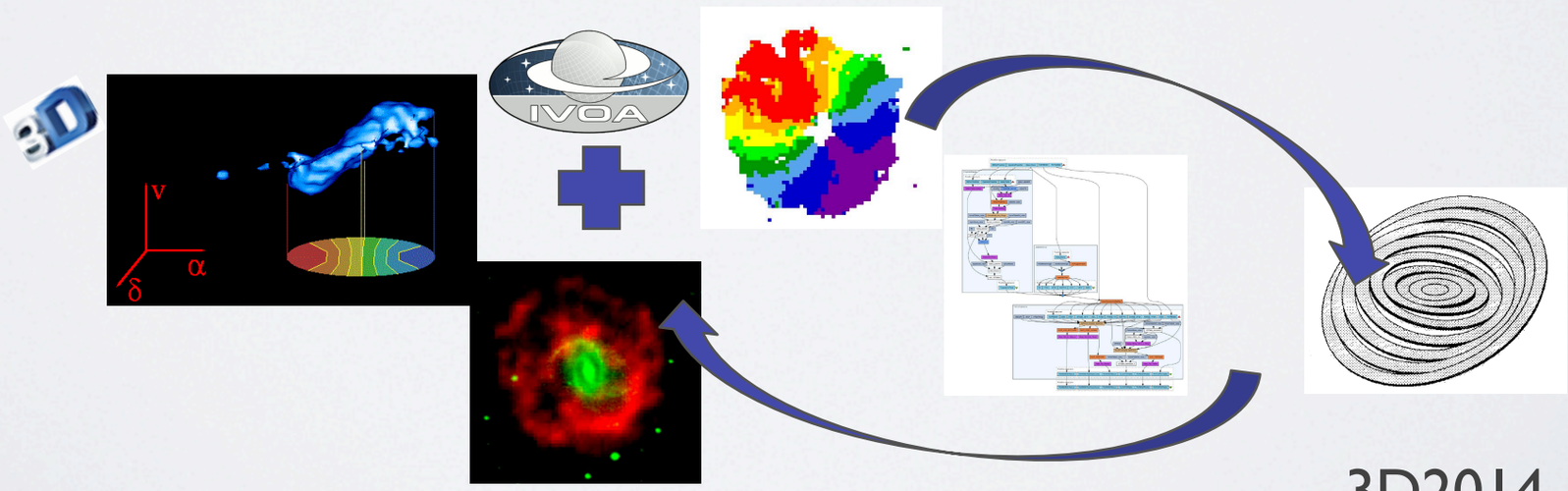
GUIpsy

A Virtual Observatory compliant tool for the kinematical modelling of HI datacubes

S. Sánchez, S., Ruiz, J.E., Vogelaar, M.G.R, Terlouw, J.P., **Verdes-Montenegro, L.**, Santander-Vela, J.D., van der Hulst, J.M, Garrido, J

Instituto de Astrofísica de Andalucía (Granada, CSIC)
University of Groningen - Kapteyn Astronomical Institute



3D2014, Garching

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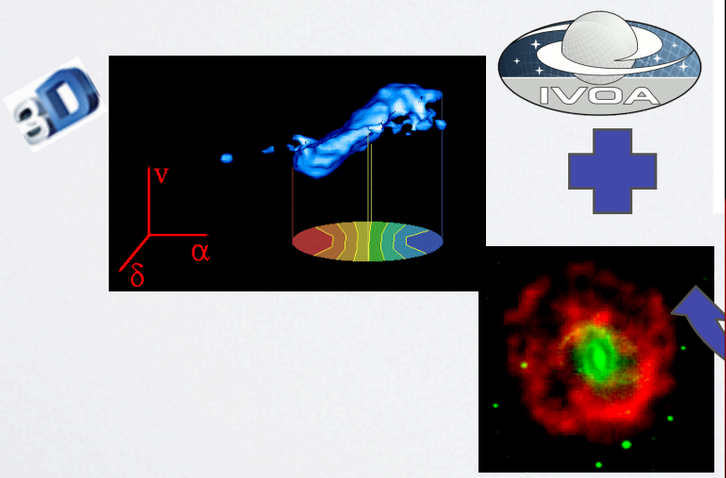
But I am not Susana Sanchez...!!! de A

University of Groningen - Ka



What is GIPSY?

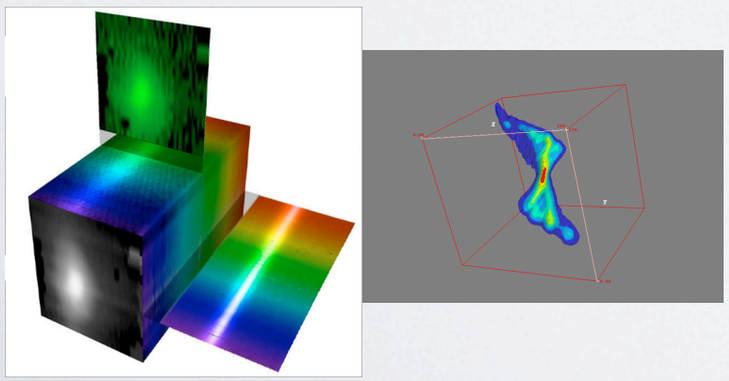
https://www.astro.rug.nl/~gipsy/

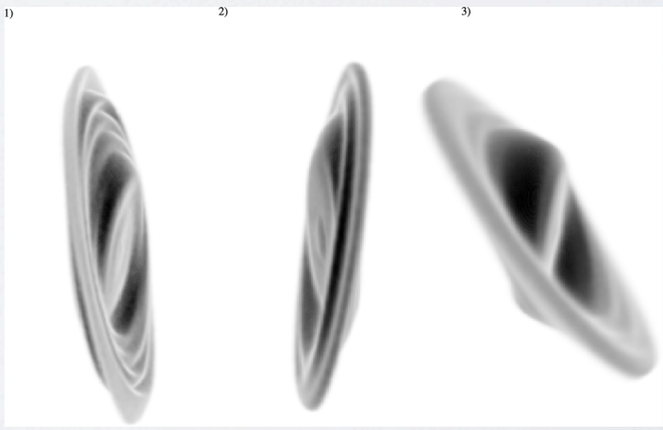
- GIPSY = Groningen Image Processing System (e.g. van der Hulst et al. 1992, Vogelaar & Terlouw 2002)

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

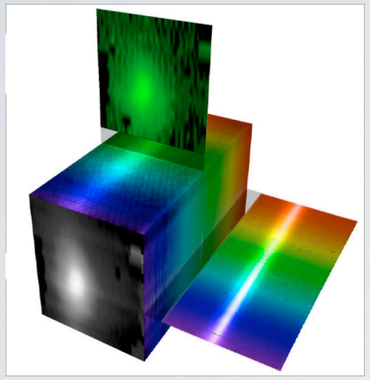
- Capable of handling any FITS data with a well defined WCS (includes ALMA MS converted to FITS)

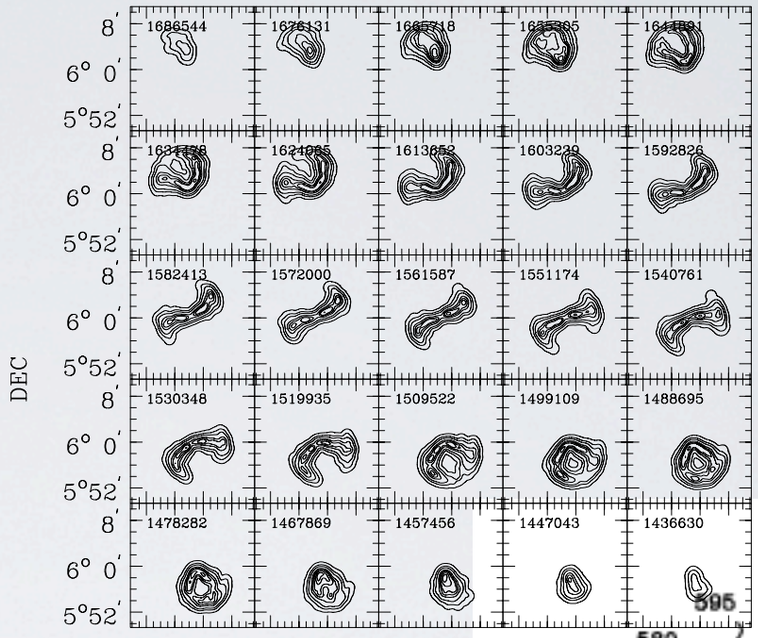
One of the more mature and powerful systems to perform **kinematical analysis and modeling of 3D data**

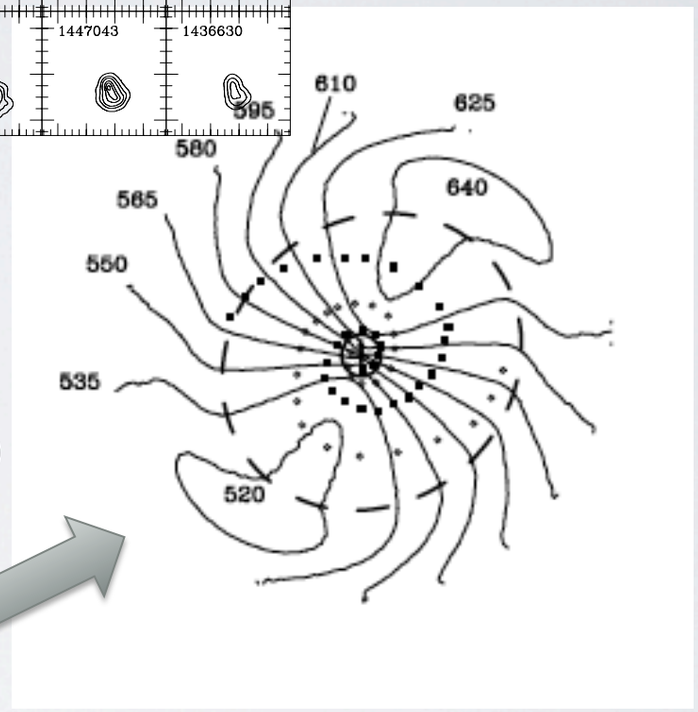




GIPSY modeling method

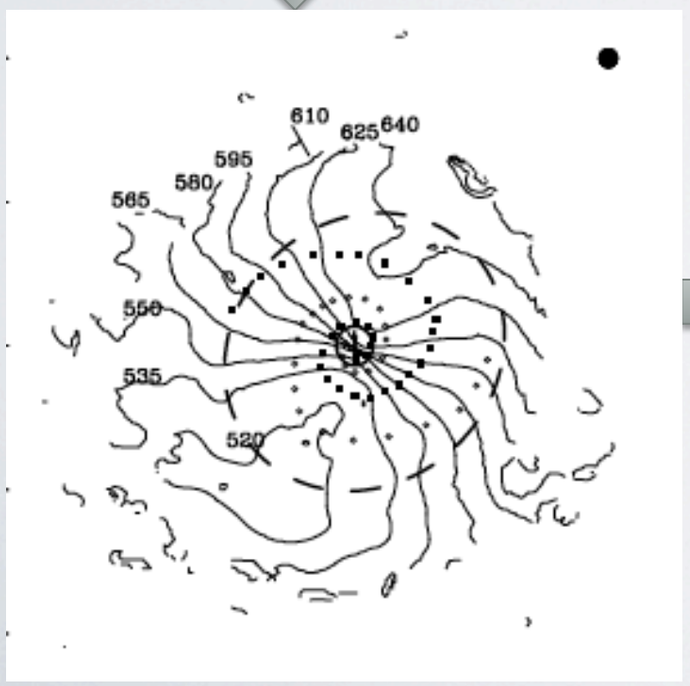




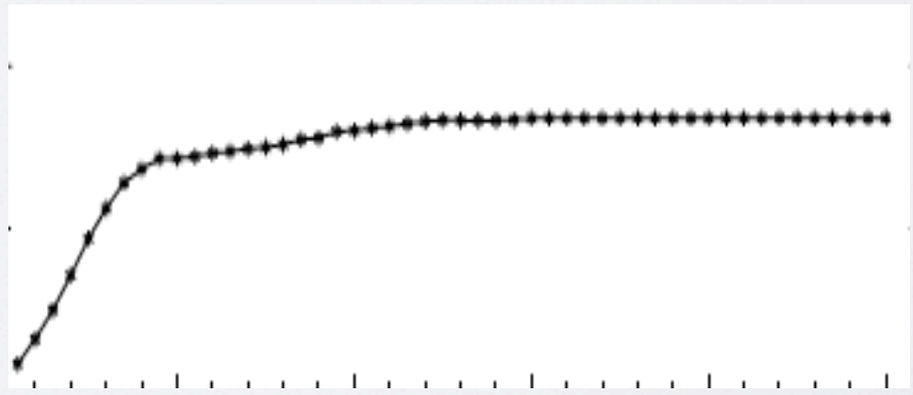


GALMOD

MOMENTS



ROTCUR



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.

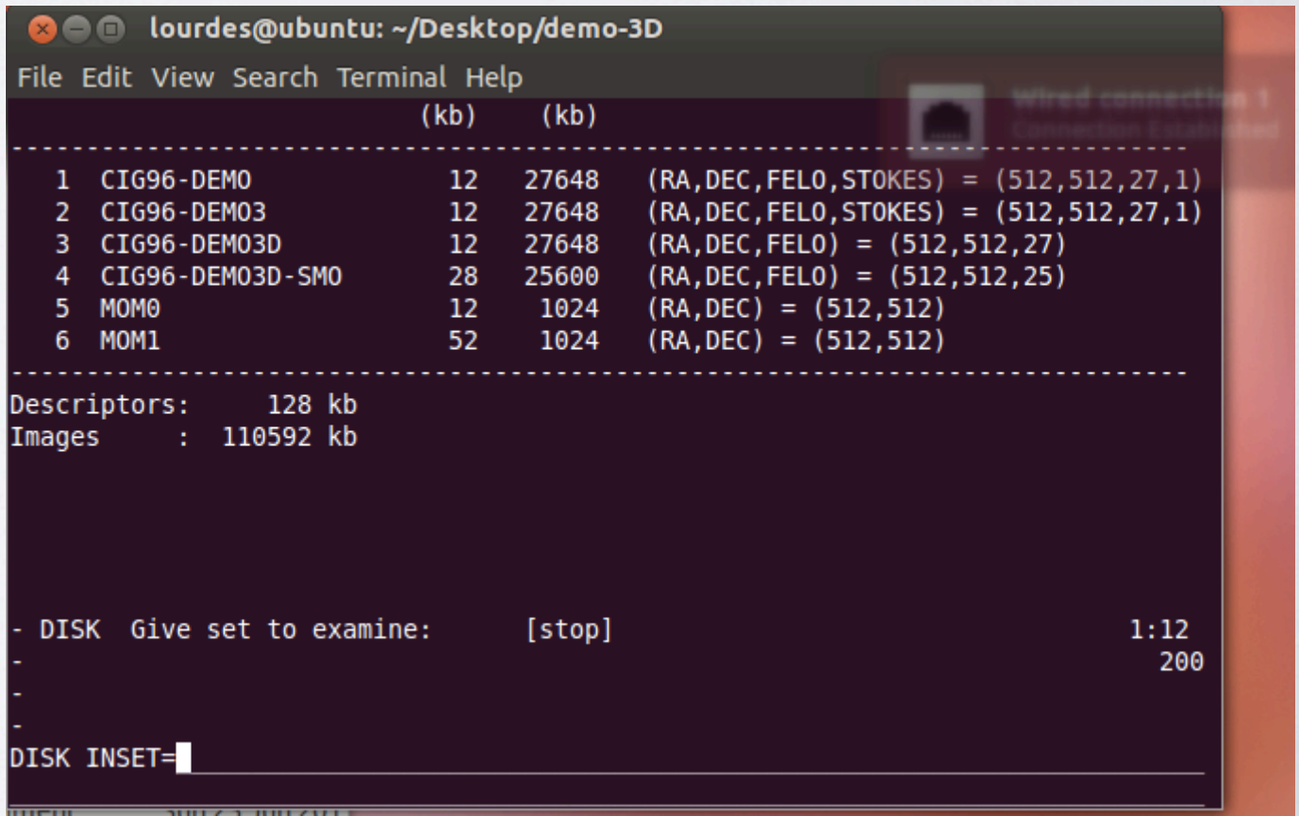
CENTRE= Initial estimates of centre of rotation in any coordinates.

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

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

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 parameters VSYS, XPOS and YPOS are automatically kept fixed.



What is **GUI**PSY?

GIPSY upgrade

Kapteyn Institute

RuG Rijksuniversiteit Groningen Department of Astronomy

INSTITUTO de ASTROFISICA de ANDALUCIA CSIC I·A·A

CSIC

Collaboration between

- AMIGA group* http://amiga.iaa.es/
- Kapteyn Astronomical Institute

Diffused to 3D2008 list in 2010

Links to Gipsy Survey

Please click one of the options below:

- **GIPSY users** **27**
- **3D data users non familiar with GIPSY** **61**

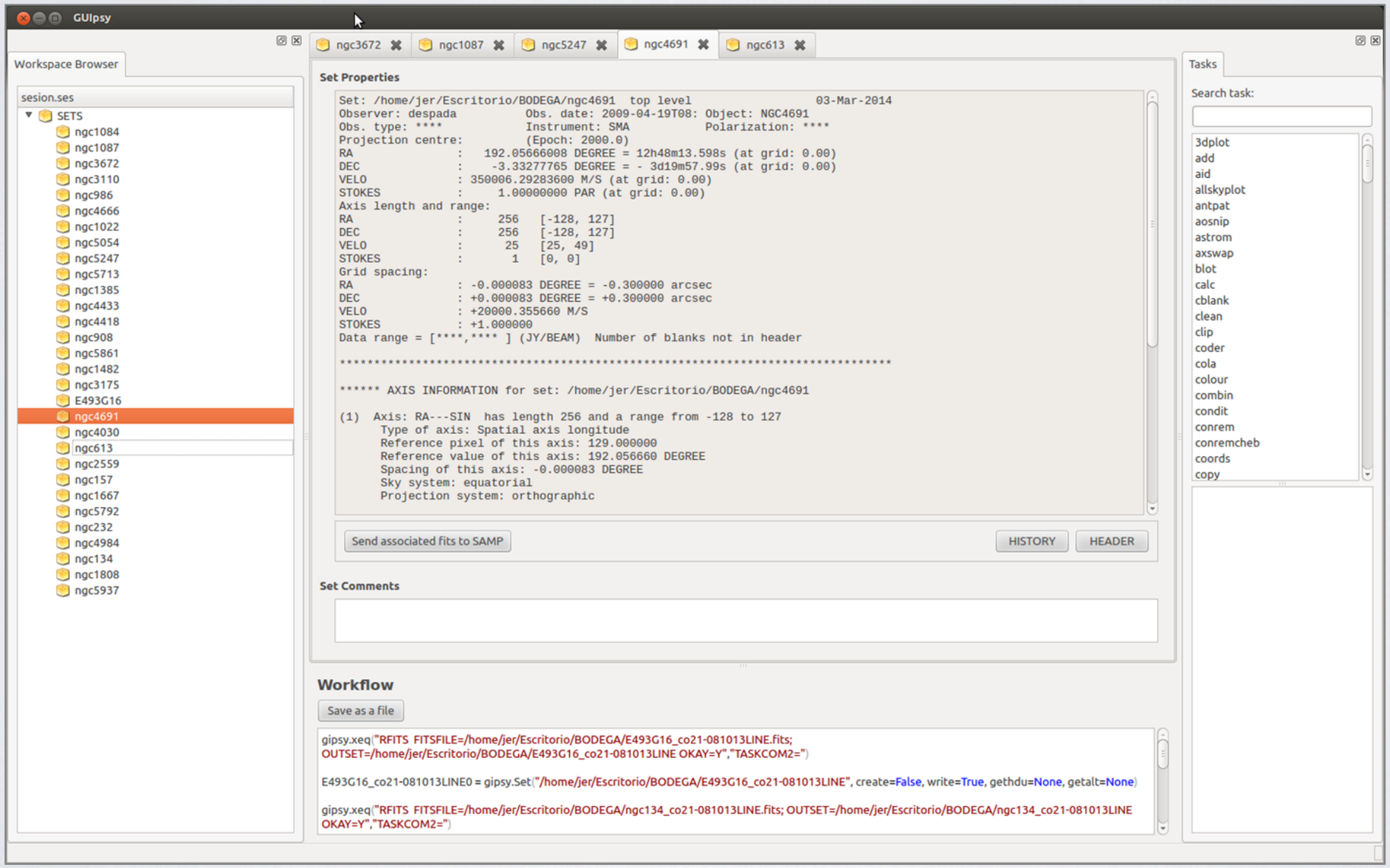
Focus on:

- Interfaces, documentation
- Connection with Python, with VO (Aladin)
- Analysis tasks for modeling: tilted ring model

*Supported by Grants AYA2008-06181-C02, AYA2011-30491-C02-01 and P08-FQM-4205

Friendly interface

- Easy discovery of needed task
- Easy access to documentation



Supported formats

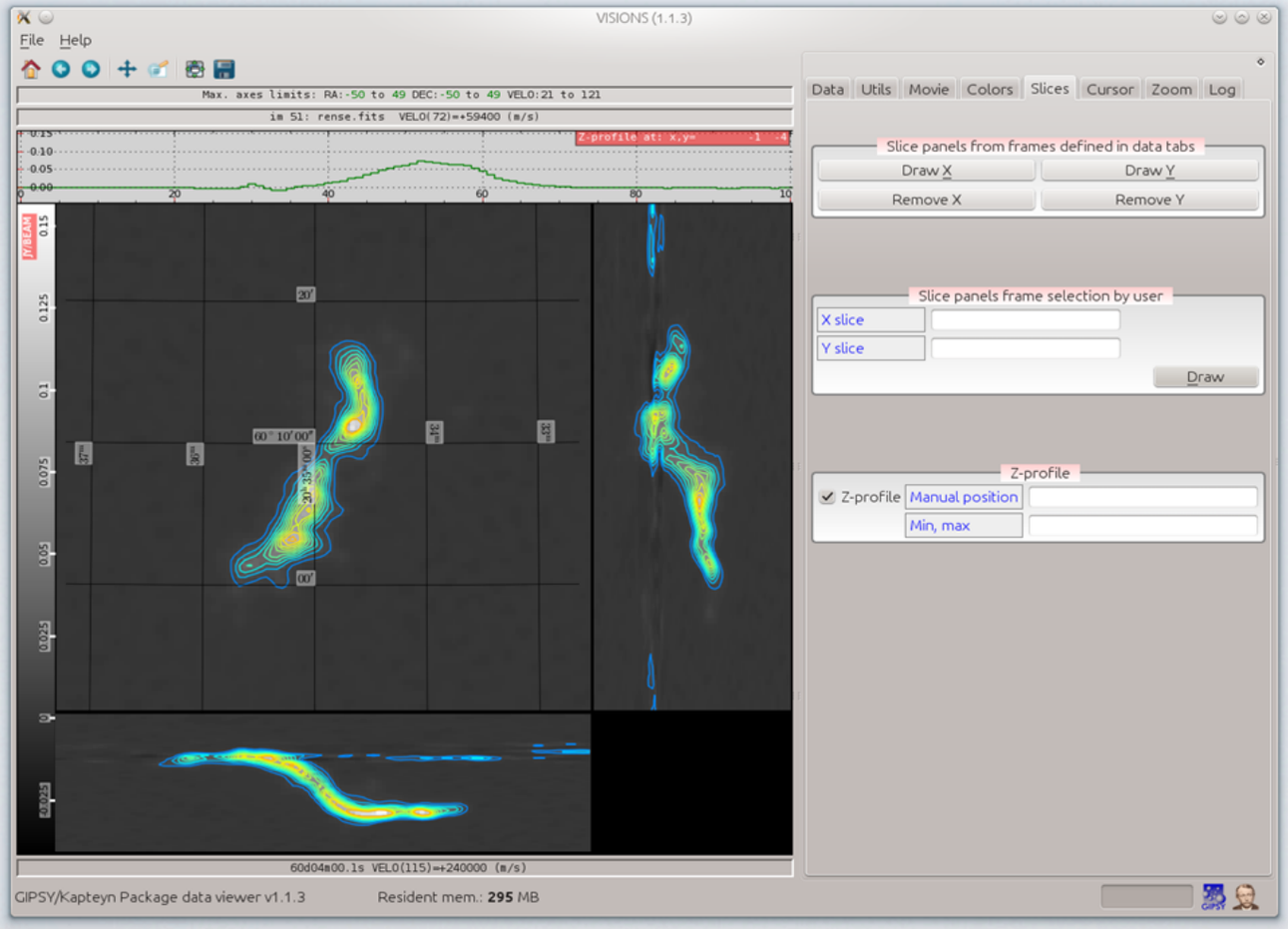
- FITS (ALMA MS converted to FITS)
- Gipsy Data Sets
- VOTables and ASCII Tables
- Python and COLA scripts
- Images JPEG, JPG, PNG, BMP, etc..
- Text Files

Session mode

- Recover your work session at the same point you left it (files and documents opened).
- Keep track in EDITABLE Python script-log of all the steps you performed in order you can reproduce it
- Keep the relation among the sets created in a session work grasping the PROVENANCE of the process

VISIONS: visualization tool for N-dimensional data

- Slices, movie loops and animations can be saved to disk.
- Multiple data cubes for comparison
- Powerful system for coordinate transformations



Connection with Virtual Observatory tools

- Available to a LARGER SCIENTIFIC USER BASE than the specialized radio astronomy community

- Send the data cubes, the moment maps, set tables, etc to your favourite visualisation tool

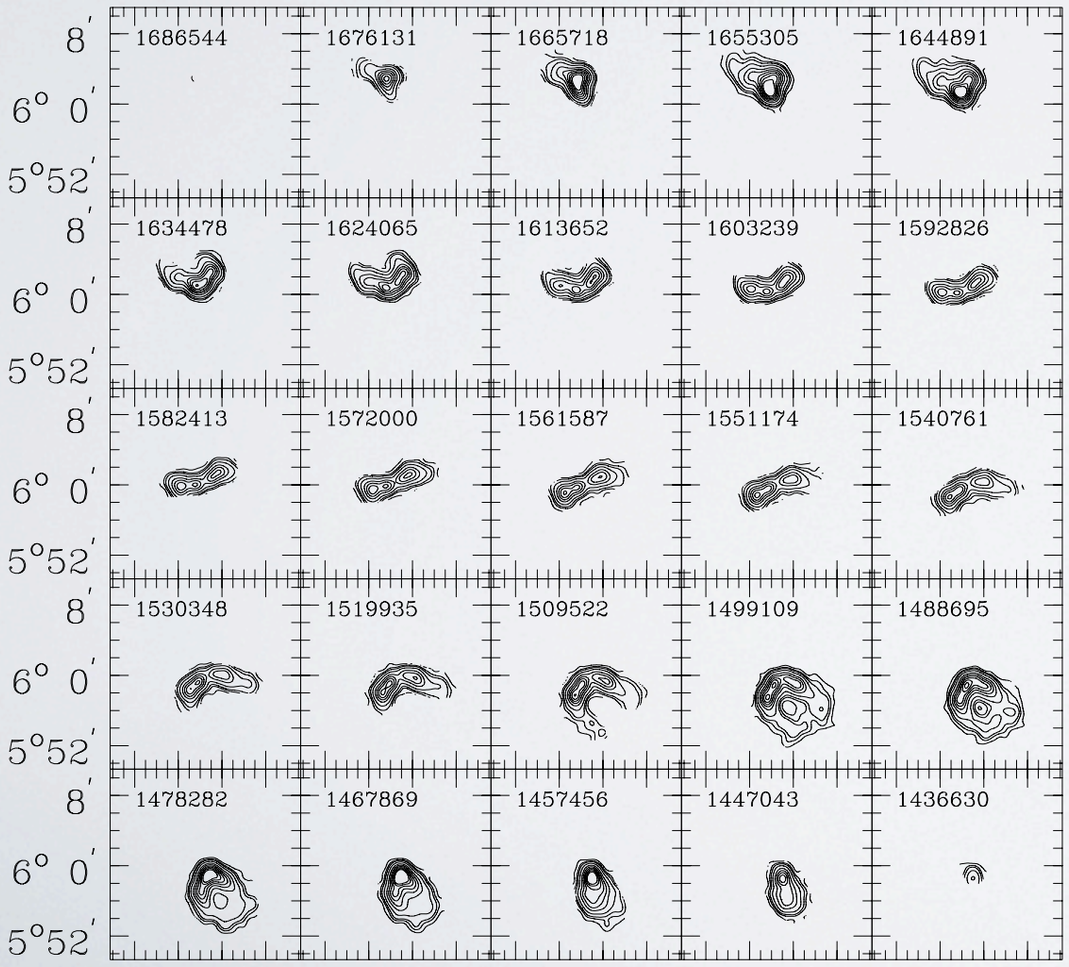
- Contributes to and benefit from the growing ecosystem of VO software, services and data.

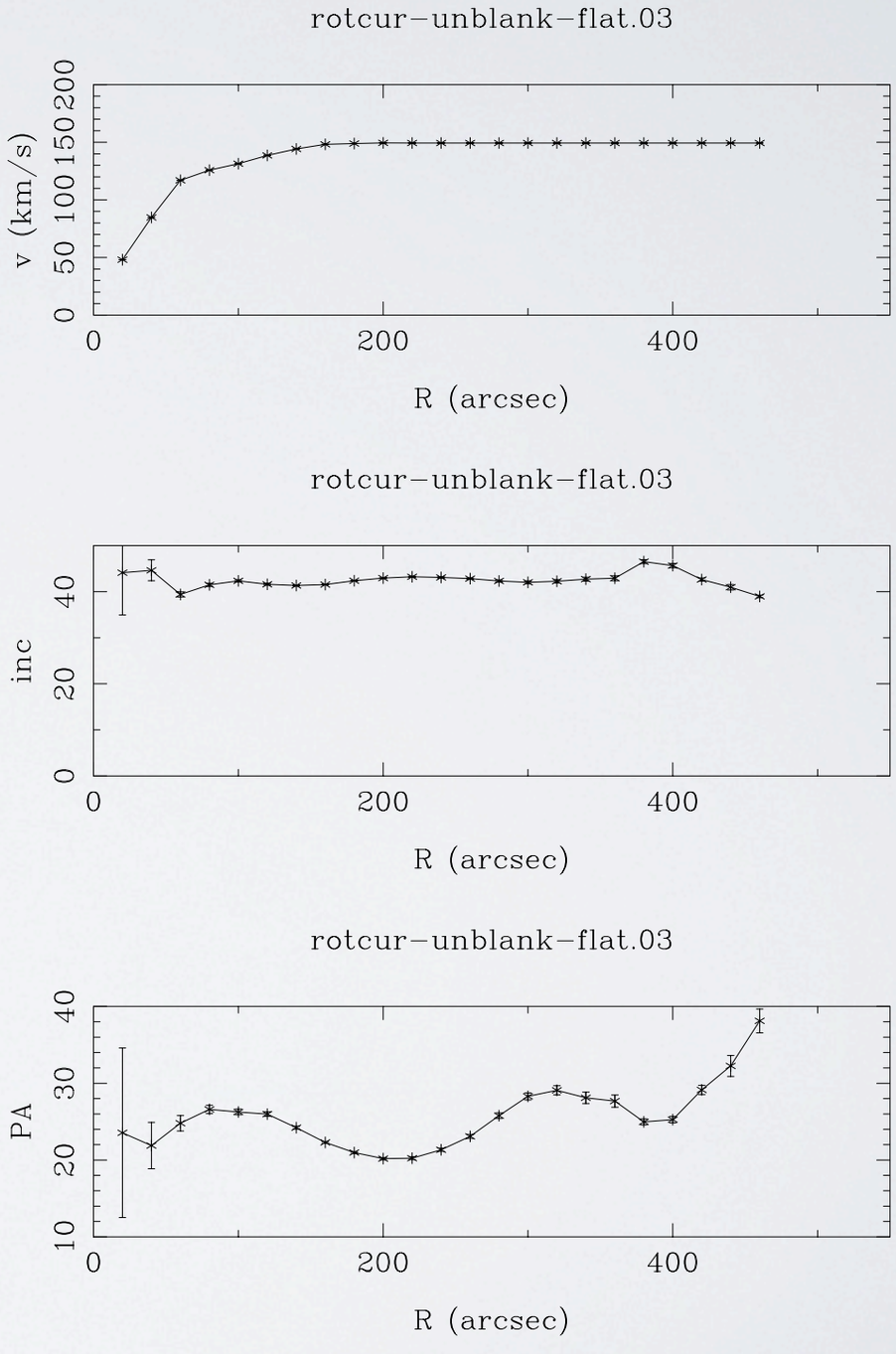
- Get input data for the GIPSY tasks from the VO archives

- Multi-wavelength datasets comparisons

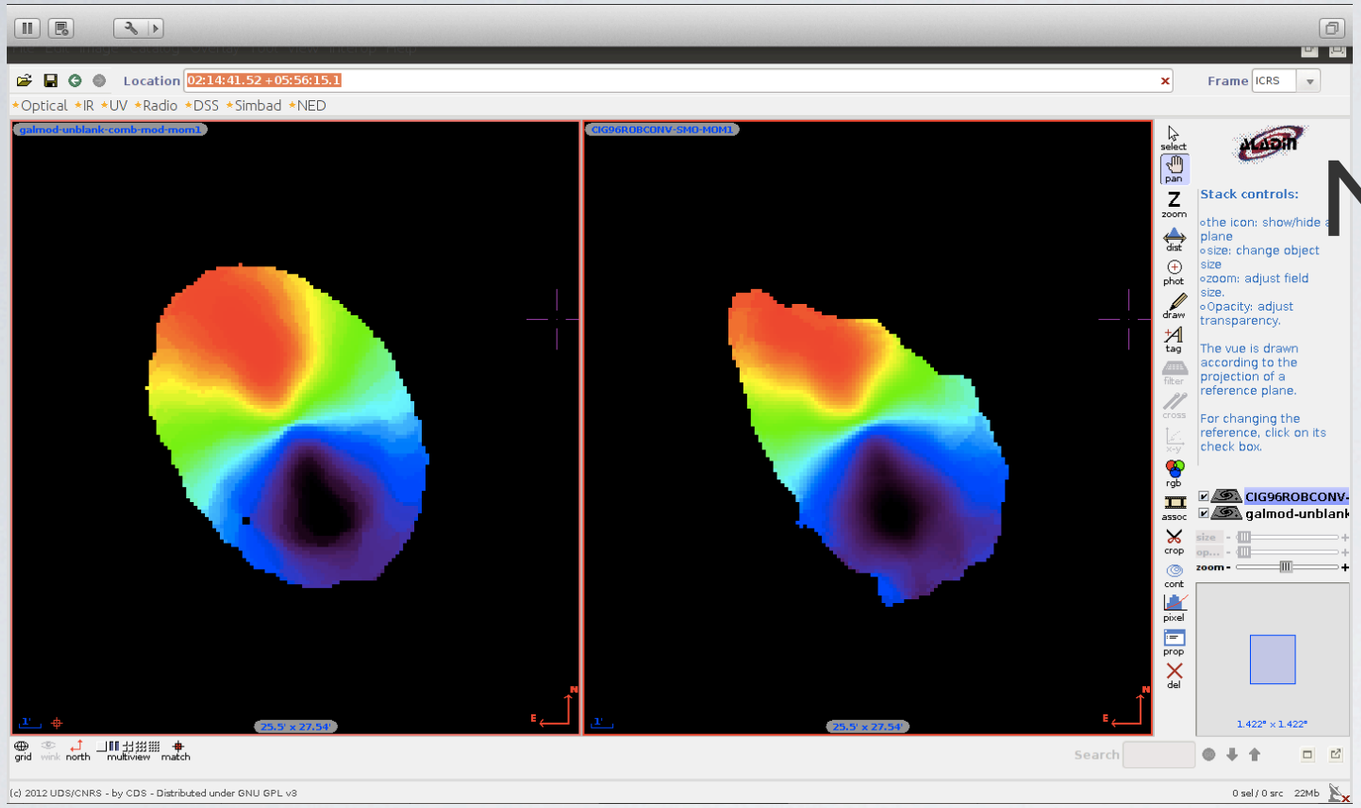
- At some point **VO should provide kinematical models as VO tables**…!

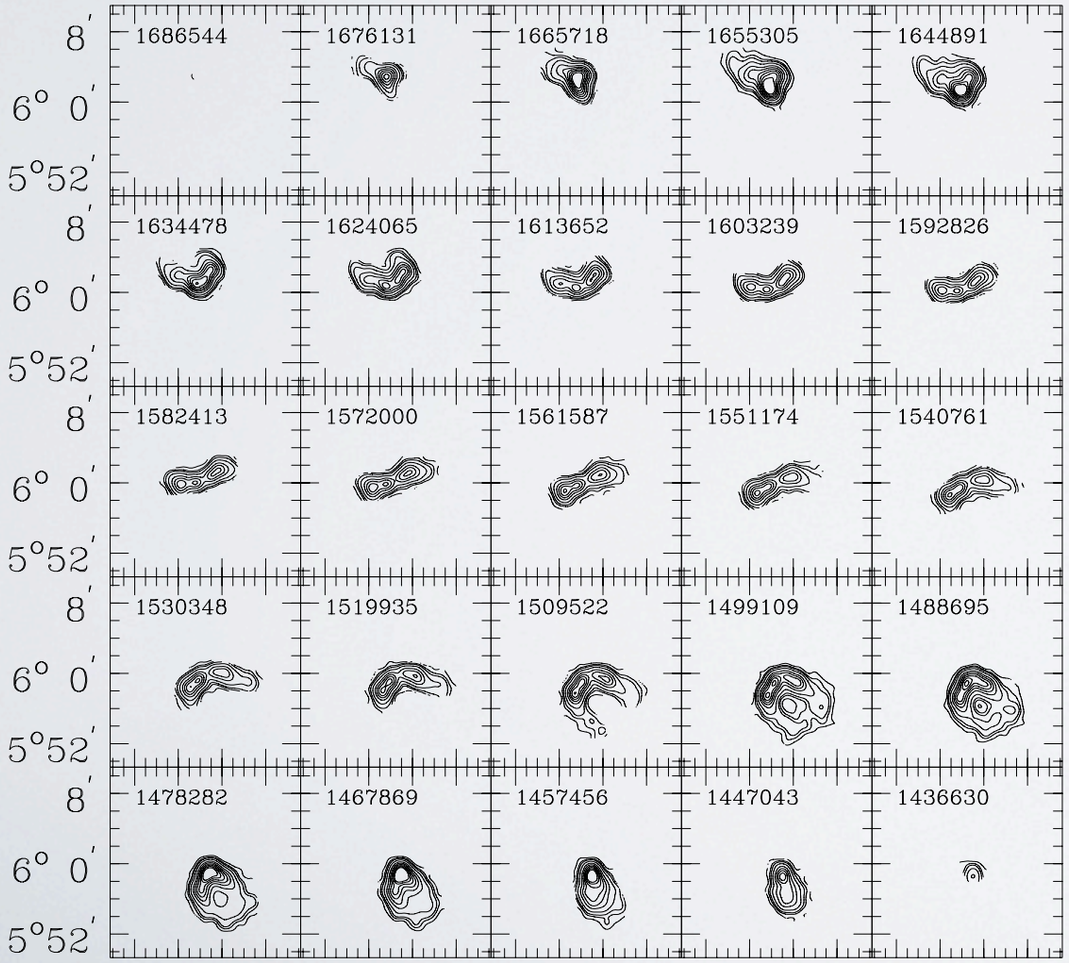
Evaluation of results: Moments +channel maps

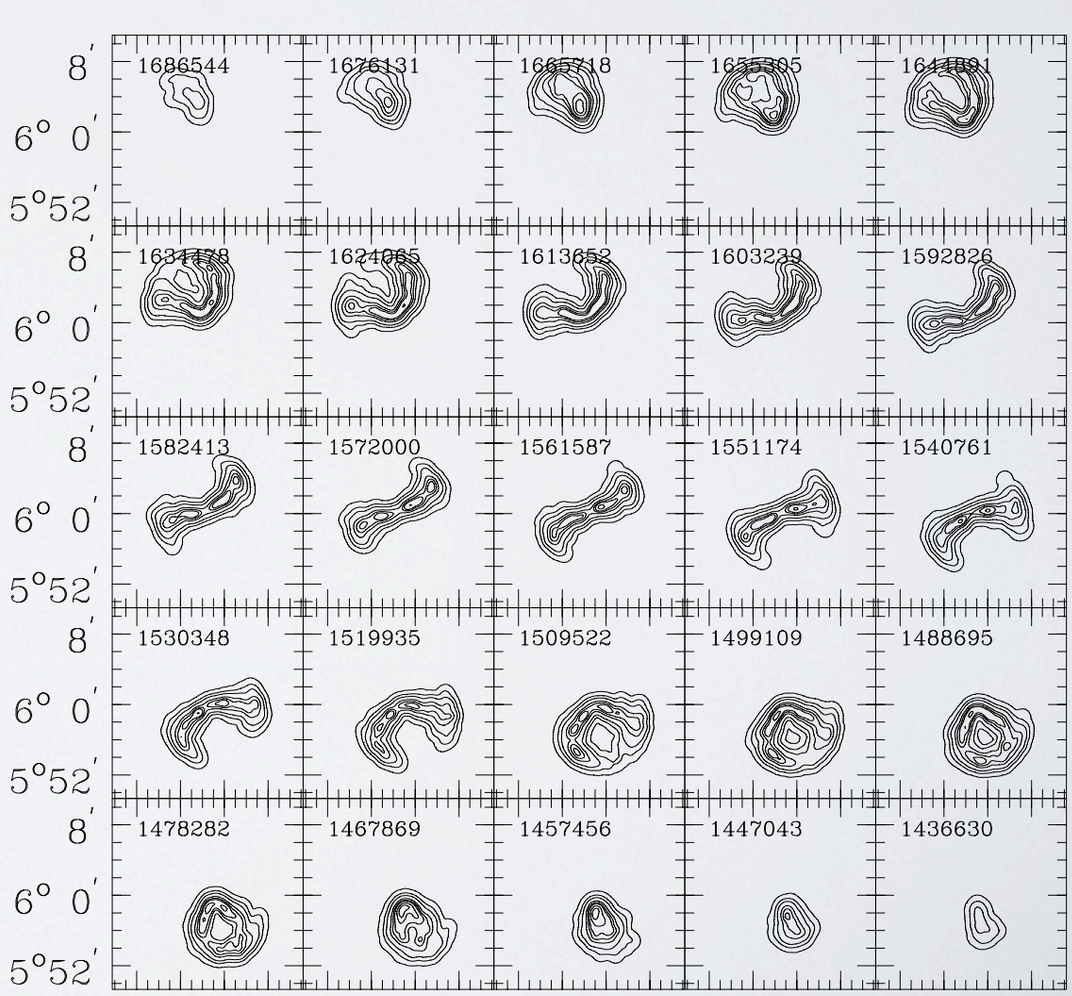




Evaluation of results: Moments +channel maps



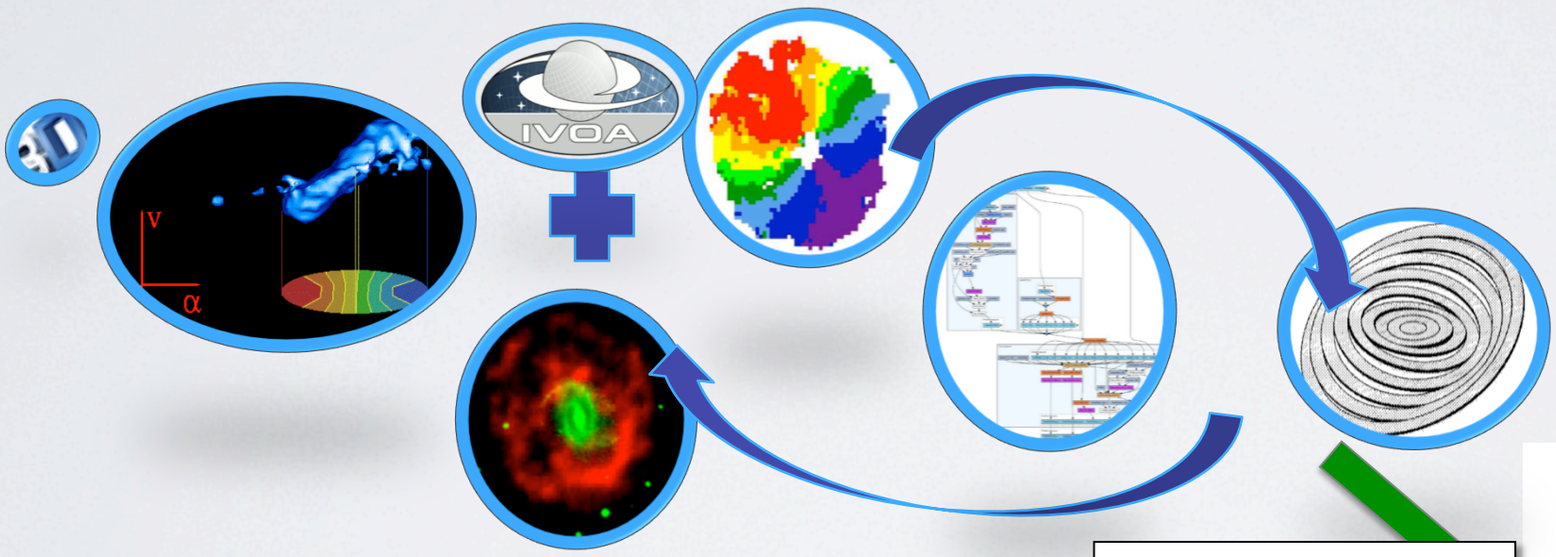


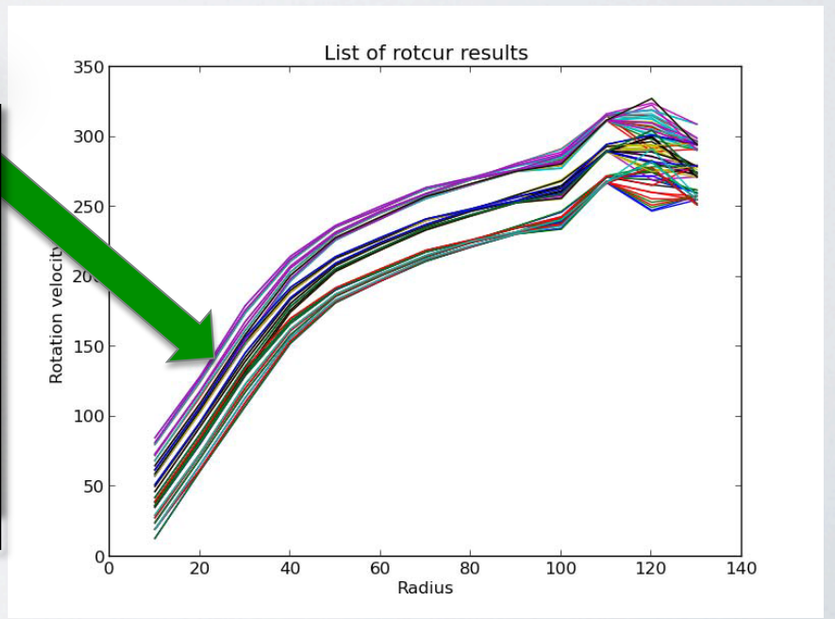


On-going work and next steps

- Iterative process required to reach optimal model of the galaxy
- Automated exploration of parameters in HPC (scalability /big data)
- Capture decisions based on visual inspection

→ TBD: Compare channel maps and measure residuals





Barcelona Supercomputing Center
Centro Nacional de Supercomputación

FCSCL
FUNDACIÓN CENTRO DE SUPERCOMPUTACIÓN DE CASTILLA Y LEÓN

On-going work and next steps

- Iterative process required to reach optimal model of the galaxy
  - Automated exploration of parameters in HPC (scalability /big data)
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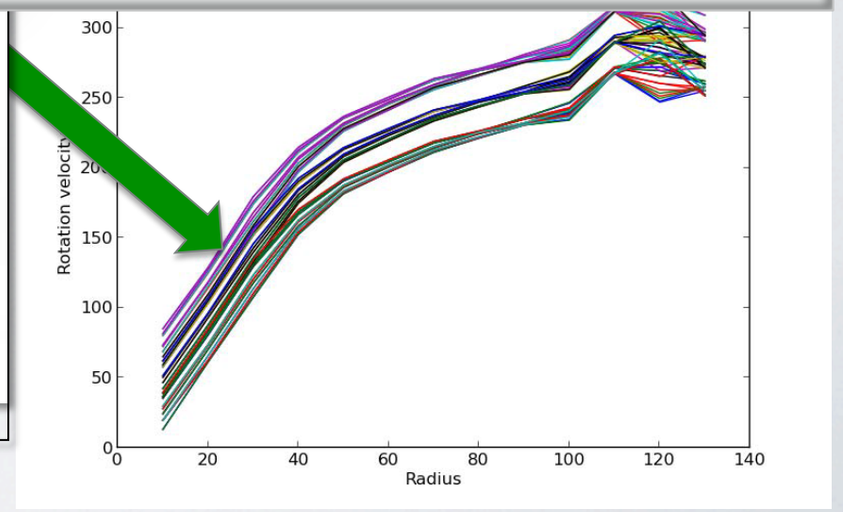
GUIpsy is a work-in-progress collaborative development

Please contact us (lourdes@iaa.es) if you would like to participate !