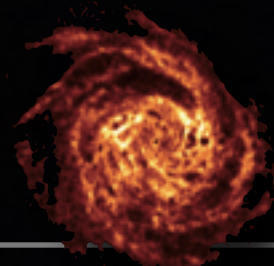


Challenges for visualisation in spectral line astronomy

Thijs van der Hulst
Kapteyn Astronomical Institute



Challenges for visualisation in spectral line astronomy

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Kapteyn Astronomical Institute

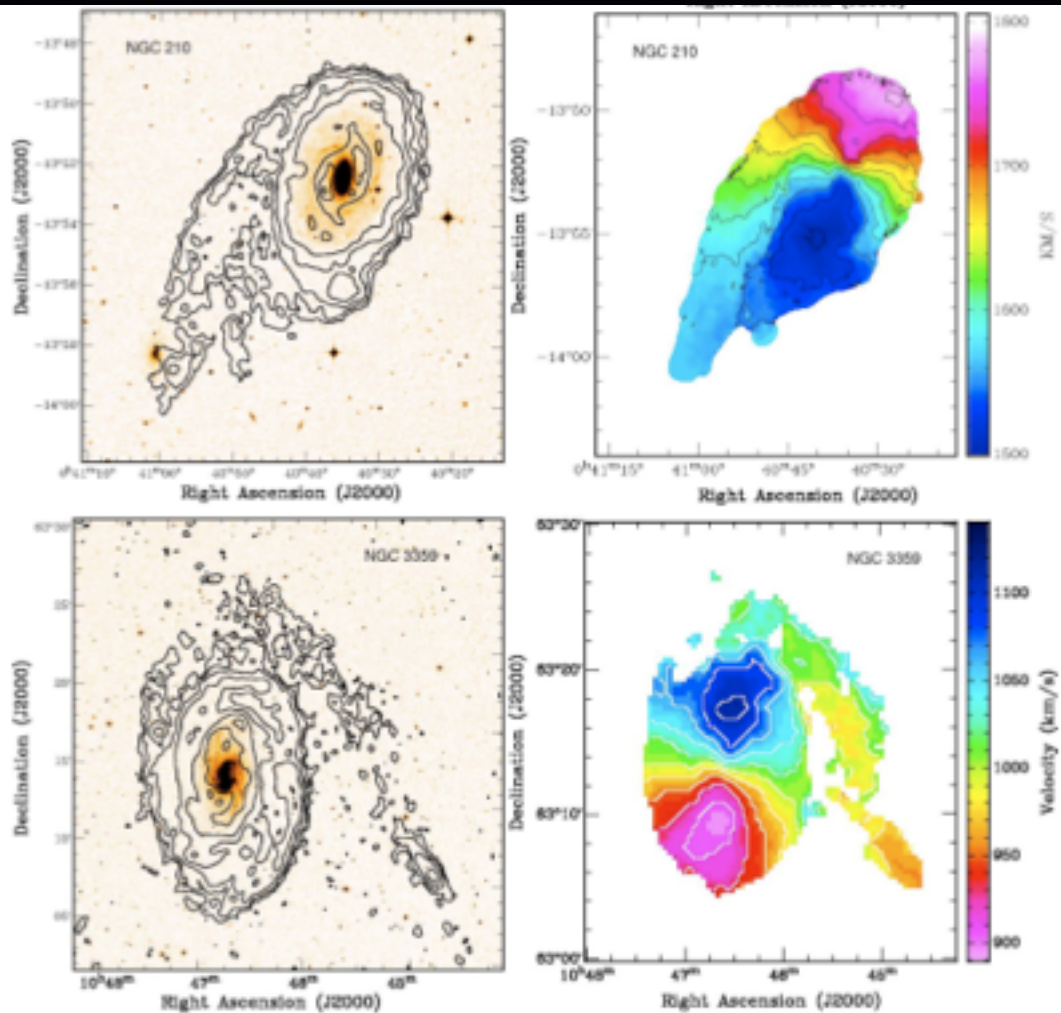
- Exploring the signatures of HI in galaxies
- Enhancing modelling of HI structures
- Providing an affordable and fast environment
- Avoiding diversity of tools

Signatures: evidence for cold accretion?

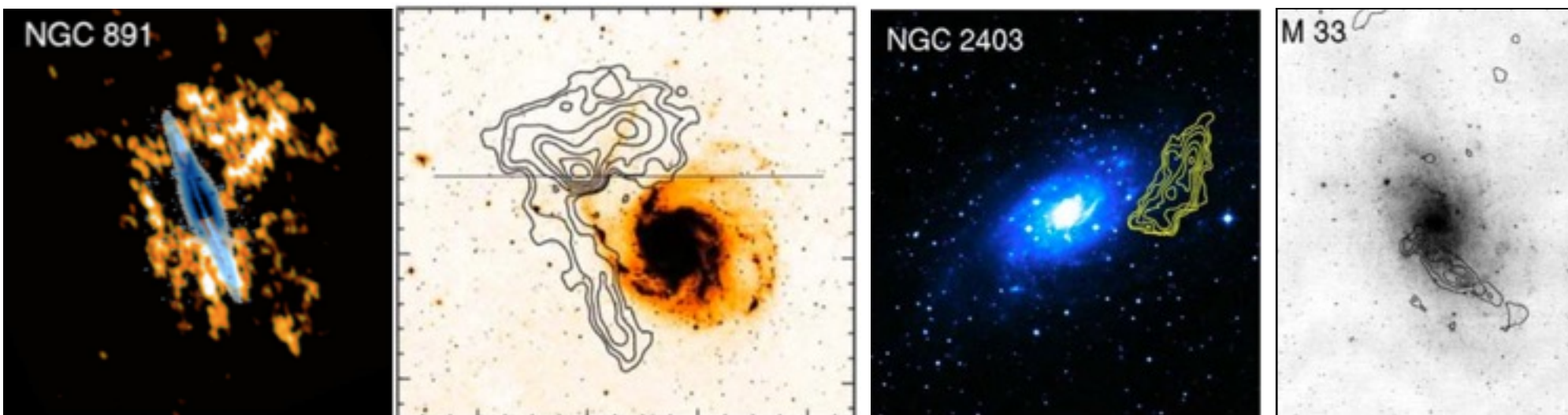
sustaining star formation
-
building up stellar mass

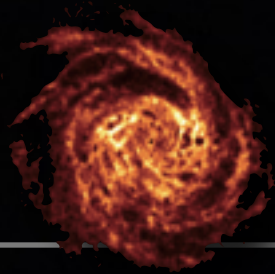
Evidence for cold accretion
or
Galactic Fountain / Fallback?

Sancisi+ 2008



Oosterloo+ 2007

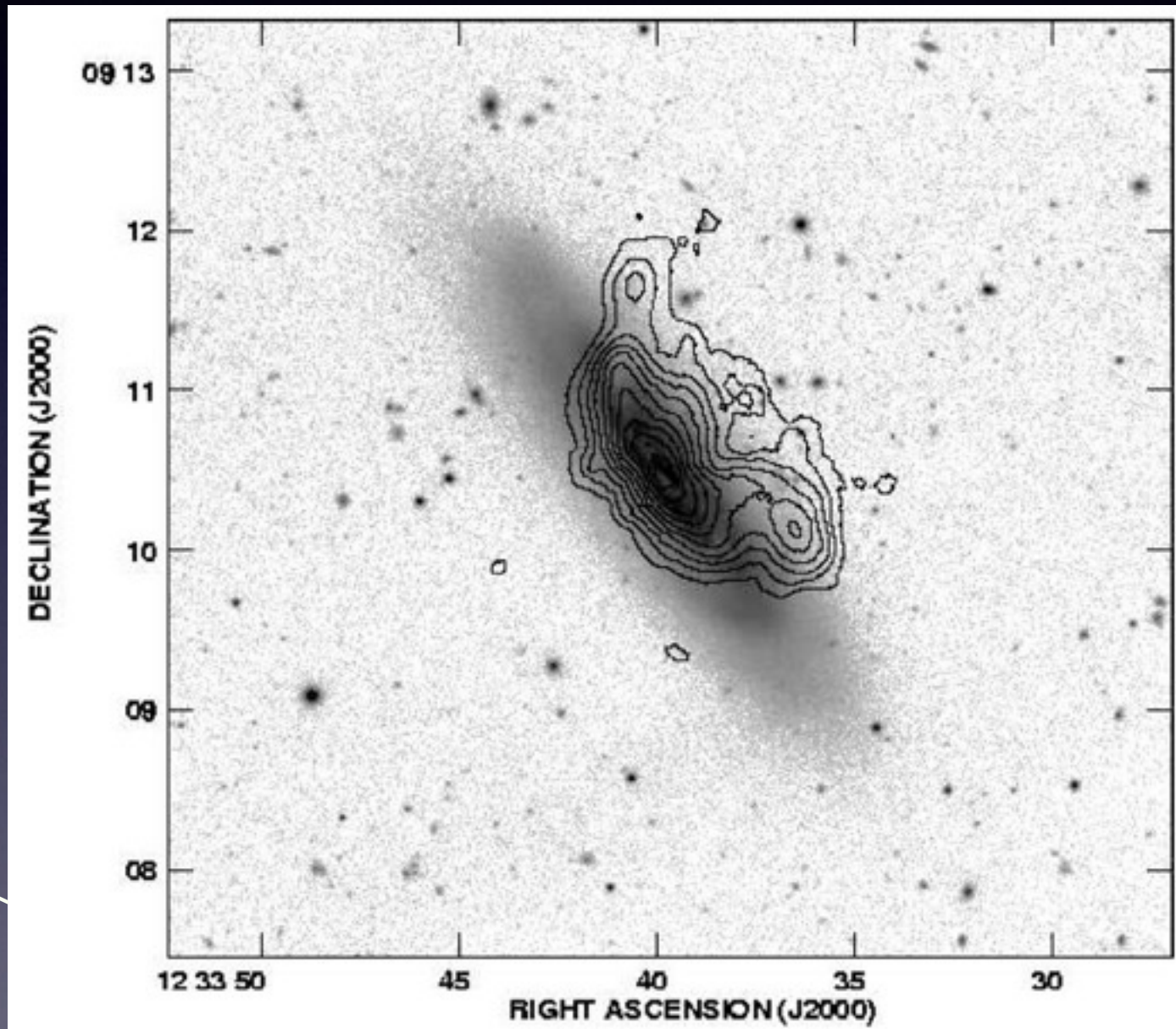




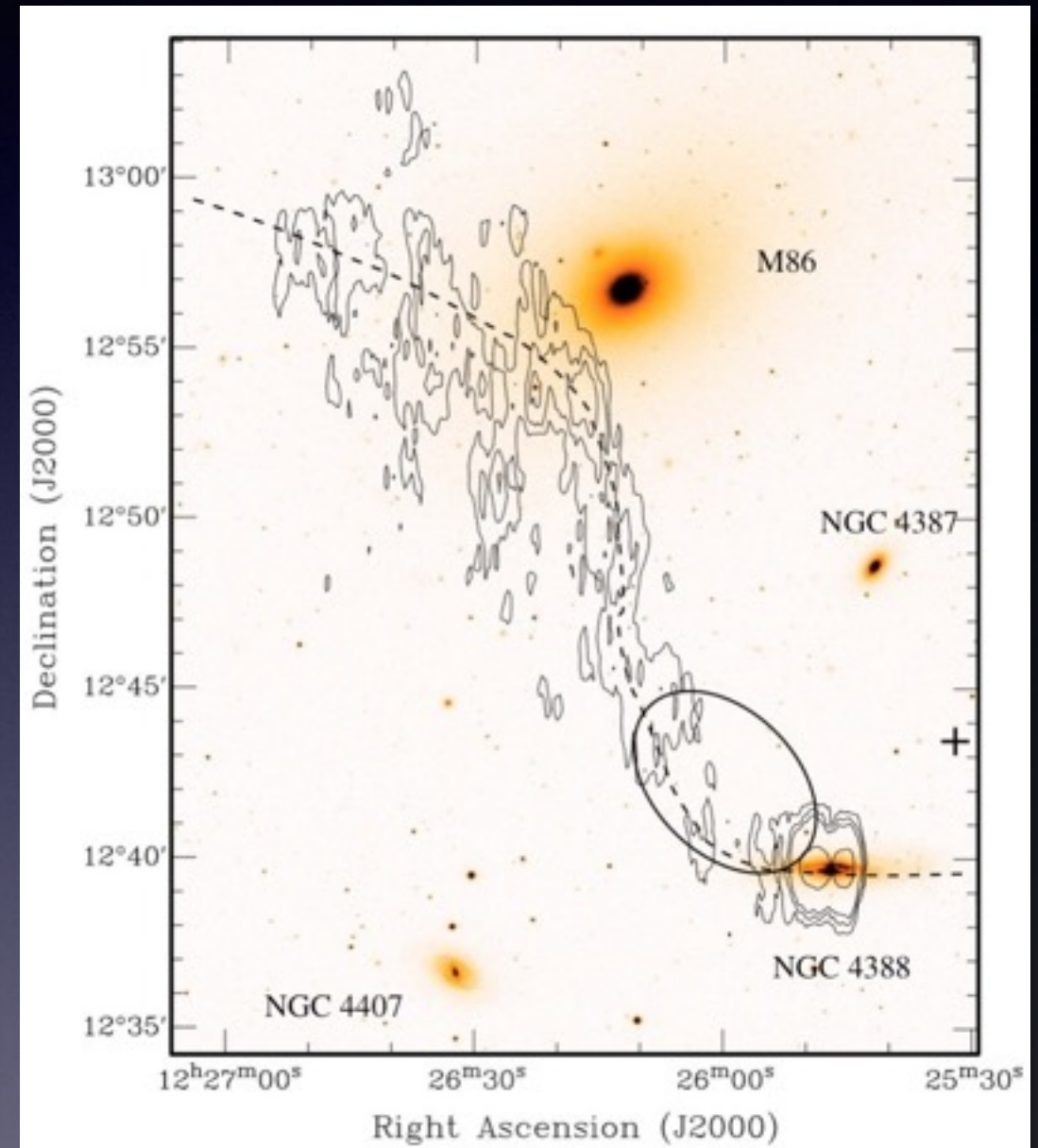
Signatures: tails and major distortions

Ram Pressure Stripping in the VIRGO Cluster

NGC 4522

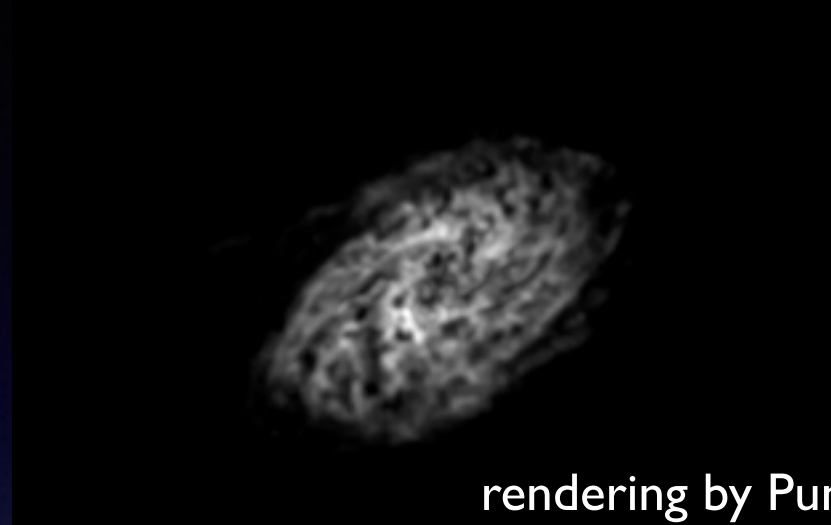


NGC 4388

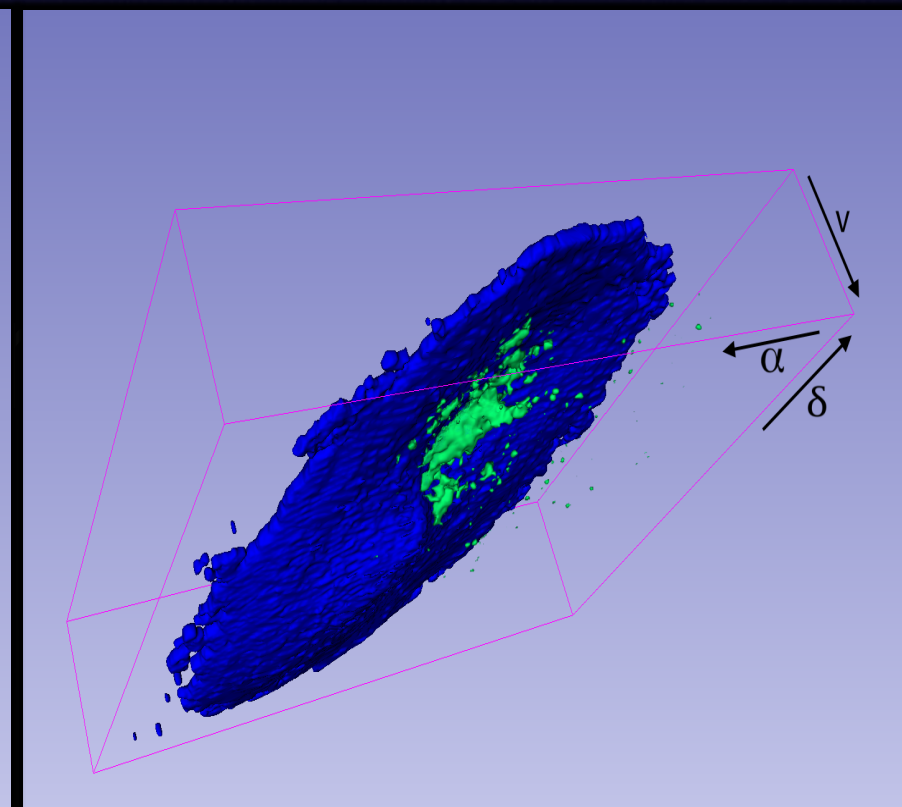
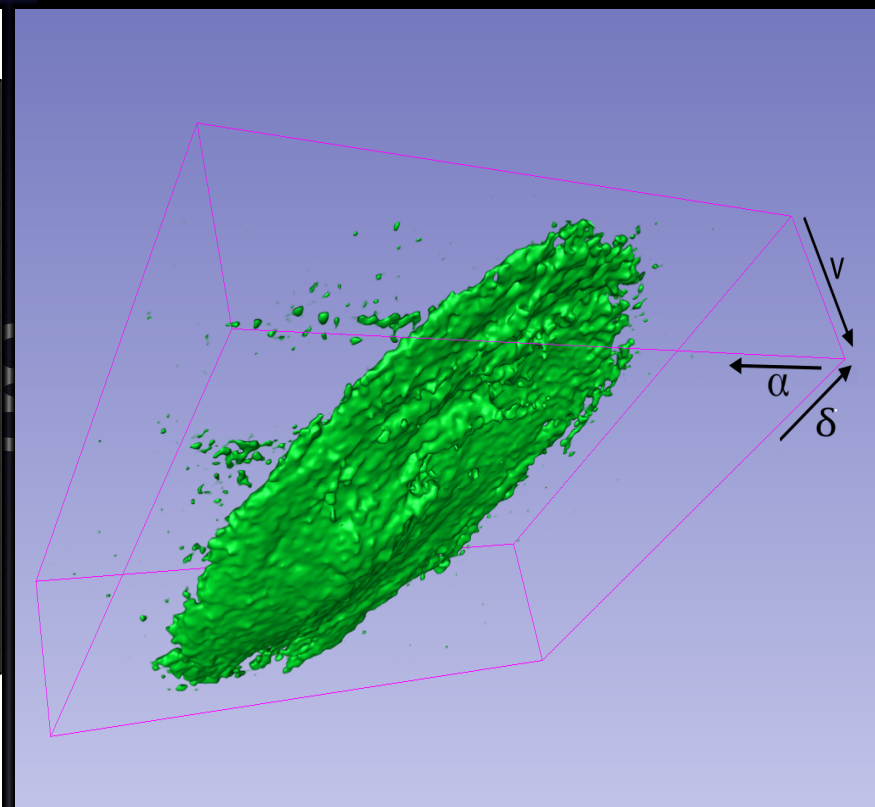
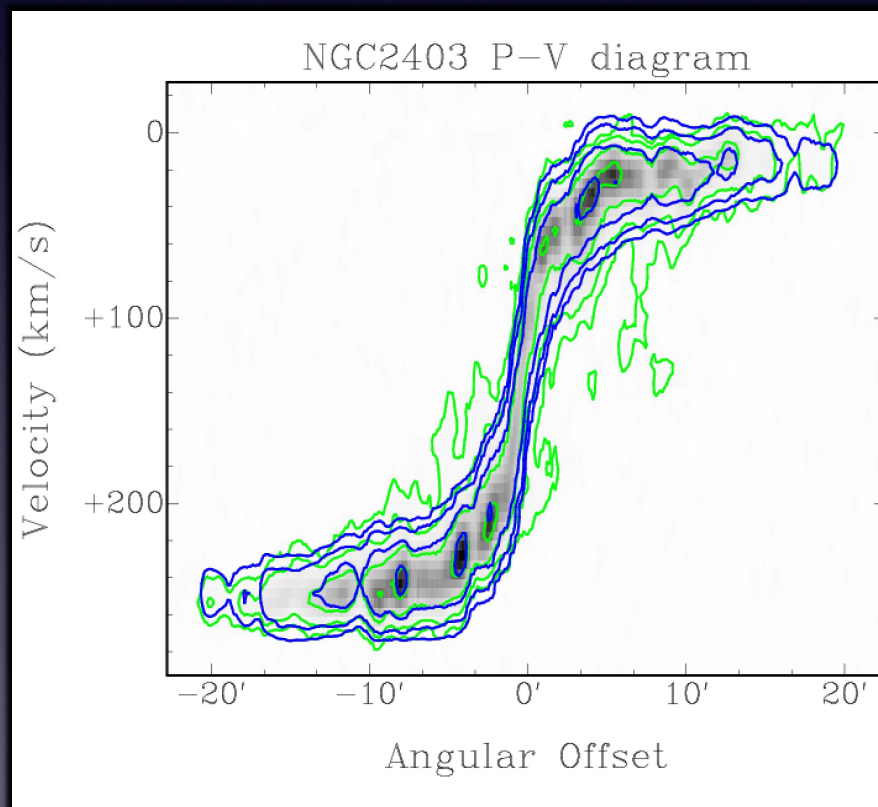


Signatures: anomalous velocity gas

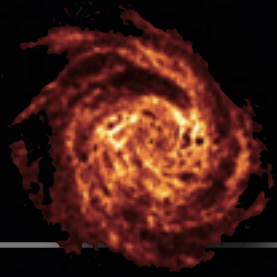
NGC 2403



rendering by Punzo

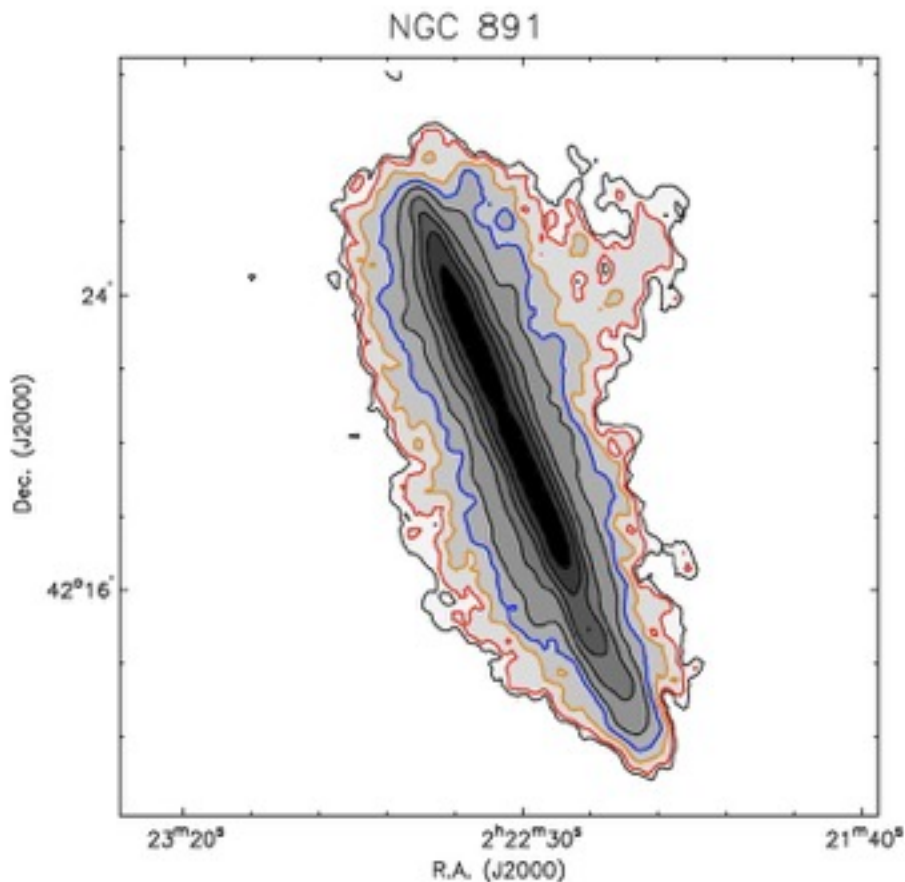


separate non-circularly rotating (extra-planar) gas (green) from the rotating disk by using a model to describe the disk (blue)

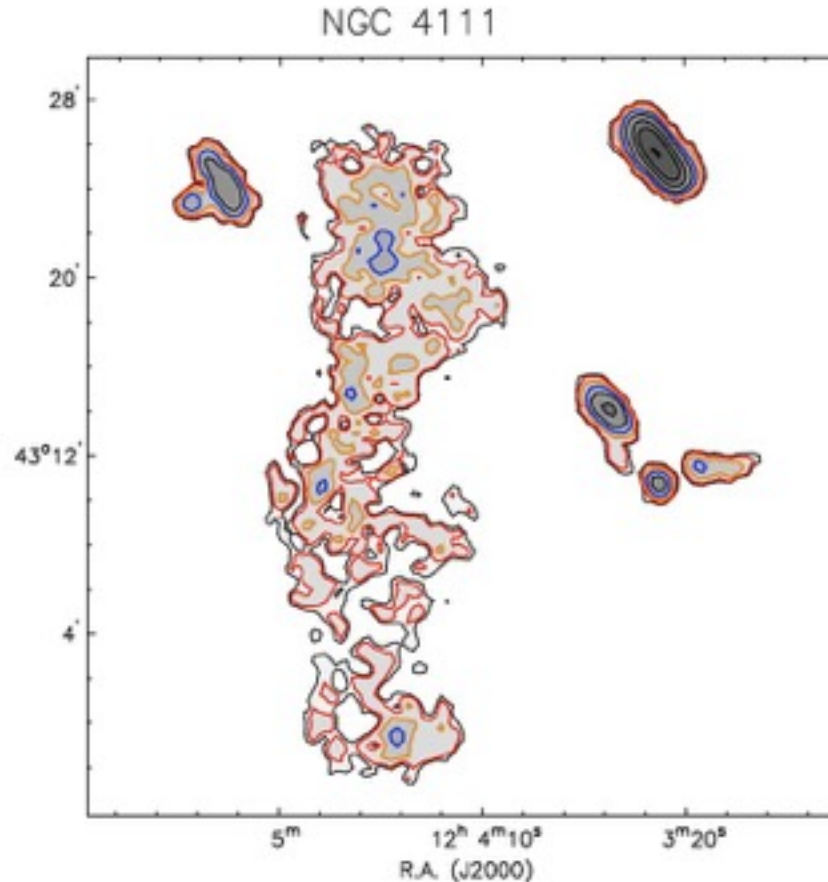


Signatures: summary

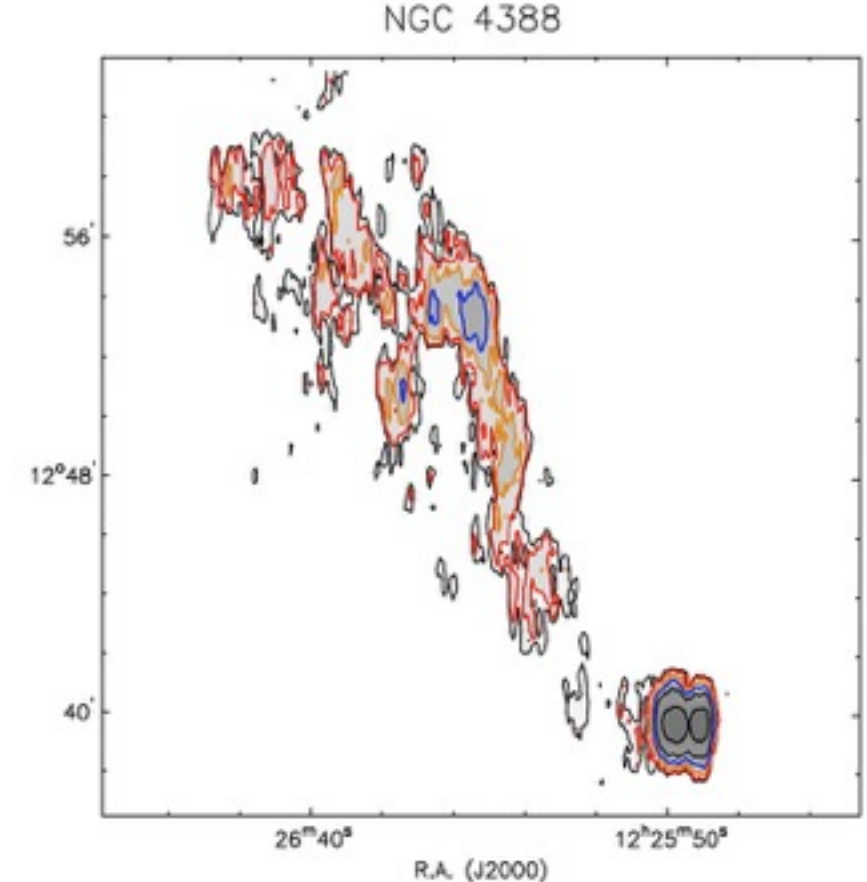
extraplanar gas



tidal filaments



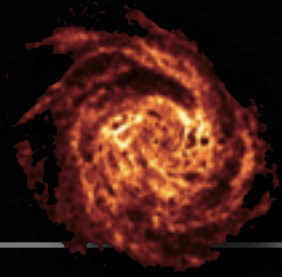
ram-pressure tails



Common to all of these tell-tale signatures:

- low column density
- unusual kinematics

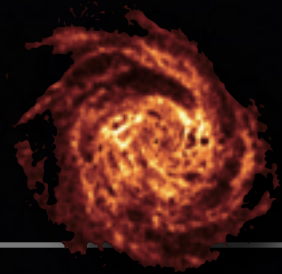
*good visualisation techniques
can uncover these easily*



Visualisation: basic meaning

- To form a picture of someone or something in your mind, in order to imagine or remember him, her, or it
- Making a visible presentation of numerical data, particularly a graphical one
- Visualization is the process of representing abstract business or scientific data as images that can aid in understanding the meaning of the data

But here: presenting 1-D, 2-D, 3-D and n-D data in a comprehensive way and be able to interact with the data so concentrate on desktop solutions



Visualisation: available 3-D viewers

Karma (kvis, kpvslice, etc.)

Gipsy viewers (sliceview, visions)

CASA viewer

DS9

Viewer in CyberSKA for uploaded data

QFitsView

FITS3D

VO: Alladin + HiPS (*Hierarchical Progressive Surveys*)

TopCat (for table data)

Volume rendering: Frelled (uses Blender)

FITS3D (Victoria U. Wellington NZ)

S2PLOT (Swinburne)

VAA3D (**hhmi** | Howard Hughes Medical Institute)

MayaVi

Visualisation: available FITS viewers



fits.gsfc.nasa.gov

Download and Installation Guide | FITS Image Viewer Page | QFitsView | Vaa3D

FITS The Astronomical Image and Table Format Flexible Image Transport System

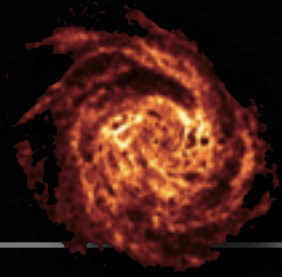
Home | News | Docs | WCS | Samples | Libraries | Viewers | Utilities | Keywords | Conventions | Resources

FITS Image Software Packages for image viewing, analysis, and format conversion

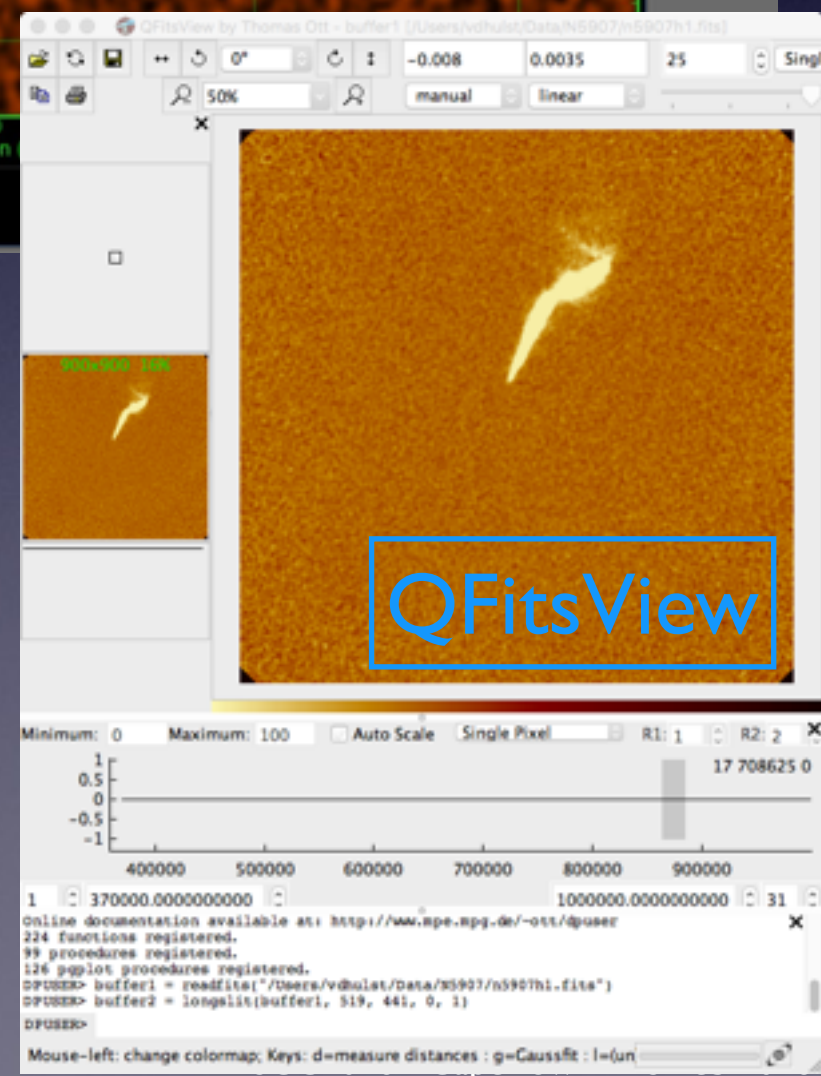
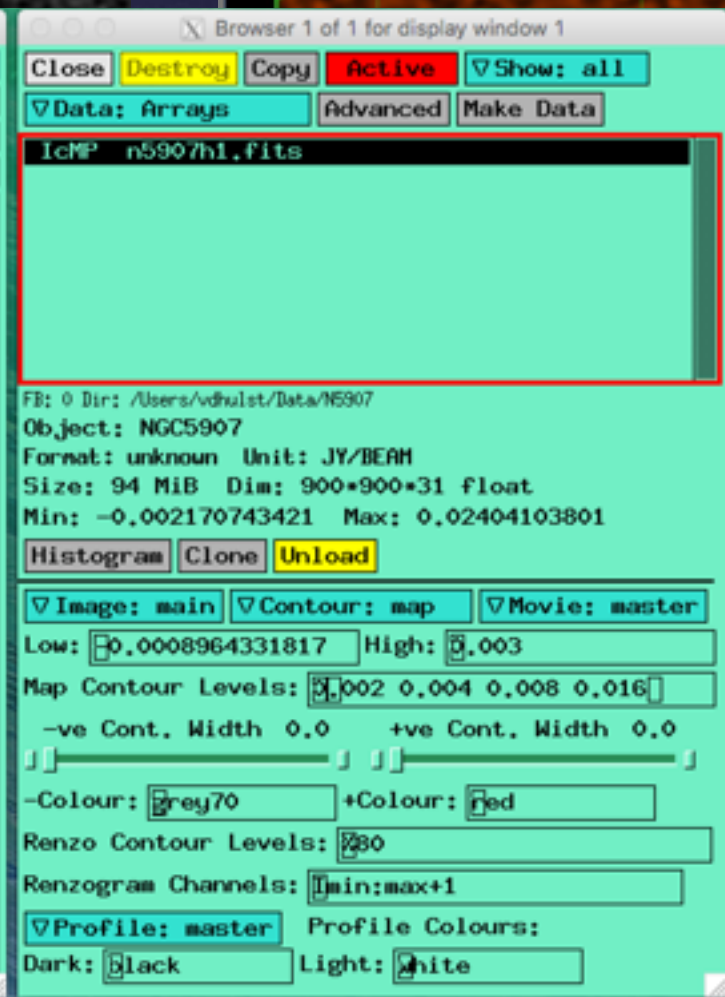
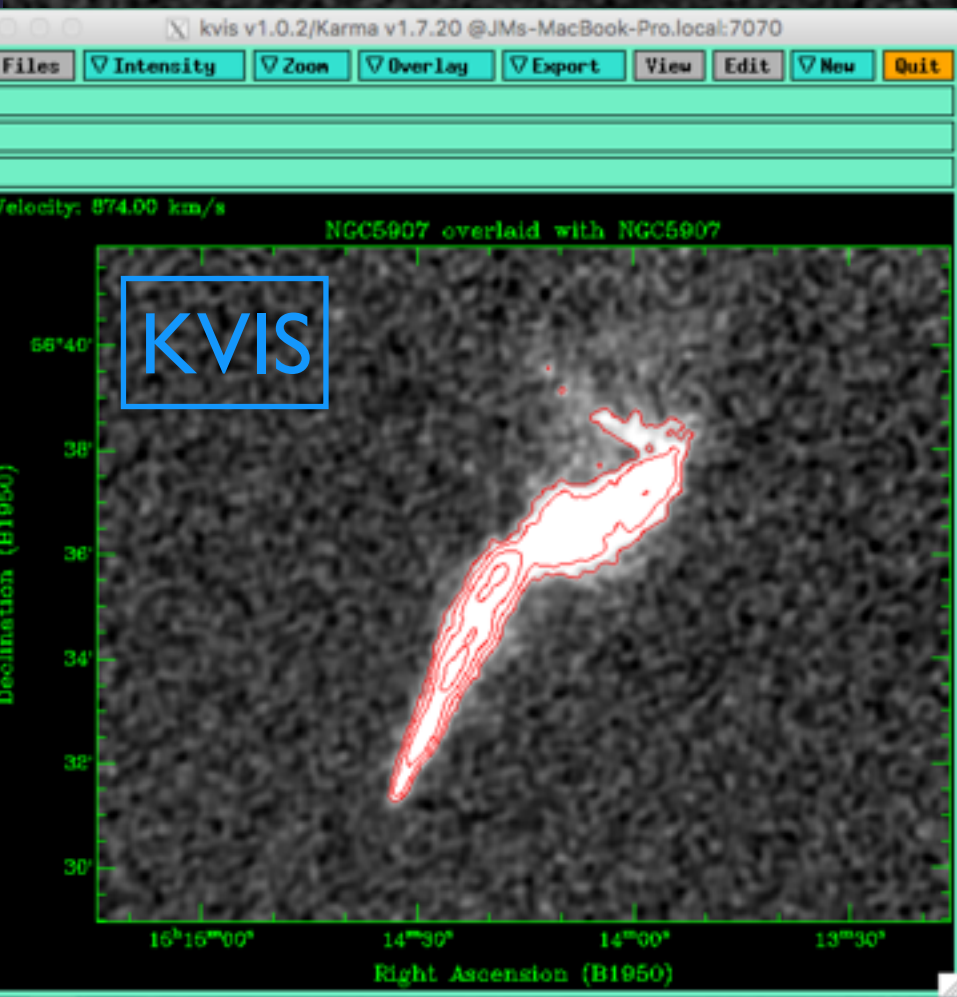
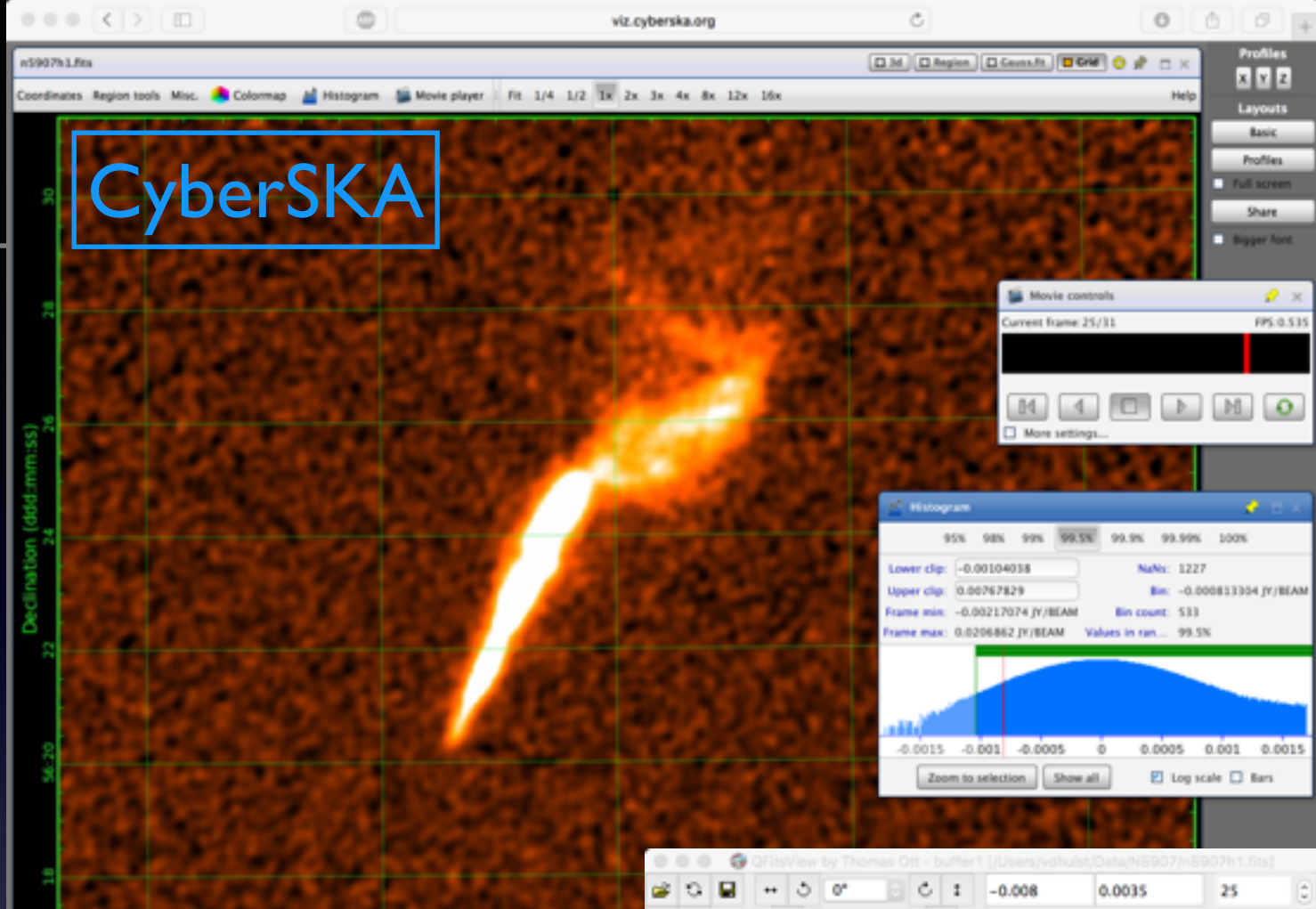
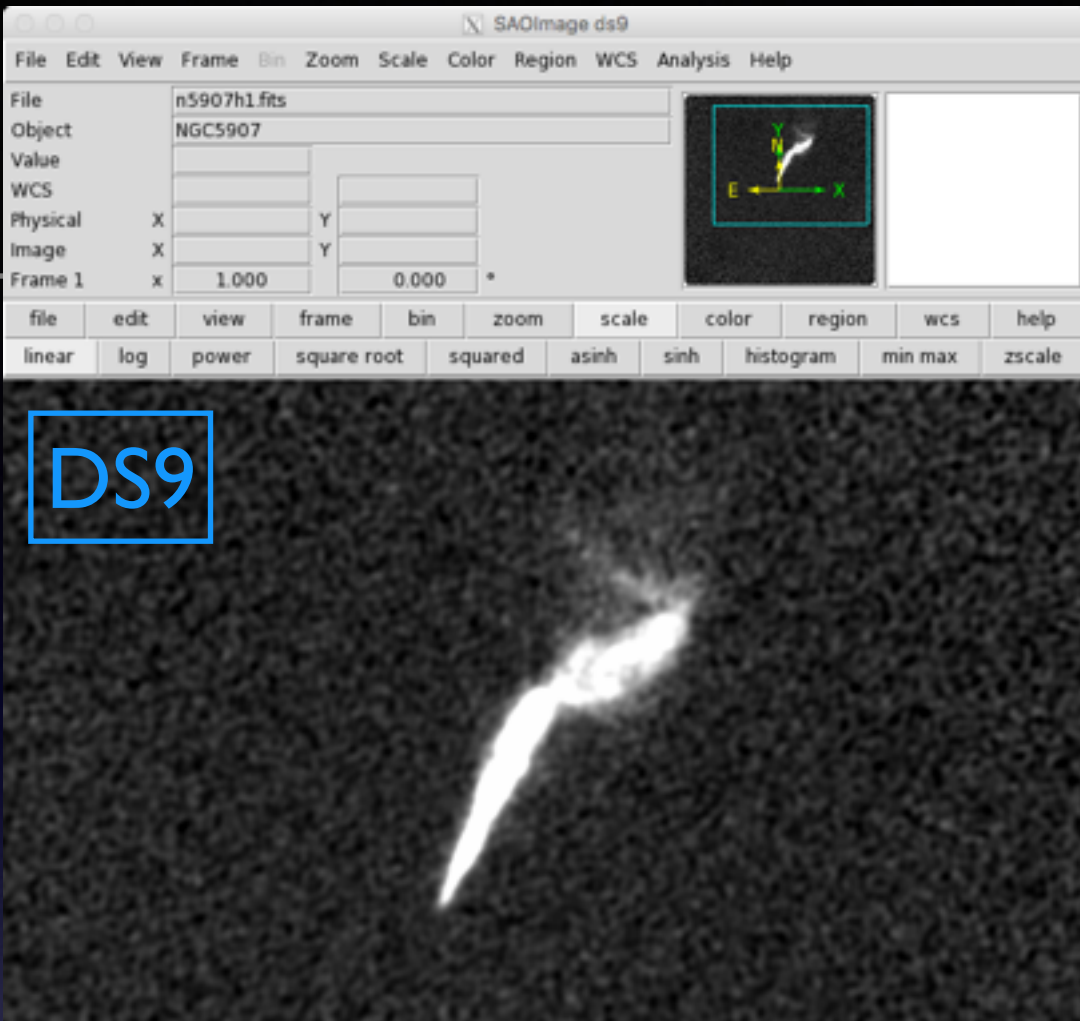
The following software packages display or manipulate the relatively simple class of FITS data files that containing 2-dimensional images, often of celestial objects in the night sky. It should be noted that FITS is a very general data format that is used for many different types of astronomical data sets, so these packages are not necessarily capable of reading every type of FITS file. Developers of new image display programs should be aware of the [special requirements](#) for effectively displaying FITS images.

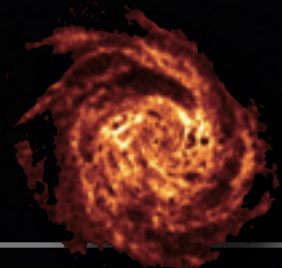
FITS Image Viewers

- [Image viewers for PC and Macs](#) - an extensive listing of commercial and freeware image processing software compiled by the Astronomy Education Committee.
- [Aladin](#) - Interactive Sky Atlas
- [APLpy](#) - Astronomical Plotting Library in Python is a Python module aimed at producing publication-quality plots of astronomical imaging data in FITS format.
- [Aperture Photometry Tool](#) - interactive software tool for visualizing and performing aperture photometry measurements on astronomical images.
- [Avis FITS Viewer](#) - a FITS viewer for Windows. Only reads 8 and 16 bit FITS images. Converts to RAW, TIF, TGA, BMP, and JPEG formats
- [ds9 \(SAOImage\)](#) - astronomical visualization application from SAO
- [FITS Liberator](#) - a plug-in for Adobe Photoshop for manipulating FITS format images. Also works with Photoshop Elements 2. Includes a short introduction to [astronomical image processing](#).
- [Fits4Win2 Viewer](#) (shareware with free beta version) - a FITS viewer for Windows. Works as an extension to Windows Explorer and includes support for viewing thumbnail images of FITS files.
- [FitsPlug v2.0](#) (shareware with free beta version) - a FITS plug-in for Adobe Photoshop for Windows
- [FITSview](#) - FITS image viewer from NRAO
- [fv](#) - FITS file viewer and editor (supports FITS images and FITS tables)
- [GAIA](#) - an image display and analysis tool from the U.K. Starlink Project. It is a derivative of the ESO SkyCat tool
- [glv](#) - A cross platform (posix and Windows) image viewer designed especially for scientific vision and computational geometry. Supports interactive brightness and contrast adjustment of 2D images and 3D cubes in various data formats, including FITS. Also supports drawing vector graphics on top of the image.
- [GLnemo2](#) - an interactive 3D visualization program for n-body snapshots which supports 2D and 3D FITS data, as well as other data formats. GLnemo2 is open source, multi-platform (linux, MacOSX, windows), and uses qt5 API and OpenGL hardware acceleration.
- [ImageJ](#) - a public domain, Java-based image processing program developed at the National Institutes of Health. ImageJ was designed with an open architecture that provides extensibility via Java plugins and recordable macros. It supports 8-bit and 16-bit integer and 32-bit floating point images and RGB color images.
- [ImageTOOLsca](#) (shareware, with a free trial period) - a FITS image viewer for Windows. Supports 16 and 32 bit integer FITS images. It can convert to or from other image formats such as TIFF, JPG, BMP, and Photoshop PSD, and can create AVI animations from a sequence of images. Also supports some image processing tasks such as bias subtraction and flatfielding.
- [Libvips](#) - a fully demand-driven, threaded image processing library with no image size limits and with good support for colour. Reads and writes FITS images, as well as TIFF, JPEG, PPM, PNG, and other file formats. Has interfaces to C, C++ and Python, and a command-line interface that can be called from shell scripts.
- [MicroObservatory Image 2.0](#) - astronomical image display program works with FITS and GIF images on PCs and Macs. Can also perform mathematical image processing operations on multiple images.
- [PhAst](#) - A flexible IDL tool to display and analyze FITS images. It can calibrate raw images, provide astrometric solutions, and do circular aperture photometry. PhAst allows the user to load, process, and blink any number of images. Requires either an IDL license, or installation of the (free) IDL Virtual Machine.
- [QFitsView](#) - An image viewer for 1-D, 2-D, and 3_D FITS images. It is written in C++ and uses the Qt widget library. Binary executables for Microsoft Windows, Linux, and Mac OSX, as well as the source code, are available.
- [SkyCat](#) - ESO tool combines image visualization and access to catalogs
- [Tria](#) - an advanced image processing suite for Windows platforms (only), including deconvolution, image registration, and noise filtering functions. Supports FITS, TIFF, BMP, JPEG, PNG, and WMF image formats.
- [xv](#) (shareware) - interactive image manipulation program for X Window systems
- [xINDI](#) - xINDI is a suite of native astronomical software tools for MacOS X built around INDI standard. It consists of binary INDI distribution wrapped into INDI Server application, INDI Control Panel application and FITS Viewer. The viewer is based on CFITSIO library and supports all standard monochromatic and color FITS image formats. It shows both an image (zoomed and stretched automatically, but manual correction of black and white point is available) and the image metadata.

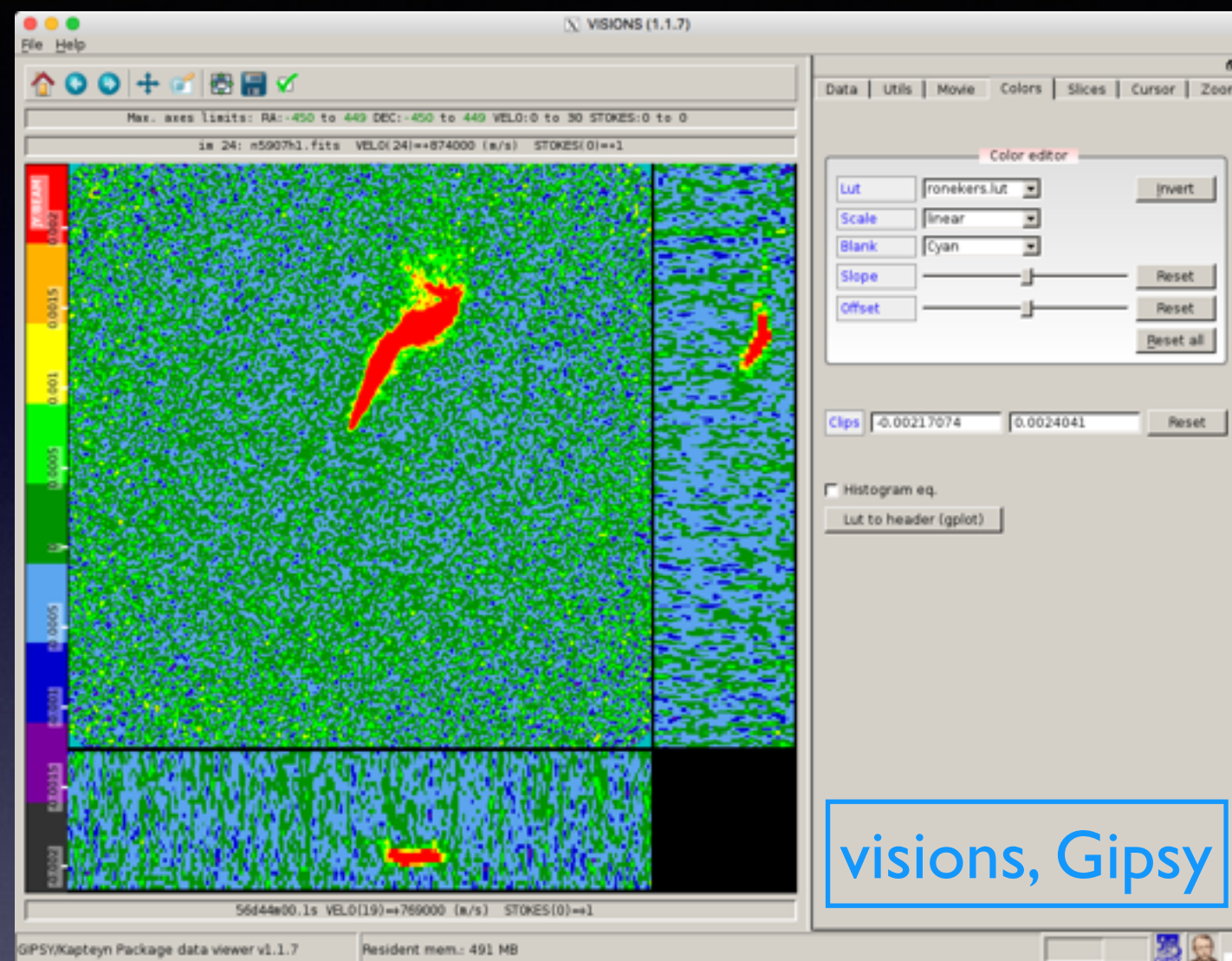
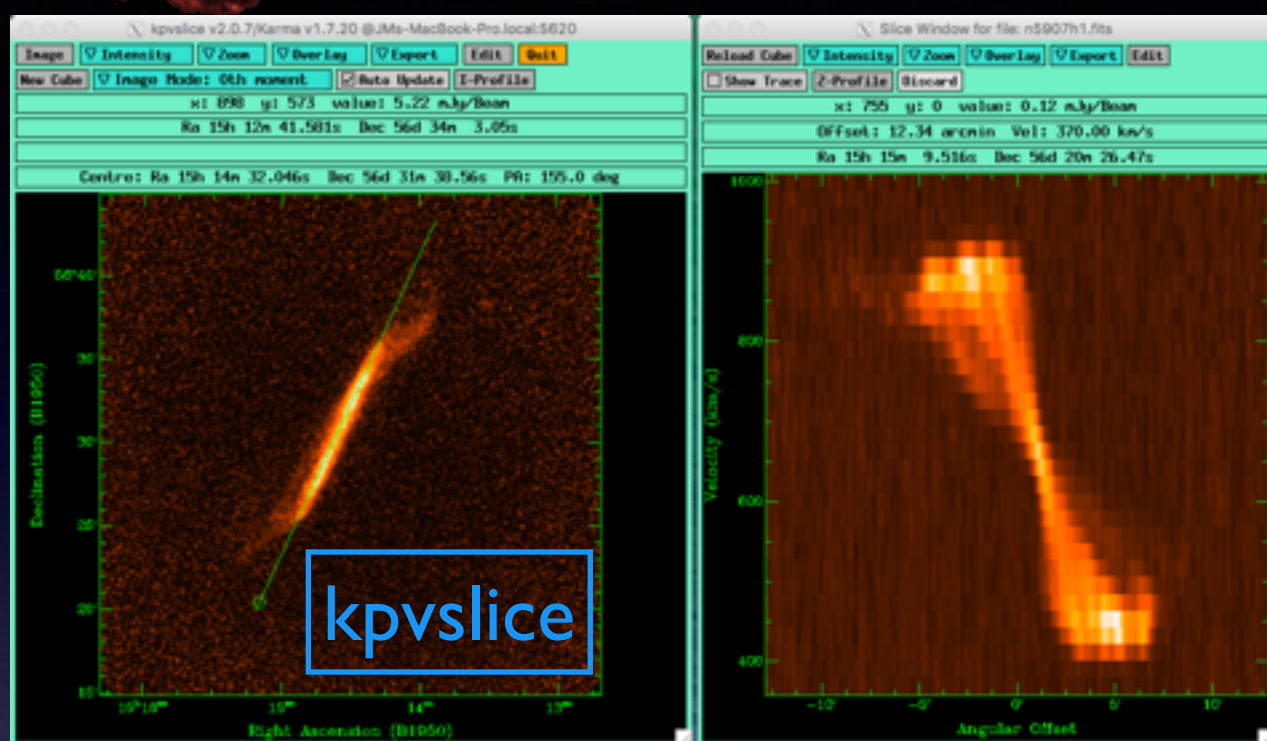


Visualisation: commonly used 3-D viewers





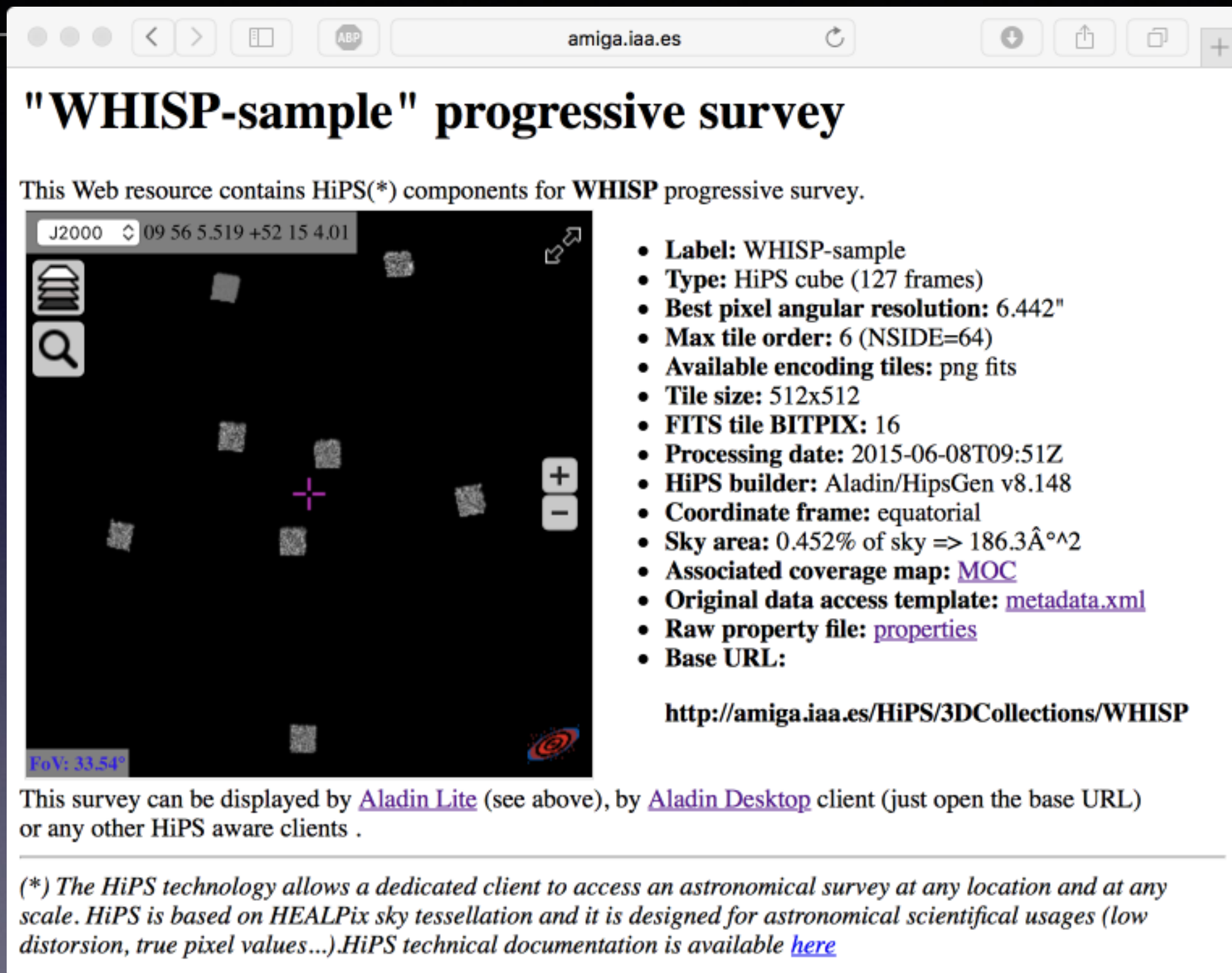
Visualisation: commonly used 3-D viewers



3-D Viewers:

- basic features present
- handling very diverse
- few can combine multiple data (kvis)
- few can display 3 dimensions at once (kpvslice, visions)
- few are coupled directly to the data analysis environment

Visualisation: first HI data in VO



"WHISP-sample" progressive survey

This Web resource contains HiPS(*) components for WHISP progressive survey.

J2000 09 56 5.519 +52 15 4.01

FoV: 33.54°

- **Label:** WHISP-sample
- **Type:** HiPS cube (127 frames)
- **Best pixel angular resolution:** 6.442"
- **Max tile order:** 6 (NSIDE=64)
- **Available encoding tiles:** png fits
- **Tile size:** 512x512
- **FITS tile BITPIX:** 16
- **Processing date:** 2015-06-08T09:51Z
- **HiPS builder:** Aladin/HipsGen v8.148
- **Coordinate frame:** equatorial
- **Sky area:** 0.452% of sky => 186.3Å^2
- **Associated coverage map:** [MOC](#)
- **Original data access template:** [metadata.xml](#)
- **Raw property file:** [properties](#)
- **Base URL:**

<http://amiga.iaa.es/HiPS/3DCollections/WHISP>

This survey can be displayed by [Aladin Lite](#) (see above), by [Aladin Desktop](#) client (just open the base URL) or any other HiPS aware clients .

(*) The HiPS technology allows a dedicated client to access an astronomical survey at any location and at any scale. HiPS is based on HEALPix sky tessellation and it is designed for astronomical scientific usages (low distortion, true pixel values...). HiPS technical documentation is available [here](#)

Verdes Montenegro et al., IAA, Grenada (<http://amiga.iaa.es/HiPS/3DCollections/WHISP/>)

Visualisation: first HI data in VO

"WHISP-sample" progressive survey

This Web resource contains HiPS(*) components for WHISP progressive survey.

J2000 09 11 49.833 +45 40 38.68

FoV: 2.05°

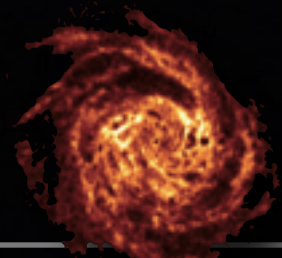
- **Label:** WHISP-sample
- **Type:** HiPS cube (127 frames)
- **Best pixel angular resolution:** 6.442"
- **Max tile order:** 6 (NSIDE=64)
- **Available encoding tiles:** png fits
- **Tile size:** 512x512
- **FITS tile BITPIX:** 16
- **Processing date:** 2015-06-08T09:51Z
- **HiPS builder:** Aladin/HipsGen v8.148
- **Coordinate frame:** equatorial
- **Sky area:** 0.452% of sky => 186.3 °^2
- **Associated coverage map:** [MOC](#)
- **Original data access template:** [metadata.xml](#)
- **Raw property file:** [properties](#)
- **Base URL:**

<http://amiga.iaa.es/HiPS/3DCollections/WHISP>

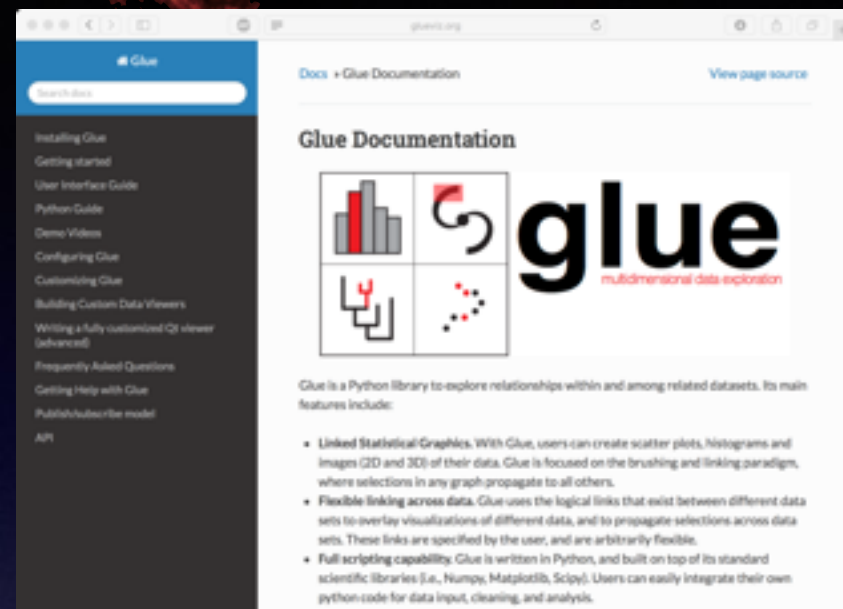
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Verdes Montenegro et al., IAA, Grenada (<http://amiga.iaa.es/HiPS/3DCollections/WHISP/>)

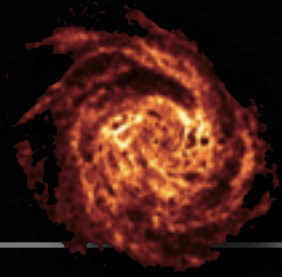


Visualisation: linked displays



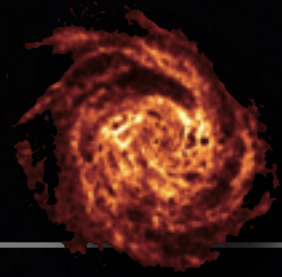
The Glue Project
by Chris Beaumont

linked views of data



Visualisation: summary

- many existing viewers
- most are standalone
- some can read several different formats
- very few provide good volume rendering (expensive)
- connecting 3-D data to VO is happening just now
- Karma probably the most versatile, despite its age

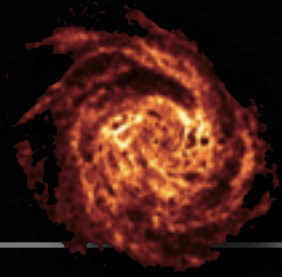


Visualisation: what is missing?

- fast and flexible volume rendering
- interaction with the data via the visualisation tools
- linked 1-D, 2-D and 3-D displays
- interactive coupling to models of the data

Ongoing work in Groningen:

adding these features to an existing 3D visualisation platform 3D Slicer (talk by Davide Punzo)



Visualisation: let's get to work

Thank You