# GUIpsy: a VO compliant tool for the kinematical modelling of HI datacubes

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Outline

- Context: AMIGA VO tools and services

- Kinematical modeling of 3D data
  → The Groningen Image Processing SYstem (GIPSY) method

- What is **GUI**psy?

- How does GUIpsy connect GIPSY to VO tools

- On-going work and next steps

AMIGA Group http://amiga.iaa.es/
Analysis of the interstellar Medium of Isolated Galaxies

- Specialists in galaxy environment

  - Multi-wavelength catalogue of ~1000 isolated galaxies

- 3D kinematical modelling: galaxy formation and evolution
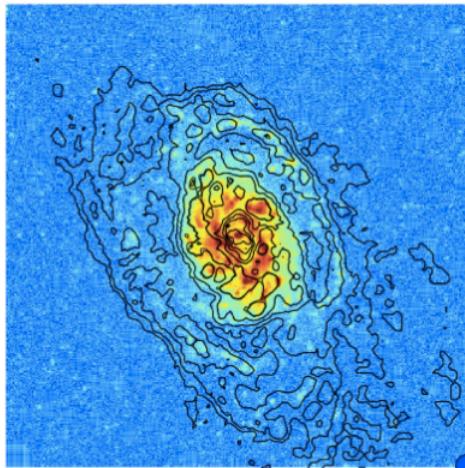
CIG96 Espada+. 2011
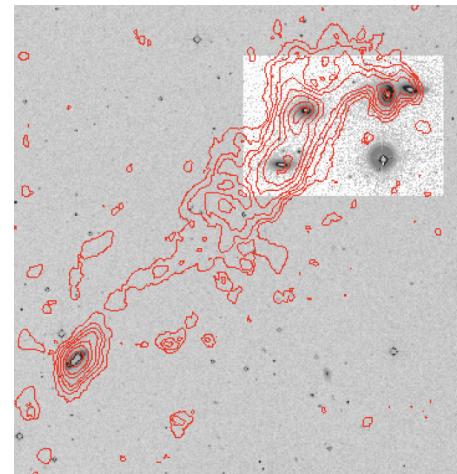
Hickson Compact Group 16
Verdes-Montenegro+. 2001

AMIGA VO developments for datacubes

- RADAMS: Radio Astronomy Data Model for Single-dish telescopes. Santander-Vela+ 2006

- TAPAS: a VO radio archive at the IRAM-30m telescope S. Leon+ 2012

- Prototype for datacube discovery and analysis. J.E. Ruiz 2014

- B0DEGA and WHISP datacubes collections as HIPS services

Prototype for datacube discovery and analysis

- Based on SIAv2, DataLink, AccessData

- Two Catalogues:

  - B0dega. 30 datacubes – submm - SMA

  - WHISP sample. 33 datacubes – HI 21 cm - WSRT

- Datacube metadata

- On the fly generated moment maps

- Cut-outs

- Spectral/radial profiles.

Reduce volume of data to be transferred

Kinematical modeling of 3D data

Groningen Image Processing System

van der Hulst et al. 1992, Vogelaar & Terlouw 2002

- Started in 1971, developed at the Kapteyn Astronomical Institute as Fortran program to process WSRT data

- Capable of handling any FITS data with a well defined WCS (includes ALMA MS converted to FITS)

One of the most mature and powerful systems to perform **kinematical analysis and modeling of 3D data**

GIPSY modeling method
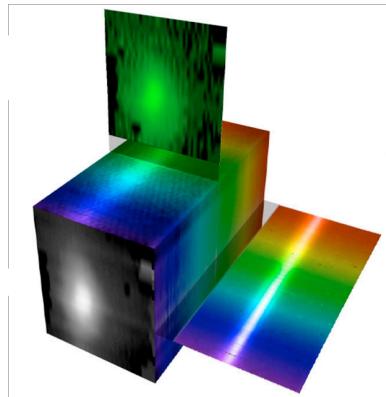
MOMENTS
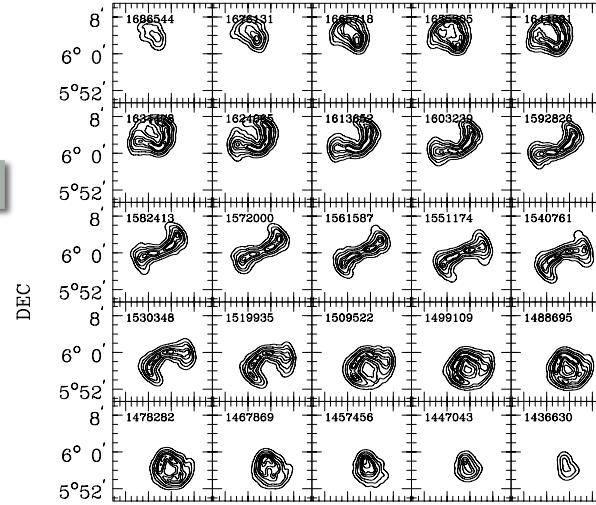
ROTCUR

GALMOD
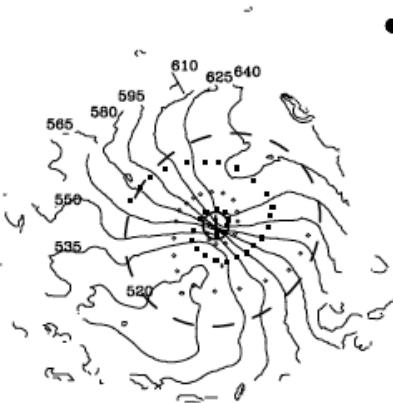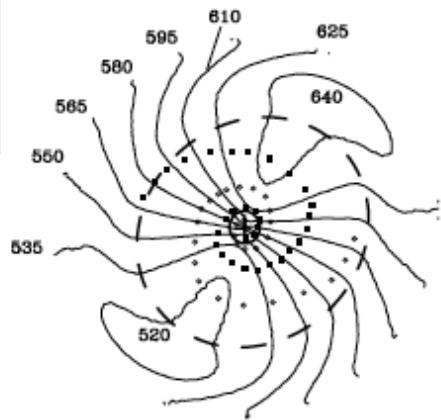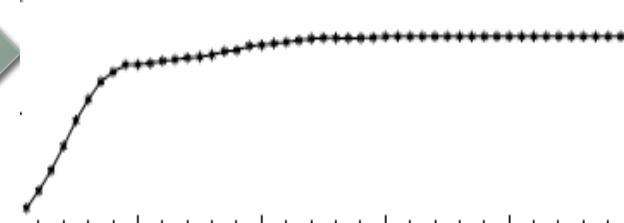
Example: Rotcur

RADII= Give central radii of concentric rings. Maximum number of rings is 512. Units are arcsec.

WIDTHS= Give width of rings. If number of widths is less than the number of radii, the last supplied width will be used for the rest of the rings. Units are arcsec.

VSYS= Give initial estimate(s) of systemic velocity(ies) in km/s. If the number of systemic velocities is less than the number of rings, the last supplied systemic velocity will be used for the rest of the rings.

VROT= Initial estimate(s) rotation velocity(ies) in km/s. If the number of rotation velocities is less than the number of rings, the last supplied rotation velocity will be used for the rest of the rings.

VEXP= Initial estimate(s) expansion velocity(ies) in km/s [0.0]. If the number of expansion velocities is less than the number of rings, the last supplied expansion velocity will be used for the rest of the rings.

PA= Initial estimate(s) position angle(s) in degrees. If the number of position angles is less than the number of rings, the last supplied position angle will be used for the rest of the rings.

INCL= Initial estimate(s) inclination(s) in degrees. If the number of inclinations is less than the number of rings, the last supplied inclination will be used for the rest of the rings.

CENTRE= Initial estimates of centre of rotation in any coordinates.

SIDE= Which half of the velocity field should be used in the fitting [RECEDING and APPROACHING half].

FREEANGLE= Angle around minor axis in degrees within which radial velocities are discarded.

WEIGHT= There are three weighting functions available: the UNIFORM weighting function, were all points in a ring have equal weights, the [COSINE] weighting function, were each point in a ring is weighted with |cos(theta)|, and the COS-SQUARED weighting function, were each point is weighted with cos(theta)^2.

FIXED= Which parameter(s) should be kept fixed [NONE]. The parameters are named VSYS, VROT, VEXP, PA, INCL, XPOS and YPOS. If you don't want to fit the inclination and the systemic velocity, you should type: INCL VSYS. If a fit is wanted to only one half of the velocity field the param. VSYS, XPOS and YPOS are automatically kept fixed.
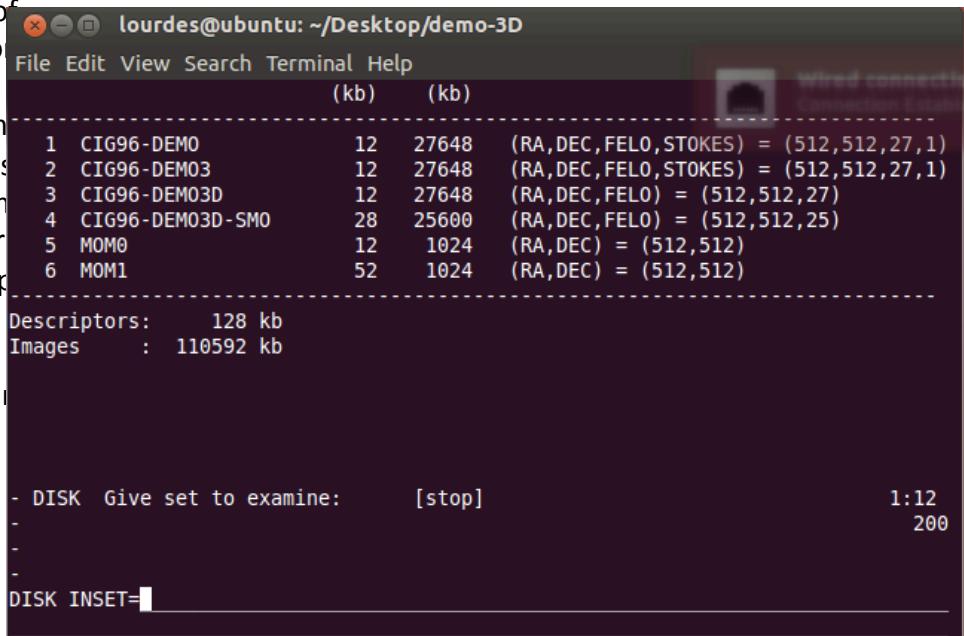
```
●●● lourdes@ubuntu: ~/Desktop/demo-3D
File  Edit  View  Search  Terminal  Help
                 (kb)     (kb)
------------------------------------------------------------
  1  CIG96-DEMO0        12    27648    (RA,DEC,FELO,STOKES) = (512,512,27,1)
  2  CIG96-DEMO3        12    27648    (RA,DEC,FELO,STOKES) = (512,512,27,1)
  3  CIG96-DEMO3D       12    27648    (RA,DEC,FELO) = (512,512,27)
  4  CIG96-DEMO3D-SMO   28    25600    (RA,DEC,FELO) = (512,512,25)
  5  MOM0               12     1024    (RA,DEC) = (512,512)
  6  MOM1               52     1024    (RA,DEC) = (512,512)
------------------------------------------------------------
Descriptors:    128 kb
Images    :  110592 kb



- DISK  Give set to examine:     [stop]                              1:12
-                                                                     200
-
-
-
DISK INSET=
```

What is GUIpsy?

Collaboration between
- AMIGA group
- Kapteyn Astronomical Institute

Focus on:
- Interfaces, documentation
- Connection with VO
- Analysis tasks for modeling: tilted ring model

Facilitate to novel users the kinematical modeling of galaxies

Easy access to tasks and documentation
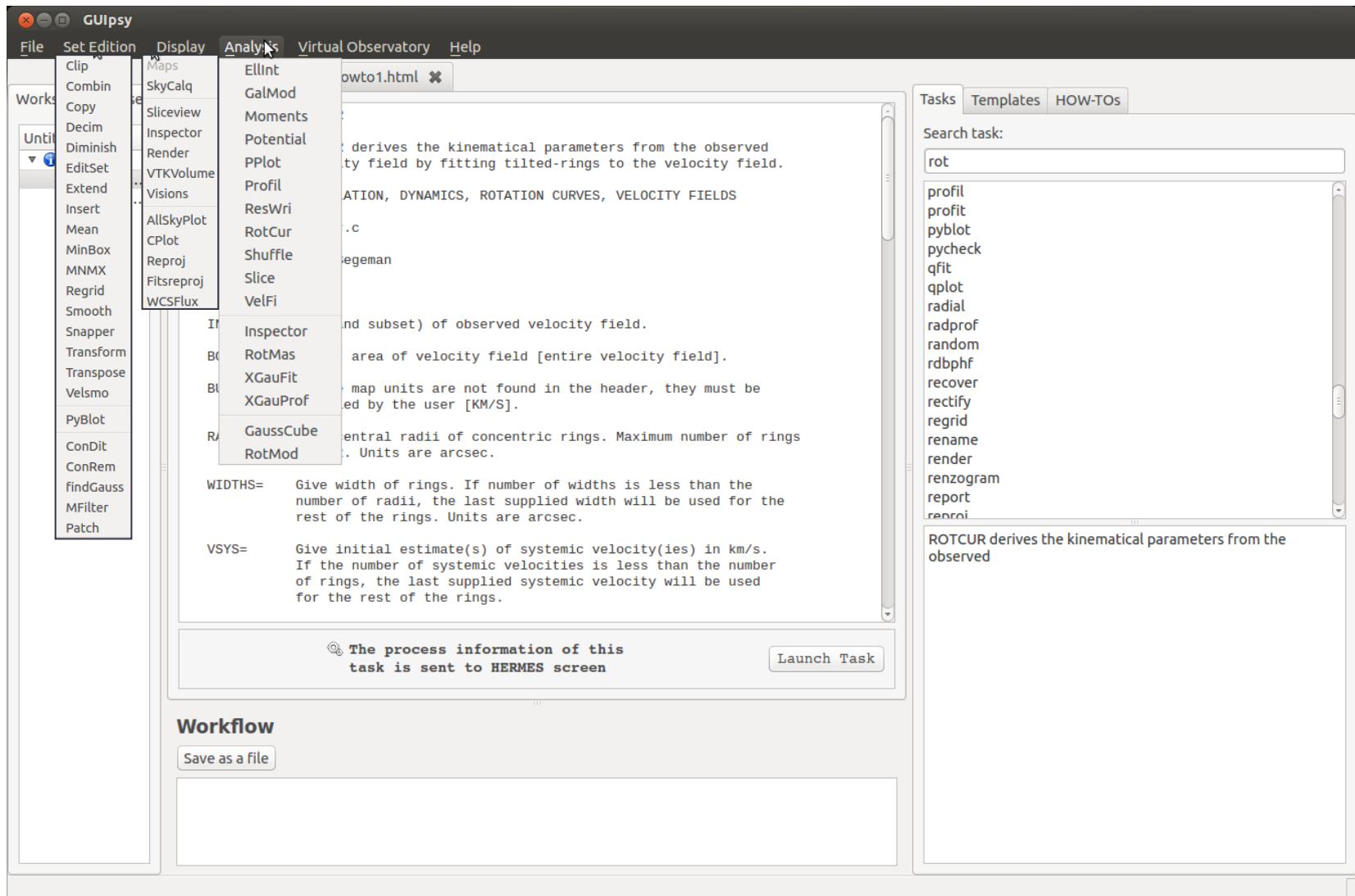
Supported formats
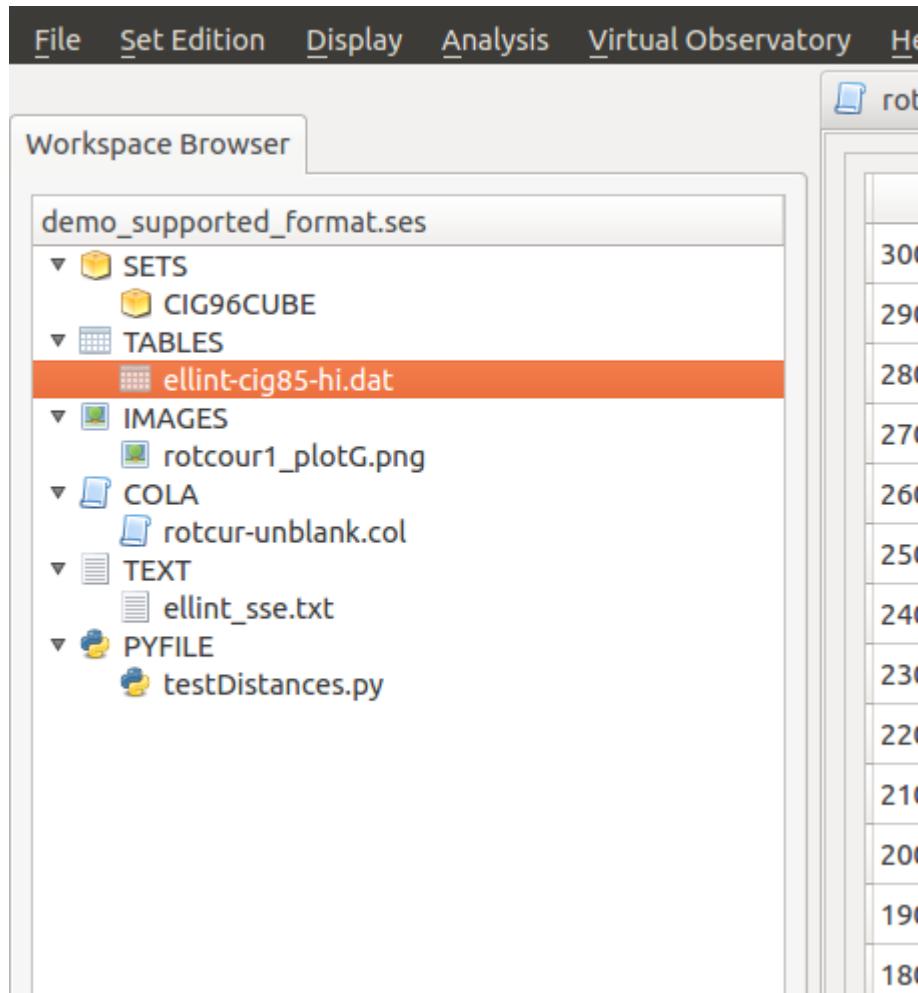
FITS (ALMA MS converted to FITS) GIPSY Data Sets

VOTables and ASCII Tables

Images JPEG, JPG, PNG, BMP

COLA scripts

Text files

Python scripts

Session mode

Workspace Browser

cig96.ses
- ▼ 📁 SETS
  - ▼ 📁 CIG96ROBCONV
    - 📦 CIG96CUBE

📦 CIG96ROBCONV ✖   📦 CIG96CUBE ✖

Set Properties

```
Set: /home/sse/Documents/guipsy/CIG96CUB
Observer: AV276              Obs. date: 20
Obs. type: ****              Instrument: V
Projection centre:          (Epoch: 2000.
RA              :      33.86500000 DEGREE
DEC             :       6.00250000 DEGREE
FELO-HEL        : 1572000.00000000 M/S
Axis length and range:
RA              :      512   [-255, 256]
DEC             :      512   [-256, 255]
FELO-HEL        :       26   [-11, 14]
Grid spacing:
RA              : -0.002778 DEGREE = -10.000000 arcsec
DEC             : +0.002778 DEGREE = +10.000000 arcsec
FELO-HEL        : -10413.066410
Data range = [-0.00340993,0.117426 ] (JY/BEAM)  Number of blanks not in header

**************************************************************************

****** AXIS INFORMATION for set: /home/sse/Documents/guipsy/CIG96CUBE

(1) Axis: RA   SIN  has length 512 and
```

Send associated fits to SAMP

Set Comments

Keep the relation among the sets created in a session work grasping the **PROVENANCE** of the process

Keep track in EDITABLE Python script-log of all the steps you performed in order to be able to reproduce it

Workflow

Save as a file

```
CIG96ROBCONV0 = gipsy.Set("/home/sse/Documents/guipsy/CIG96ROBCONV", create=False, write=True, gethdu=None, getalt=None)

gipsy.xeq("DIMINISH INSET=/home/sse/Documents/guipsy/CIG96ROBCONV STOKES BOX= -255 -256 -11 256 255 14
OUTSET=/home/sse/Documents/guipsy/CIG96CUBE MAKEBLANK= OKAY=Y")

CIG96CUBE0 = gipsy.Set("/home/sse/Documents/guipsy/CIG96CUBE", create=False, write=True, gethdu=None, getalt=None)
```

How GUIpsy connects GIPSY to VO tools

→ Send the datacube, moment maps, tables to your favourite
  visualisation tool
   → It improves the data visualisation
   → It allows multi-wavelength datasets comparisons

→ Convert measurement set tables to VOTables

→ Get input data for the GIPSY tasks from the VO archives.

On-going work

- Sampy → astropy.vo.samp
- New documentation and HOW-TOs

- GUIpsy is distributed together with GIPSY
  - As you install GIPSY you will install GUIpsy
  - GUIpsy source code in github.
    - https://github.com/susanasanchez/GUIPSY

e-mail:sse@iaa.es

http://amiga.iaa.es/p/163-gipsy-upgrade-survey.htm