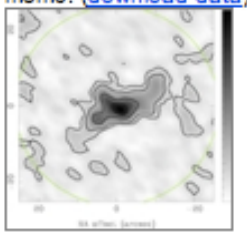
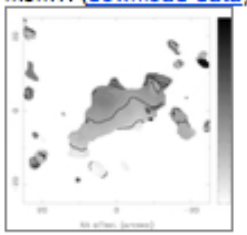
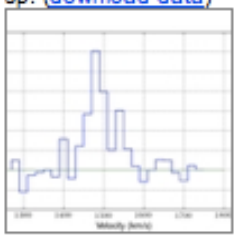


mom1: (download data)



sp: (download data)



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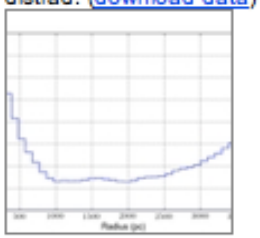
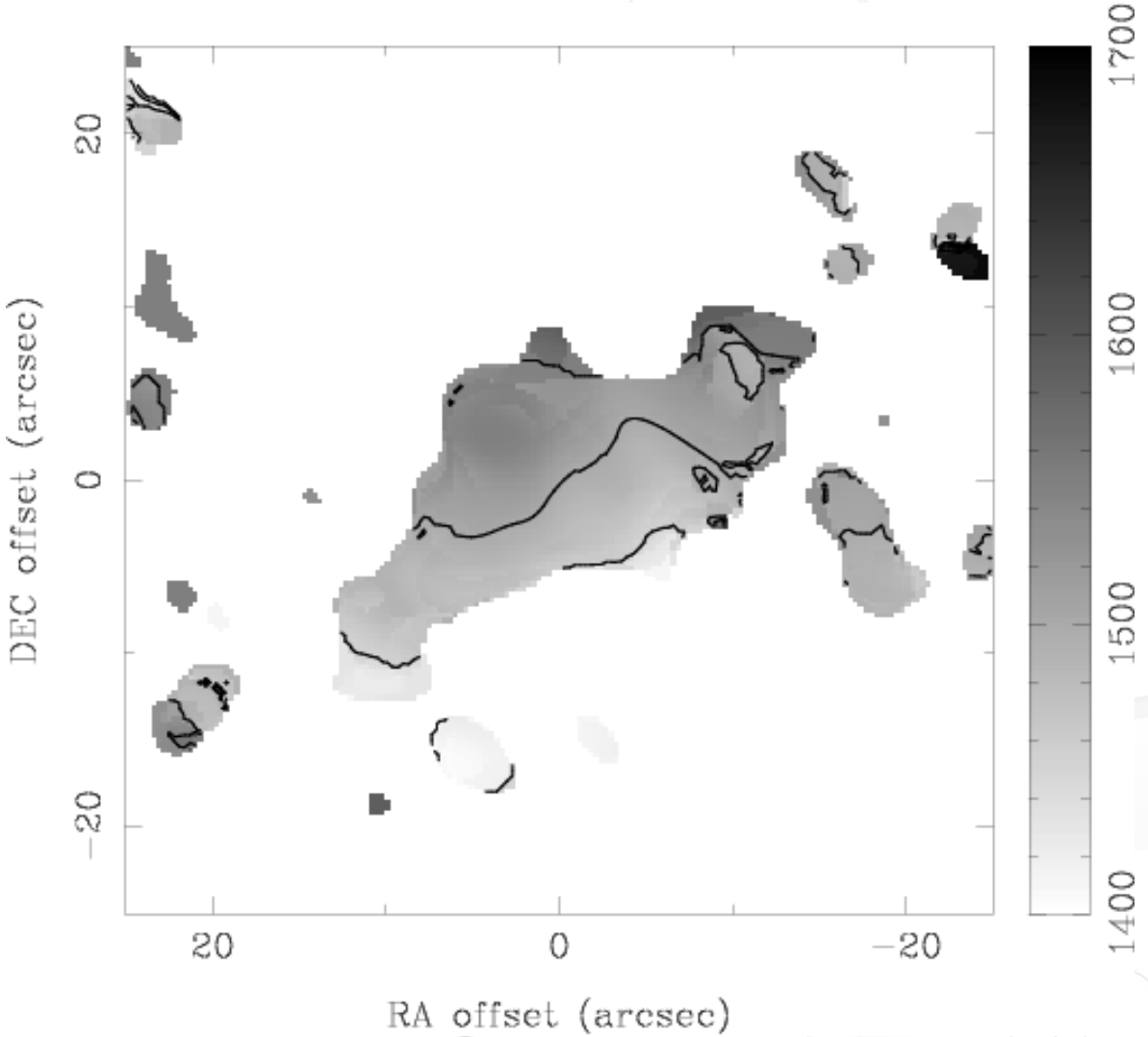




Velocity Map

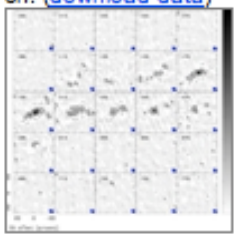
Char.VelocityAxis.Coverage.Bounds.Extent

Derived datasets from velocity cubes

Images

12CO21

ch: (download data)



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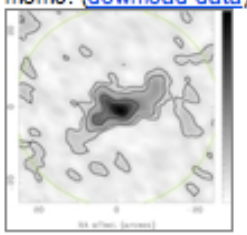

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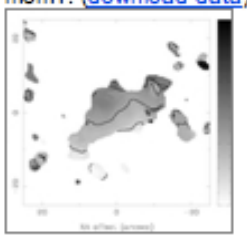

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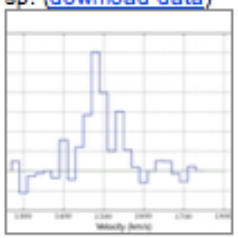
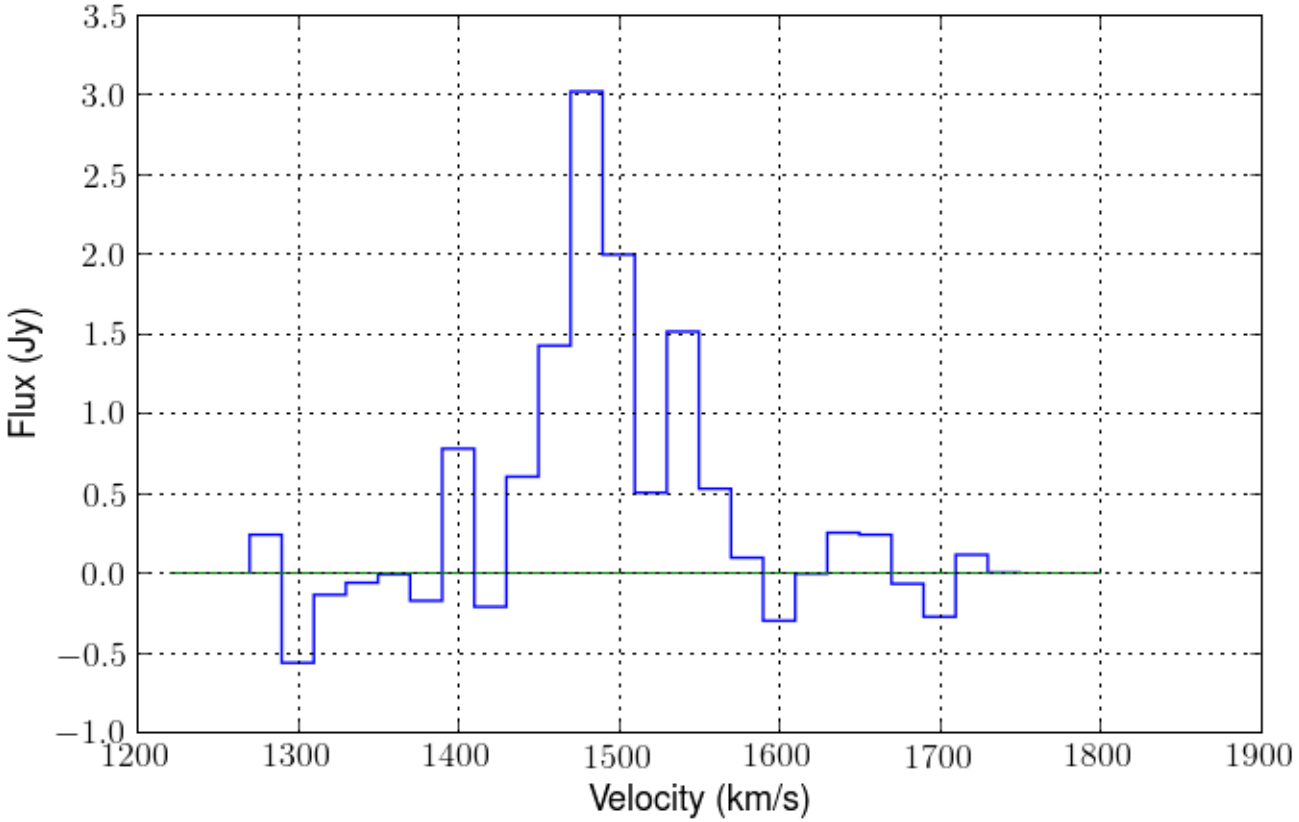


distrad: (download data)

Spectral Profile



Char.VelocityAxis.Coverage.Bounds.Extent

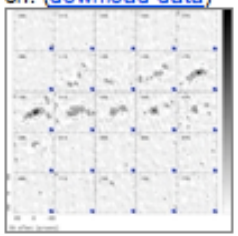
Char.SpatialAxis.Coverage.Support.Extent

Derived datasets from velocity cubes

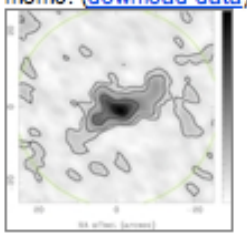
Images

12CO21

ch: (download data)



mom0: (download data)



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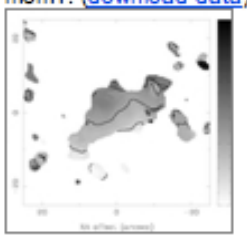
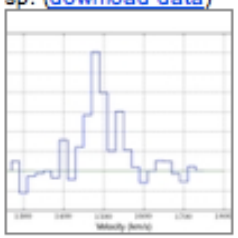
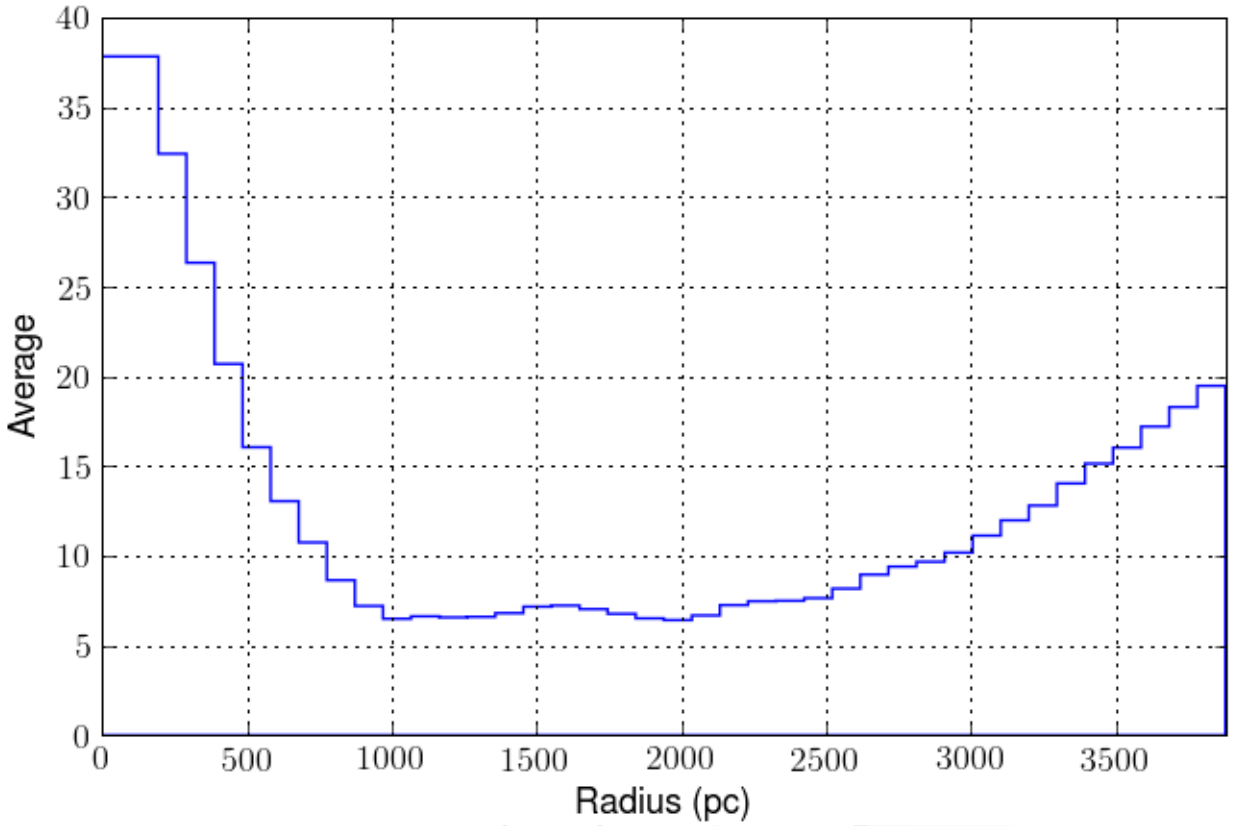


sp: (download data)



distrad: (download data)

Radial Profile



Char.VelocityAxis.Coverage.Bounds.Extent

Position angle, Length and Width of the radius of the galaxy

Other considerations

- 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				Polarization Axis Characterization
Char.PolarizationAxis.AxisName	meta.id	char	*	Name for polarization axis
Char.PolarizationAxis.Ucd	meta.ucd	char	*	UCD for polarization
Char.PolarizationAxis.Enumeration		char	*	List of available polarization parameters