EUROPEAN ARC
ALMA Regional Centre || Italian

CASA Software & Data Products

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CASA
COMMON ASTRONOMY SOFTWARE APPLICATIONS

Contents

- Introduction to CASA
- Status of the sw development
- CASA User Support and training
- ALMA data product
- f2f Support at the ARCs

Introduction to CASA

- What is CASA?
- Who develops CASA?
- What are the main requirements and how does CASA meet them?
- How does CASA look and work?

CASA is...

CASA = Common Astronomy Software Applications

- CASA is a set of C++ application libraries for the data reduction and analysis of radio astronomical data
- applications run through the IPython interface to Python
- developed for ALMA and EVLA projects
- ...but also for data from other radio, millimeter, and sub-mm telescopes

Development team

Originally only developed at NRAO (Socorro, NM), now

Approx. 17 FTE developers are at work at

NRAO Socorro (7.5)
NRAO Charlottesville (2+1)
NAOJ (3)
University of Virginia (0.5)
University of Calgary (1)
Observatoire de Paris (0.5)
ESO Garching (2)

+ 1 Deputy manager (NRAO Socorro)
+ 1 Project Scientist (NRAO Socorro) = Steve Myers
+ 1 Manager (NRAO Socorro) = Brian Glendenning = Manager ALMA Computing IPT
+ a few 5% FTEs at ASTRON, ATNF, and other places

CASA requirements …

Requirements Document:

ALMA Offline Data Processing Requirements
(first draft: 3 Jun 01, latest draft: 4 Oct 07)

describes on 68 pages requirements concerning:

1) Interaction with the ALMA pipeline
2) User Interface
3) Data handling (import/export)
4) Calibration and editing
5) Imaging
6) Scientific analysis (image analysis, unit conversion, etc.)
7) Visualization
8) Simulation and other special features

… and how CASA meets them

Overall architecture:

- A data structure
  Tables: Images, Caltables, and the Measurement Set
- A set of data import/export facilities
  the so-called fillers: ASDM → MS, FITS → MS, UVFITS → MS, PdBI → MS, etc.
- A set of low-level tools for data access, display, and editing
  tools to load/write data into/from casacore datatypes, matplotlib for basic x/y plotting, Qt-based table browser

… and how CASA meets them

- A set of high-level tools for science analysis algorithms
  the Measurement Equation = a set of C++ classes for radio astronomical calibration and imaging
- A programmable command line interface with scripting
  Python (augmented by IPython) gives a MATLAB-like interactive language
- Documentation
  inline documentation using doxygen + an extensive cookbook (500 pages) + user reference manual

Task and Tools

- Task: high (user) level functionality
  - call from Python as functions
  - standard tasking interface
    - parameter manipulation using inp, default, saveinputs, tget
    - arguments are parameters
    - documentation: Cookbook
- Toolkit: full functionality represented
  - tools are functions and underlying tasks
  - documentation: Reference Manual

CASA in practice

- Data in CASA are stored in tables
  - also tables for images and calibration tables
- Visibility data are stored in Measurement Set (MS) table
  - the MS is a directory on the disk
    - MAIN table containing the visibility data
    - sub-tables *(=sub-directories)* containing auxiliary information
      - e.g. FIELD, SOURCE, ANTENNA, etc.

Example :

- ls jupiter6cm_demo.ms

Terminal

File Edit View Terminal Tabs Help

```
paramay:/Locale/CASA/tutorials/Bonn09-tutorial/Jupiter/flagdemo> ls jupiter6cm_demo.ms
ANTENNA           OBSERVATION    SPECTRAL_WINDOW  table.f2_TSM1  table.f6       table.info
DATA_DESCRIPTION  POINTING       STATE            table.f3       table.f6_TSM0  table.lock
FEED              POLARIZATION   table.dat        table.f3_TSM1  table.f7
FIELD             PROCESSOR      table.f0         table.f4       table.f7_TSM1
FLAG_CMD          SORTED_TABLE   table.f1         table.f5       table.f8
HISTORY           SOURCE         table.f2         table.f5_TSM1  table.f8_TSM1
paramay:/Locale/CASA/tutorials/Bonn09-tutorial/Jupiter/flagdemo>
```

- ls jupiter6cm_demo.ms/FIELD/

Terminal

File Edit View Terminal Tabs Help

```
paramay:/Locale/CASA/tutorials/Bonn09-tutorial/Jupiter/flagdemo> ls jupit
er6cm_demo.ms/FIELD
table.dat  table.f0  table.f0i  table.info  table.lock
paramay:/Locale/CASA/tutorials/Bonn09-tutorial/Jupiter/flagdemo>
```

CASA in practice

The Measurement Set …

- developed by Cornwell, Kemball, & Wieringa between 1996 and 2000
- designed to store both interferometry (multi-dish) and single-dish data
- supports (in principle) any setup of radio telescopes
- supports description and processing of the data via the Measurement Equation

The Measurement Equation
(Hamaker, Bregman & Sault 1996)

- decompose into individual calibration components,

$$\vec{V}_{ij}^{obs} = \vec{\vec{B}}_{ij}\vec{\vec{G}}_{ij}\vec{\vec{D}}_{ij}\vec{\vec{P}}_{ij}\vec{\vec{T}}_{ij}\vec{\vec{F}}_{ij}\vec{V}_{ij}^{ideal}$$

where:
B = Bandpass, G = gain, D = D-Term (pol. leackage),
T = Tropospheric effects, F = Faraday rotation

- linearise and solve by χ^2 minimization

CASA in practice

Starting up CASA

Terminal

File Edit View Terminal Tabs Help

```
[rossetti@arcbl02 ~]$ casapy
CASA Version 2.4.0 (build #8115)
  Built on: Thu 2009/06/18 20:26:05 UTC


--------------------------------------------------------------------------------
Available tasks:

   accum          flagdata       listcal      sdlist
   applycal       flagmanager    listhistory  sdplot
   bandpass       fluxscale      listobs      sdsave
   blcal          ft             listvis      sdscale
   browsetable    gaincal        makemask     sdsmooth
   clean          hanningsmooth  mosaic       sdstat
   clearcal       imcontsub                   setjy
   clearplot      imhead         plotants     smoothcal
   clearstat      immoments      plotcal      specfit
   concat         importfits     plotxy       split
   deconvolve     importuvfits   sdaverage    tget
   exportfits     importvla      sdbaseline   uvcontsub
   exportuvfits   imregrid       sdcal        uvcontsub2
   feather        imsmooth       sdcoadd      uvmodelfit
   filecatalog    imstat         sdfit        viewer
   find           imval          sdflag       vishead
   fixvis         invert                      widefield

Additional tasks available for ALMA commissioning use
         (still alpha code as of Beta release):

 simdata        importasdm

Available tools:

   cb (calibrater)       cp (cal plot)    fg (flagger)
   ia (image analysis)   im (imager)      me (measures)
   mp (MS plot)          ms (MS)          qa (quanta)
   sm (simulation)       tb (table)       tp (table plot)
   vp (voltage patterns)                  at (atmosphere)

   pl (pylab functions)
   sd (ASAP functions - run asap_init() to import into CASA)

   casalogger             - Call up the casalogger (if it goes away)


--------------------------------------------------------------------------------
Help:
   help taskname          - Full help for task
   help par.parametername - Full help for parameter name
   apropos string         - List tasks with string in their brief help.
   tasklist               - Task list organized by catagory
   taskhelp               - One line summary of available tasks
   toolhelp               - One line summary of available tools
   startup                - The start up screen
```

The Logger

Log Messages (paramay.ira.inaf.it:/Locale/CASA/tutorials/Bonn09-tutorial/Jupiter/flagdemo/casapy.log)

File Edit View

Search Message: Filter: Time

Time	Origin	Message
2009-11-12 10:10…	importuvfi…	
2009-11-12 10:10…	importuvfi…	##
2009-11-12 10:10…	importuvfi…	##### Begin Task: importuvfits #####
2009-11-12 10:10…	importuvfi…	
2009-11-12 10:10…	importuvfi…	
2009-11-12 10:10…	importuvfi…	Converting FITS file 'planets_6cm.fits' to MeasurementSet 'jupiter6cm_demo.ms'
2009-11-12 10:10…	importuvfi…	Using tile shape [4, 1, 4096] for VLA with obstype=0
2009-11-12 10:10…	importuvfi…	Reading and writing 1010712 visibility groups
2009-11-12 10:10…	importuvfi…	Found binary table of type AIPS AN following data
2009-11-12 10:10…	importuvfi…	Found binary table of type AIPS NX following data
2009-11-12 10:10…	importuvfi…	Skipping table, duplicate or unrecognized type: AIPS NX
2009-11-12 10:10…	importuvfi…	Found binary table of type AIPS SU following data
2009-11-12 10:10…	importuvfi…	Assuming standard epoch for VENUS. Be aware that this may not be correct.
2009-11-12 10:10…	importuvfi…	Assuming standard epoch for MARS. Be aware that this may not be correct.
2009-11-12 10:10…	importuvfi…	Assuming standard epoch for NEPTUNE. Be aware that this may not be correct.
2009-11-12 10:10…	importuvfi…	Assuming standard epoch for URANUS. Be aware that this may not be correct.
2009-11-12 10:10…	importuvfi…	Assuming standard epoch for JUPITER. Be aware that this may not be correct.
2009-11-12 10:10…	importuvfi…	Found binary table of type AIPS FQ following data
2009-11-12 10:10…	importuvfi…	Found binary table of type AIPS CL following data
2009-11-12 10:10…	importuvfi…	Skipping table, duplicate or unrecognized type: AIPS CL
2009-11-12 10:11…	importuvfi…	Found binary table of type AIPS TY following data
2009-11-12 10:11…	importuvfi…	Skipping table, duplicate or unrecognized type: AIPS TY
2009-11-12 10:11…	importuvfi…	
2009-11-12 10:11…	importuvfi…	##### End Task: importuvfits #####
2009-11-12 10:11…	importuvfi…	##

Insert Message: Lock scroll

The CASA tools with GUI

In a typical CASA session you will use tools such as:

- plotxy: An X-Y plotter/interactive flagger for visibility data
- plotcal: An all-purpose plotter for calibration results
- browsetable: allows you to display any CASA table, e.g. Measurement Sets
- viewer:
  - view an image or visibility data set
  - view residuals and set boxes during the interactive cleaning

browsetable

Table Browser

File Edit View Tools Export Help

jupiter6cm_flagdemo.ms

table data | field keywords

	UVW	FLAG	FLAG_CATEGORY	WEIGHT	SIGMA	ANTENNA1	ANTENNA2	AR
0	[-68.7658, -4...	[4, 1] Boolean	[0, 0, 0] Boolean	[0, 0, 0.333333, 0]	[0, 0, 1.73205, 0]	0	9	0
1	[-68.7658, -4...	[4, 1] Boolean	[0, 0, 0] Boolean	[0.333333, 0, 0.333333, 0]	[1.73205, 0, 1.73205, 0]	0	9	0
2	[-218.848, 42...	[4, 1] Boolean	[0, 0, 0] Boolean	[0, 0, 0, 0]	[0, 0, 0, 0]	7	9	0
3	[-218.848, 42...	[4, 1] Boolean	[0, 0, 0] Boolean	[0.333333, 0, 0.333333, 0]	[1.73205, 0, 1.73205, 0]	7	9	0
4	[-16.7846, 12...	[4, 1] Boolean	[0, 0, 0] Boolean	[0, 0, 0, 0]	[0, 0, 0, 0]	4	9	0
5	[-16.7846, 12...	[4, 1] Boolean	[0, 0, 0] Boolean	[0, 0, 0.333333, 0]	[0, 0, 1.73205, 0]	4	9	0
6	[150.083, -86...	[4, 1] Boolean	[0, 0, 0] Boolean	[0, 0, 0, 0]	[0, 0, 0, 0]	0	7	0
7	[150.083, -86...	[4, 1] Boolean	[0, 0, 0] Boolean	[0.333333, 0.333333, 0.33333...	[1.73205, 1.73205, 1.73...	0	7	0
8	[-51.9812, -5...	[4, 1] Boolean	[0, 0, 0] Boolean	[0, 0, 0, 0]	[0, 0, 0, 0]	0	4	0
9	[-51.9812, -5...	[4, 1] Boolean	[0, 0, 0] Boolean	[0, 0.333333, 0, 0.333333]	[0, 1.73205, 0, 1.73205]	0	4	0
10	[202.064, -30...	[4, 1] Boolean	[0, 0, 0] Boolean	[0, 0, 0, 0]	[0, 0, 0, 0]	4	7	0
11	[202.064, -30...	[4, 1] Boolean	[0, 0, 0] Boolean	[0, 0, 0.333333, 0.333333]	[0, 0, 1.73205, 1.73205]	4	7	0

Restore Columns | Resize Headers

PAGE NAVIGATION | First | << | [1 / 2022] | >> | Last | 1 | Go | Loading 1000 rows.

browsetable

Table Browser

File Edit View Tools Export Help

jupiter6cm_flagdemo.ms

table data | table keywords | field keywords

	Keyword	Type	Value	Extra Information
1	MS_VERSION	Float	2	
2	ANTENNA	Table	/Locale/CASA/tutorials/ESO-tutorial/Jupiter/flagdemo/jupiter6cm_flagdemo.ms/ANTENNA	Subtable has 28 rows.
3	DATA_DESCRIPTION	Table	/Locale/CASA/tutorials/ESO-tutorial/Jupiter/flagdemo/jupiter6cm_flagdemo.ms/DATA_DESCR...	Subtable has 2 rows.
4	FEED	Table	/Locale/CASA/tutorials/ESO-tutorial/Jupiter/flagdemo/jupiter6cm_flagdemo.ms/FEED	Subtable has 28 rows.
5	FLAG_CMD	Table	/Locale/CASA/tutorials/ESO-tutorial/Jupiter/flagdemo/jupiter6cm_flagdemo.ms/FLAG_CMD	Subtable has no rows.
6	FIELD	Table	/Locale/CASA/tutorials/ESO-tutorial/Jupiter/flagdemo/jupiter6cm_flagdemo.ms/FIELD	Subtable has 13 rows.
7	HISTORY	Table	/Locale/CASA/tutorials/ESO-tutorial/Jupiter/flagdemo/jupiter6cm_flagdemo.ms/HISTORY	Subtable has 6943 rows.
8	OBSERVATION	Table	/Locale/CASA/tutorials/ESO-tutorial/Jupiter/flagdemo/jupiter6cm_flagdemo.ms/OBSERVATION	Subtable has 1 rows.
9	POINTING	Table	/Locale/CASA/tutorials/ESO-tutorial/Jupiter/flagdemo/jupiter6cm_flagdemo.ms/POINTING	Subtable has no rows.
10	POLARIZATION	Table	/Locale/CASA/tutorials/ESO-tutorial/Jupiter/flagdemo/jupiter6cm_flagdemo.ms/POLARIZATION	Subtable has 1 rows.
11	PROCESSOR	Table	/Locale/CASA/tutorials/ESO-tutorial/Jupiter/flagdemo/jupiter6cm_flagdemo.ms/PROCESSOR	Subtable has no rows.
12	SPECTRAL_WINDOW	Table	/Locale/CASA/tutorials/ESO-tutorial/Jupiter/flagdemo/jupiter6cm_flagdemo.ms/SPECTRAL_...	Subtable has 2 rows.
13	STATE	Table	/Locale/CASA/tutorials/ESO-tutorial/Jupiter/flagdemo/jupiter6cm_flagdemo.ms/STATE	Subtable has no rows.
14	SOURCE	Table	/Locale/CASA/tutorials/ESO-tutorial/Jupiter/flagdemo/jupiter6cm_flagdemo.ms/SOURCE	Subtable has no rows.
15	SORTED_TABLE	Table	/Locale/CASA/tutorials/ESO-tutorial/Jupiter/flagdemo/jupiter6cm_flagdemo.ms/SORTED_TAB...	Subtable has 57375 rows.
16	SORT_COLUMNS	String Array	[ARRAY_ID, SCAN_NUMBER, FIELD_ID, DATA_DESC_ID, TIME]	

CASA in practice

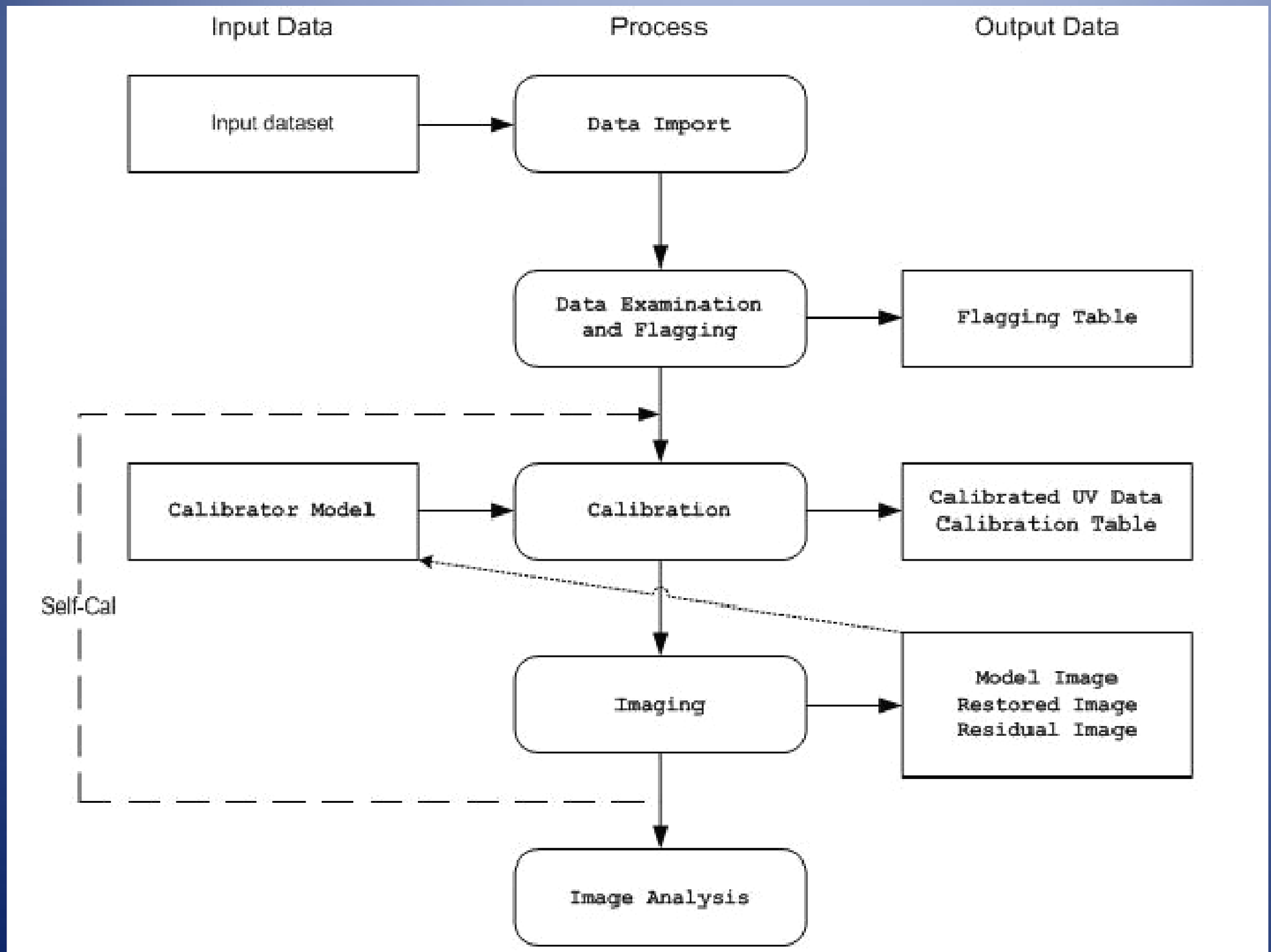
Functionality Census

- **Import**: importuvfits (for uv FITS e.g. from AIPS), importfits (for image FITS)
- **Export**: exportuvfits (for uv FITS), exportuvfits (for image FITS)
- **Information**: listobs, listcal, listhistory, imhead
- **Editing**: flagautocorr, flagdata, flagmanager, plotxy,viewer
- **Display**: clearplot, plotants, plotcal, plotxy, viewer
- **Calibration**: accum, applycal, bandpass, gaincal, fluxscale, clearcal, listcal, smoothcal
- **Imaging**: clean, feather, ft, invert, makemask
- **Modelling**: setjy, uvcontsub, uvmodelfit
- **Analysis**: imhead, imcontsub, imfit, immath, immoments, imstat, imval, imregrid

Data Philosophy

- Original data kept intact by default
  - DATA (and WEIGHT) columns
    - do not change in original MS
    - user can use toolkit to mess with these also
- MS "scratch columns" are used
  - used for adjusted data and model visibilities

CASA in practice



CASA Workflow Chart

Import Data

- task importuvfits
  - UVFITS data (e.g. from AIPS)
- task importvla
  - VLA "export" format (e.g. from archive)
- task importasdm
  - ALMA data format (also EVLA eventually)

Data Examination

- task listobs
  - list summary of MS
- task plotxy
  - x-y line plots
- task browsetable
  - java browser for tables
- casaviewer
  - view raster images of MS

Flagging

- interactive flagging
  - task plotxy
  - task viewer (casaviewer)
- non interactive flagging
  - task flagdata
- managing flags
  - task flagmanager

Plotxy for data plotting & flagging

CASA in practice

Applications Places System

Arturo Mignano 9 °C Thu Nov 26, 3:10:17 PM

Log Messages (arcbl01.ira.inaf.it:/arcfs0/homesarc/amignano/casapy.log) (on arcbl01.ira.inaf.it)

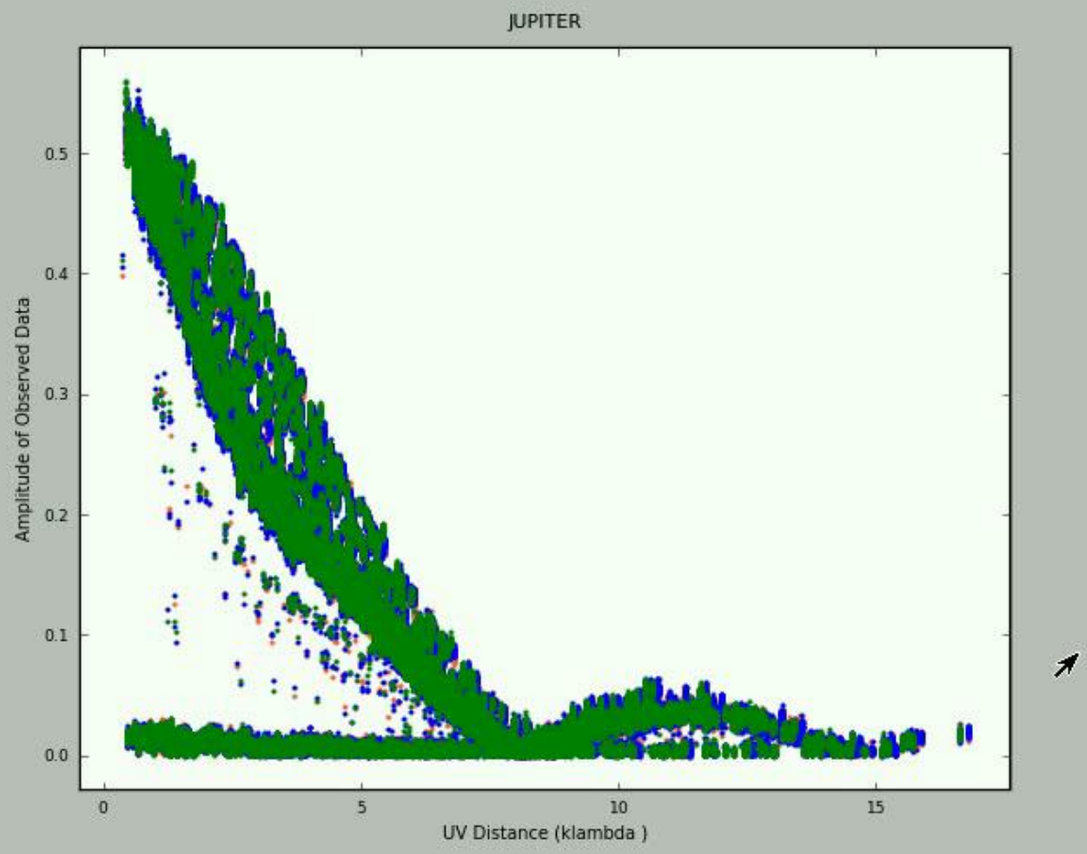
File Edit View

Search Message: Filter: Origin

Time	Priority	Origin	Message
2009-11-26 14:09:52	INFO	plotxy::::	Done Processing data ...
2009-11-26 14:09:52	INFO	plotxy::::ca…	
2009-11-26 14:09:52	INFO	plotxy::::ca…	##### End Task: plotxy #####
2009-11-26 14:09:52	INFO	plotxy::::ca…	##

Insert Message: Lock scroll

CASA Plotter



Mark Region Flag Unflag Locate Next Quit

Mark Region mode

IPy dataset/Jupiter

File Edit View Terminal Tabs Help

```
Look in logger to see what it is
You see much is Antenna 9 (ID=8) in spw 1
Return to continue script
INFO2 Number of points being plotted : 139905

INFO2 Number of points being plotted : 5376
Total process time 4.93 sec.
Total wall clock time 5.55 sec.

-------------------------------------------------------
Plotting vs. time antenna='9' and spw='1'
Box up last 4 scans which are bad and Flag
Return to continue script
INFO2 Number of points being plotted : 2594

INFO2 Number of points being plotted : 71571
INFO2 Number of points being plotted : 68334
Total process time 6.46 sec.
Total wall clock time 7.26 sec.

-------------------------------------------------------
Back to all data
Clean up remaining bad points

Return to continue script

INFO2 Number of points being plotted : 114750
INFO2 Number of points being plotted : 114750
Total process time 7.14 sec.
Total wall clock time 7.77 sec.

-------------------------------------------------------
Now plot JUPITER versus uvdist
Lots of bad stuff near bottom
Lets go and find it - try Locate
Looks like lots of different antennas but at same time
Return to continue script
```

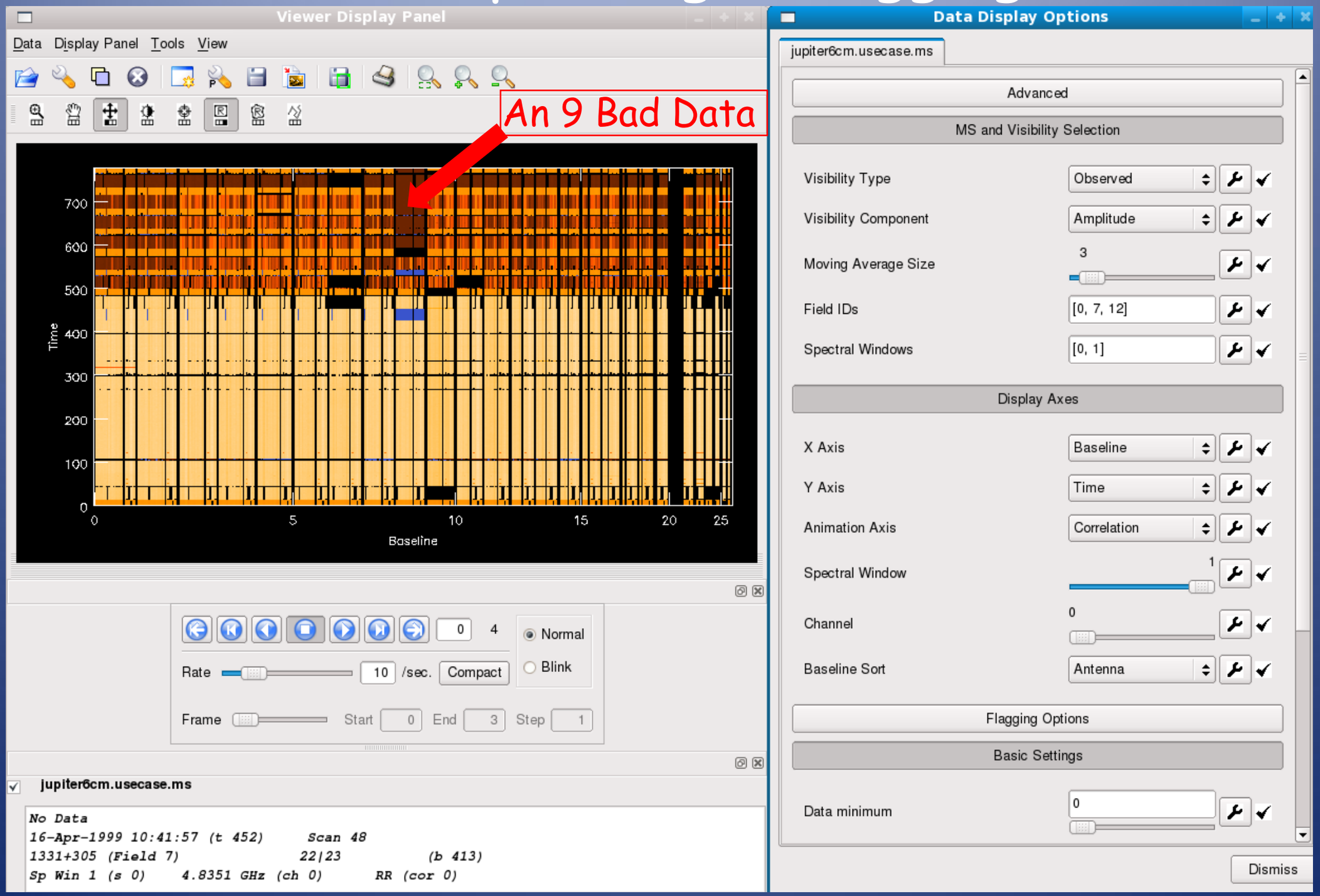
IPy dataset/Jupiter | (on arcbl01.ira.inaf.it) | [Terminal] | CASA Plotter

Workspace 1 | brera | Workspace 3

FLS | CASA | Workspace 6

2010

Viewer for data plotting & flagging



CASA in practice

- use flagdata to clip data

```
CASA <19>: inp
---------> inp()
#  flagdata ::  All purpose flagging task based on selections
vis                 = 'jupiter6cm_flagdemo.ms' #  Name of file to flag
mode                = 'manualflag'      #  Mode (manualflag, quack, shadow, autoflag, summary)
     autocorr       =      False        #  Flag autocorrelations
     unflag         =      False        #  Unflag the data specified
     clipexpr       =    'ABS RR'       #  Expression to clip on
     clipminmax     = [0.0, 0.75]       #  Range to use for clipping
     clipcolumn     =      'DATA'       #  Data column to use for clipping
     clipoutside    =       False       #  Clip outside the range, or within it

spw                 =          ''       #  spectral-window/frequency/channel
field               = '1331+305'        #  Field names or field index numbers: ''==>all, field='0~2,3C286'
selectdata          =       True        #  More data selection parameters (antenna, timerange etc)
     antenna        =          ''       #  antenna/baselines: ''==>all, antenna = '3,VA04'
     timerange      =          ''       #  time range: ''==>all, timerange='09:14:0~09:54:0'
     correlation    =          ''       #  Select data based on correlation
     scan           =          ''       #  scan numbers: ''==>all
     feed           =          ''       #  multi-feed numbers: Not yet implemented
     array          =          ''       #  (sub)array numbers: ''==>all
     uvrange        =          ''       #  uv range: ''==>all; uvrange = '0~100klambda', default units=meters

async               =      False        #  If true the taskname must be started using flagdata(...)
```

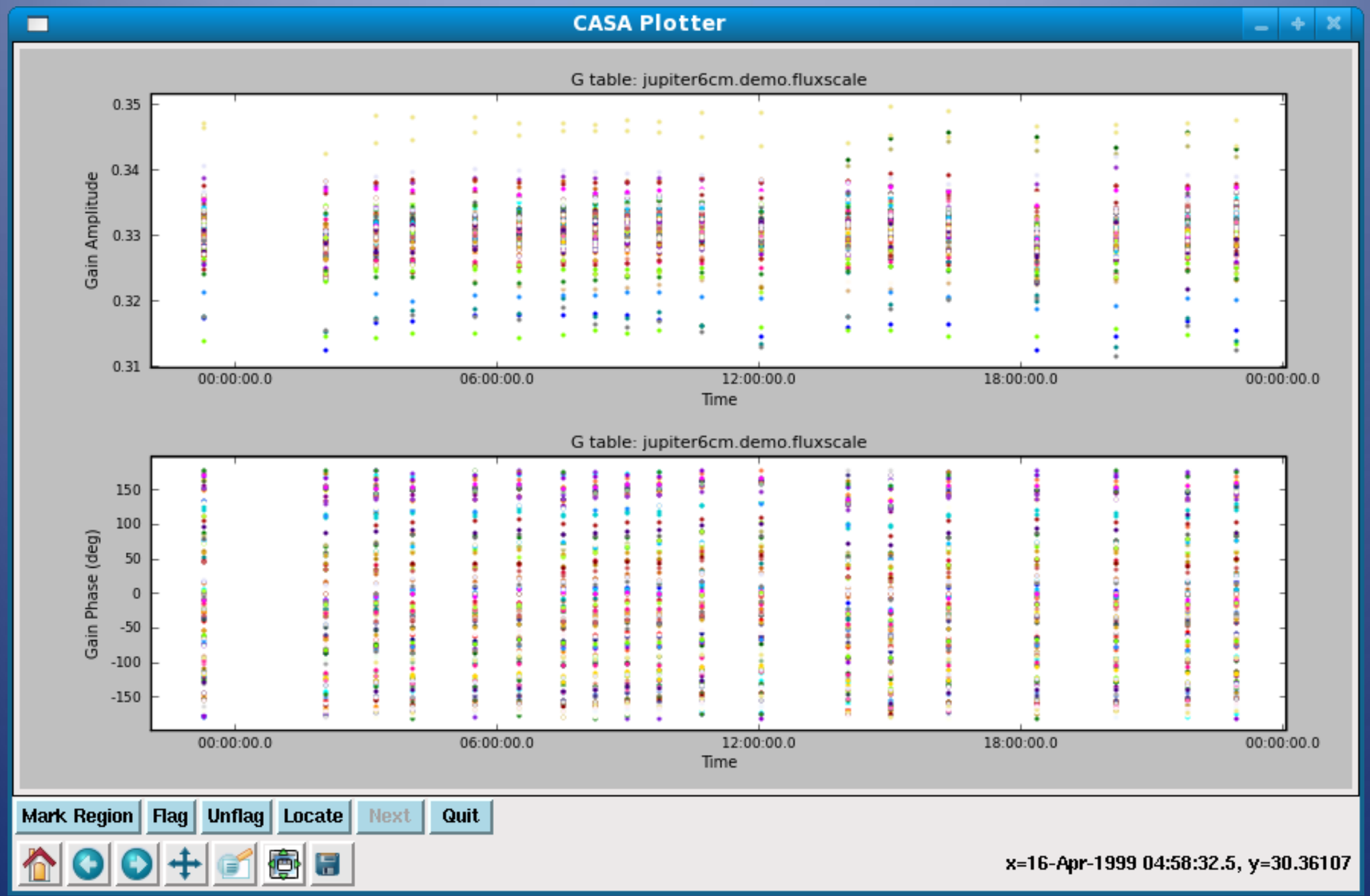
- set clipping levels as [min,max]

Calibration

- prior calibration: setjy
- solvers: gaincal, bandpass, blcal, fringecal
- manipulation: plotcal, accum, smoothcal
- application: applycal, split
- other: uvcontsub, uvmodelfit

CASA in practice

task plotcal will plot & edit calibration tables



CASA in practice

Imaging

- task clean (variety of algorithms)
  - single-field cleaning
  - uses mosaic uv-gridder (uv-plane mosaicing on single image)
- task feather: combine single-dish and uvMS
- task widefield: prototype task!

Interactive Clean

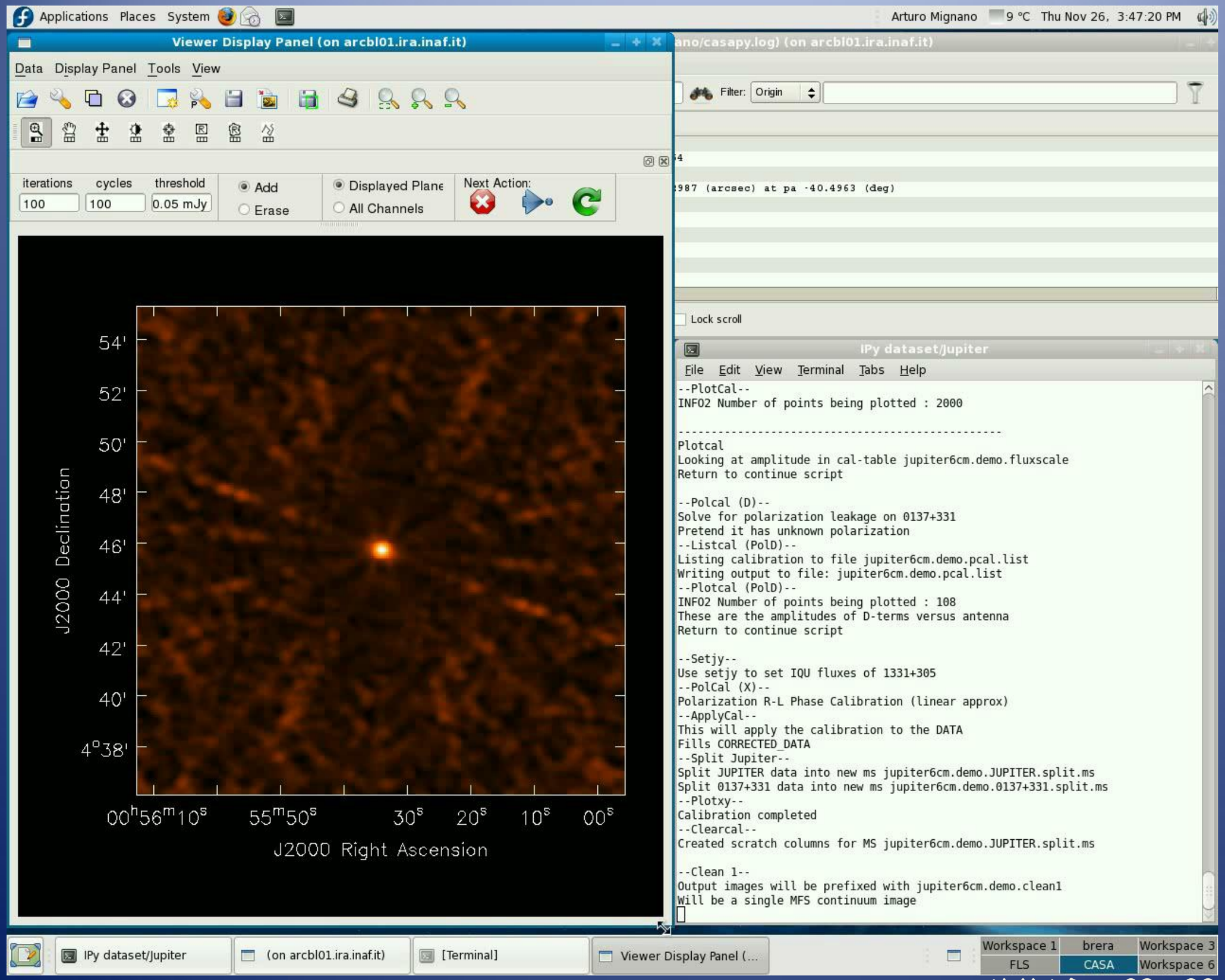


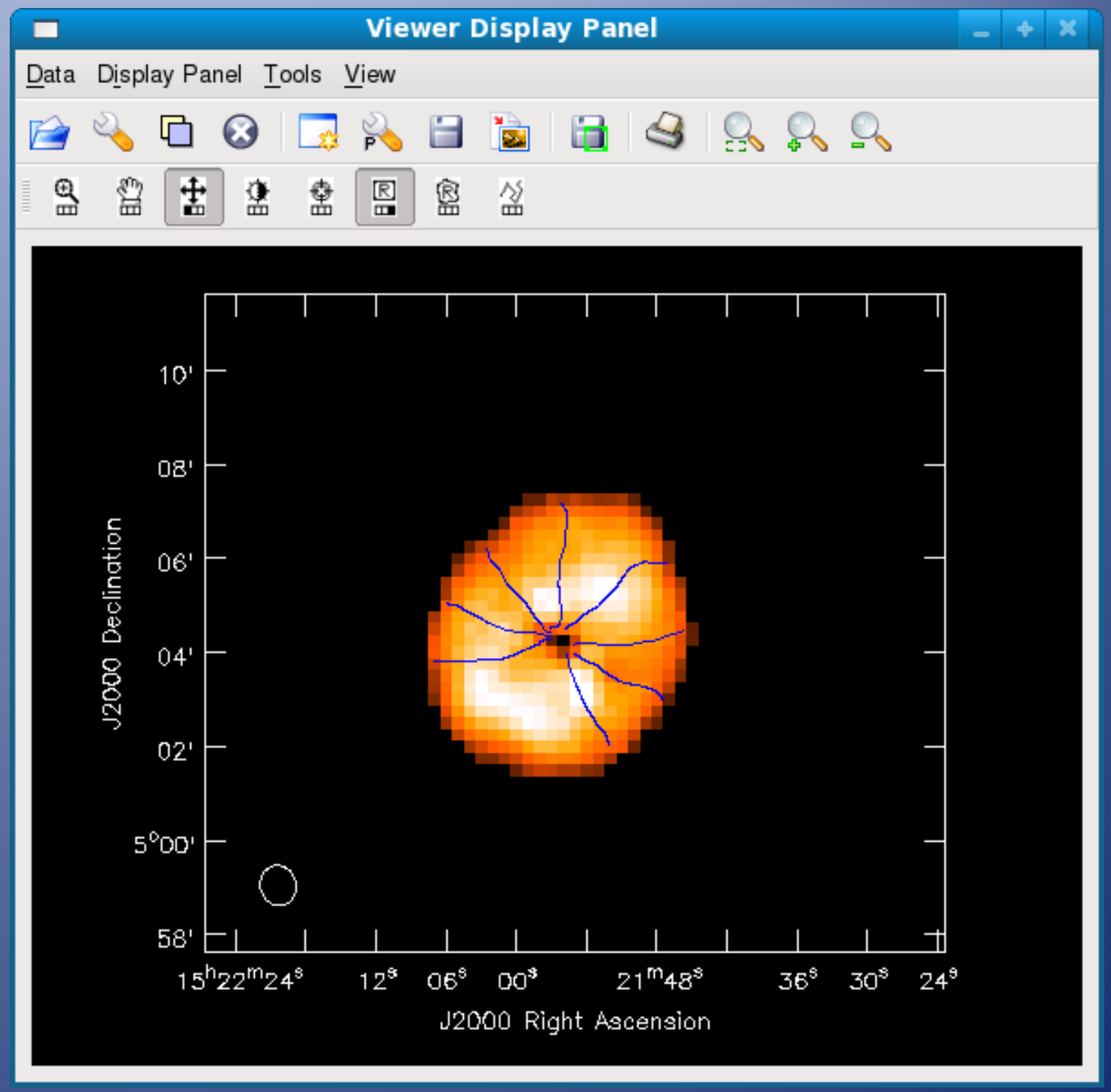
Image Analysis

- task imhead
  - get and change image header information, whole image statistics
- task immoments
  - computes moment images of spectral line cube
- task imstat
  - displays statistical information from an image region

CASA in practice

Task immoments

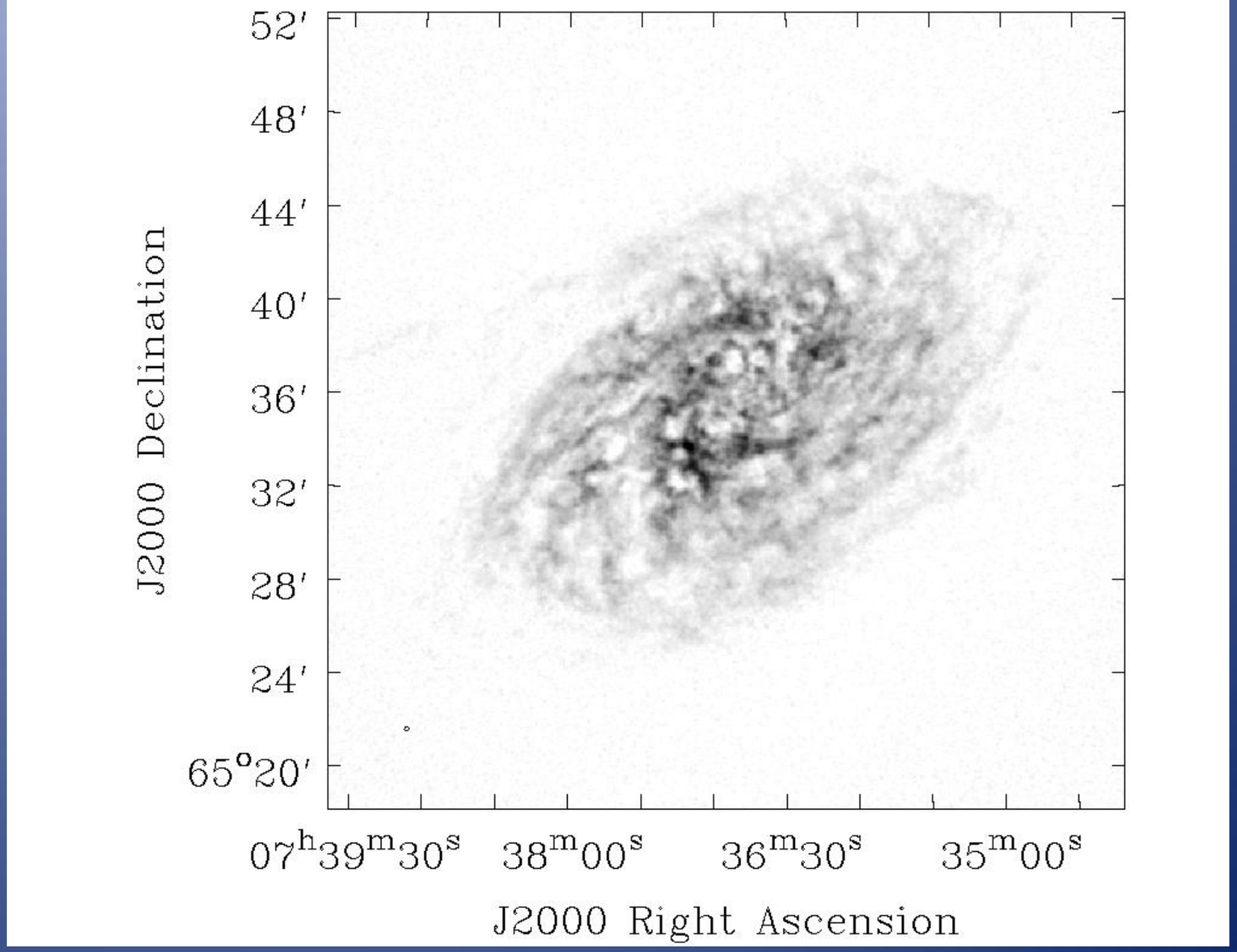
- use viewer to look NGC5921 VLA images
- Integrated intensity (m0) of HI
  +
  velocity contours (m1)



CASA in practice

Task immoments

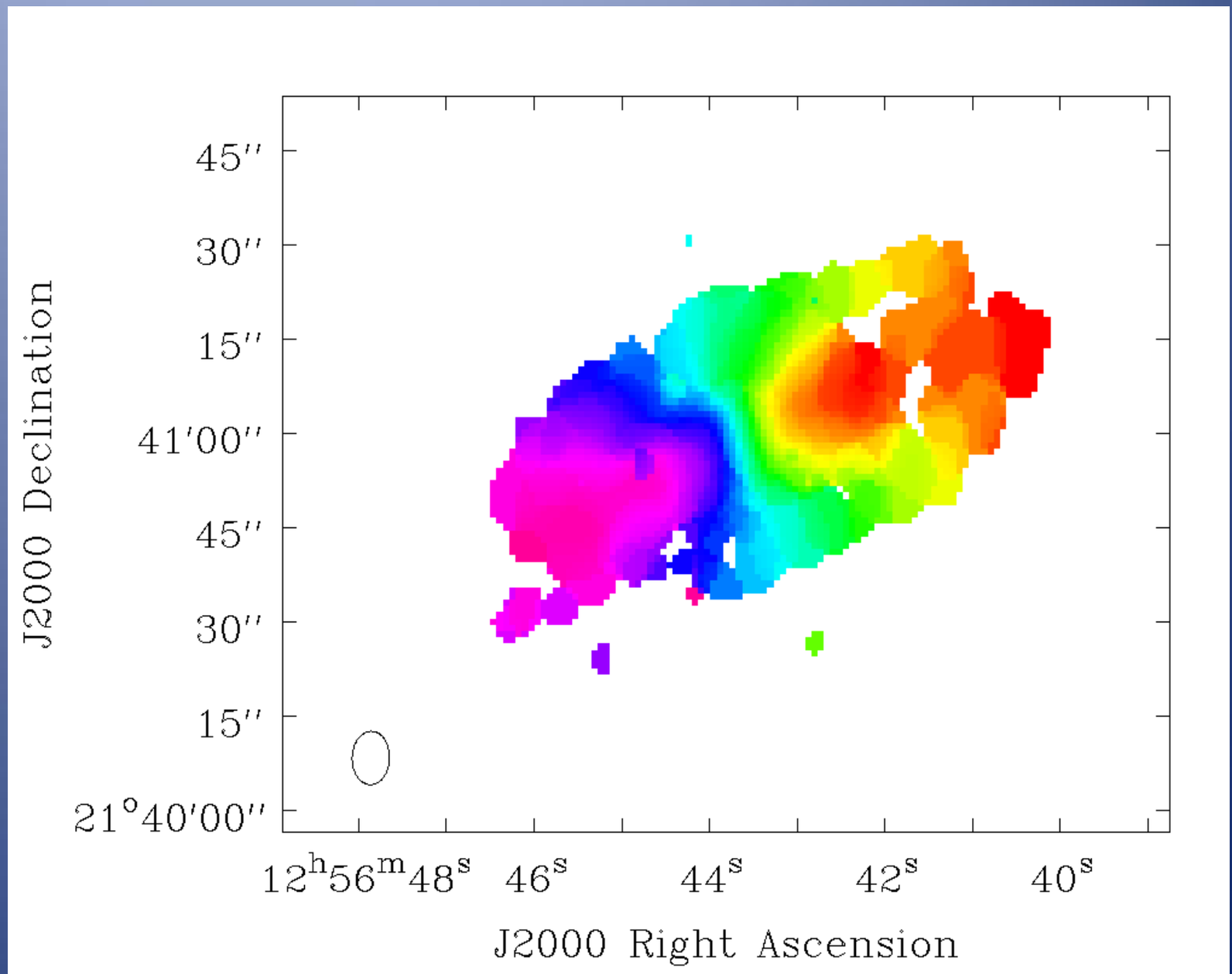
- Integrated VLA HI intensity (m0) in NGC2403



CASA in practice

Task immoments

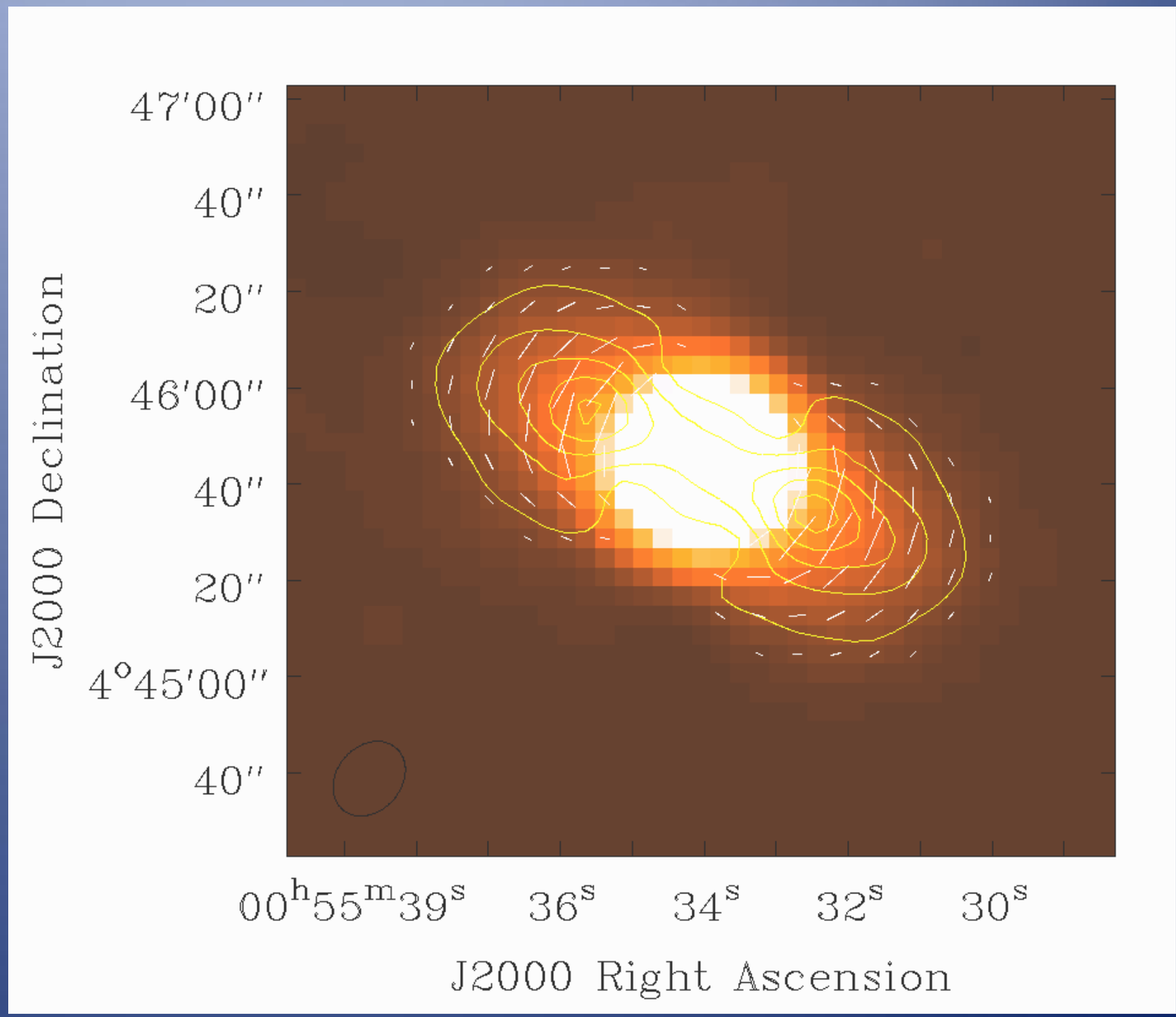
- CO velocity field (m1) for the BIMA SONG NGC4826
- BIMA 3mm mosaic (7 pointings)



CASA in practice

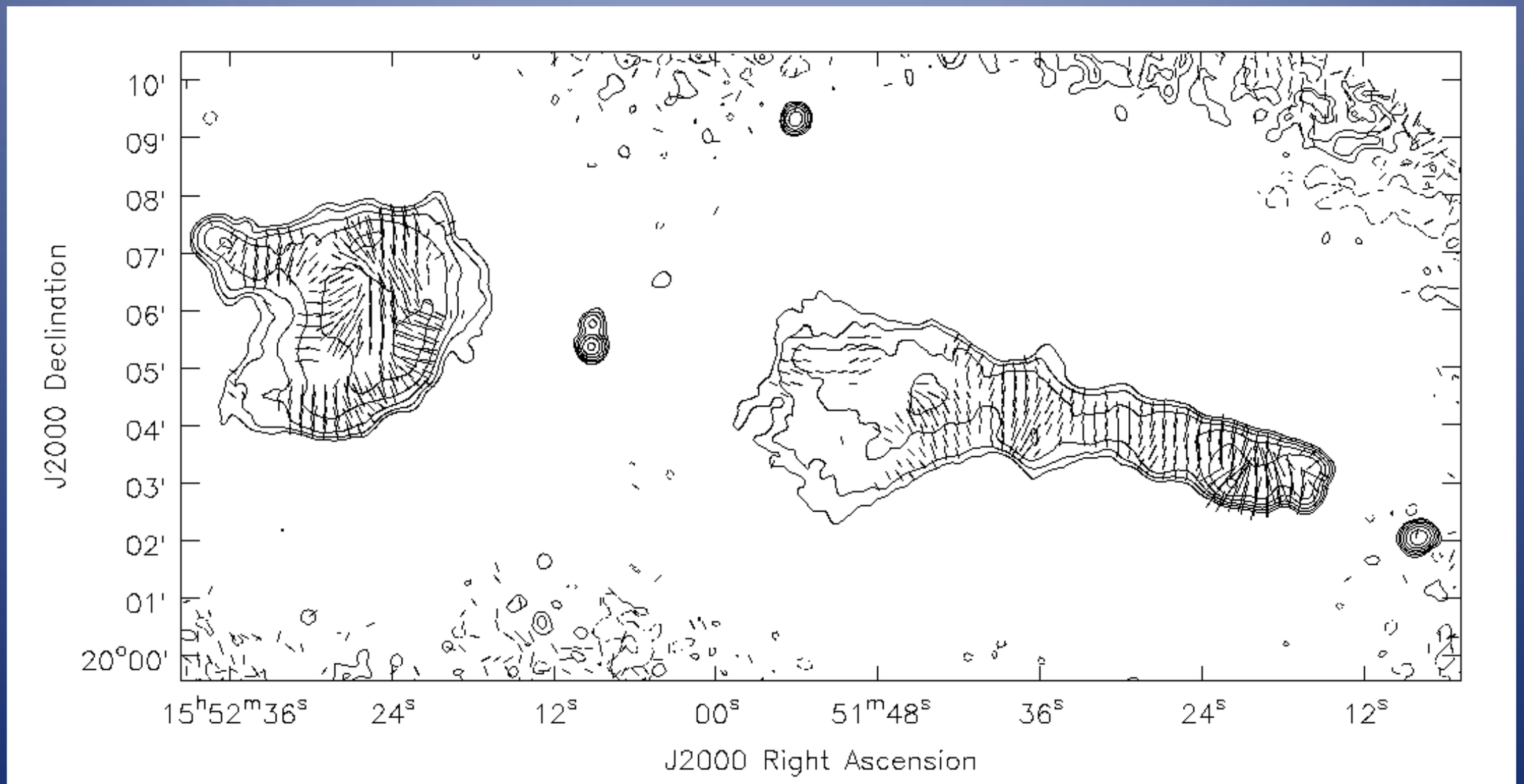
VLA C band image of Jupiter

- Total intensity
+
polarised int. contours
+
magnetic field polarisation vectors



VLA C band mosaic of 3C326

- Total intensity + electric field polarisation vectors



CASA in practice

Casa can:

- Import/export uvfits, VLA archive data, ASDM
  - VLA, ATCA (through MIRIAD), SMA and PdB (work in progress)

Casa can't:

- Import FITS calibration tables (e.g. CL,FG,etc.)
- solve delay, phase, rate VLBI combinations
- have mosaic and widefield
- Painful flagging through plotxy (→ plotms, beta v.)

Overall impression

- Works well for most VLA
- worth using for ATCA, CARMA etc. if AIPS unsuitable
- will be suitable for ALMA
  - See simdata task and future development
- and you can invoke any python functions (including accessing the rest of your system)

Status of the sw development

- Since Oct 2007 in Beta release.
  - still lacking of functionality
  - there are known failure modes
  - finding new problems

- download allowed after registration at the NRAO website (http://my.nrao.edu)

- the first public release (3.x) in December 2009, patch 3.0.1 (April 2010)

- development platforms: Linux (RH) + Mac Os X

  - supported platforms: also Fedora, openSuSe, Ubuntu, Debian

CASA User Support

- First cadre of "support specialists" trained in CASA Training Boot Camp, Socorro October 2007
- After that, CASA training sessions have been organized in Santiago, Socorro…
- … in Europe from April 2008 about 2 tutorials per year…
  - Casa Tutorial in Bologna (27-29 of April 2010)
  - Next one in Oxford ? (July 2010)

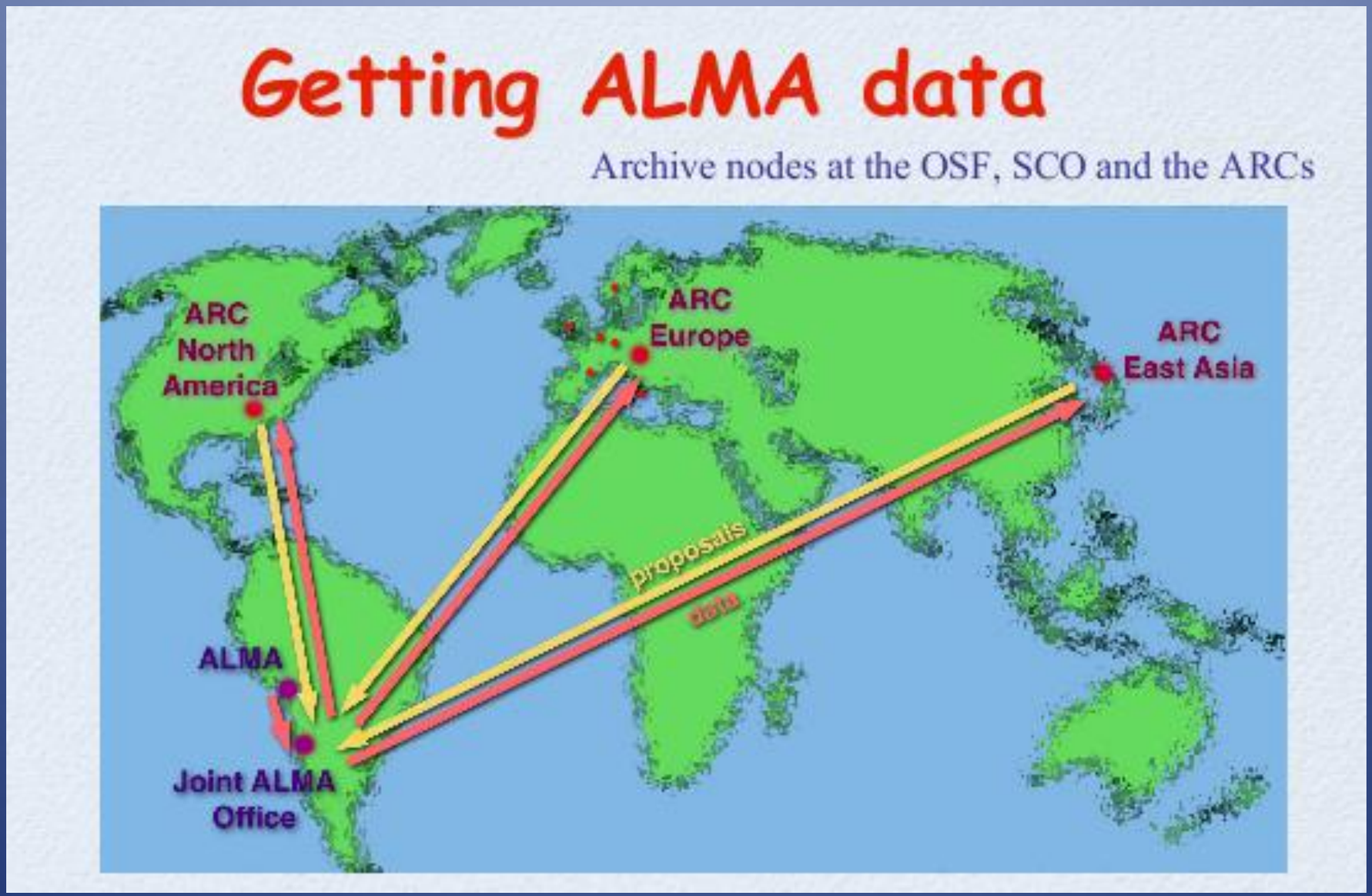
CASA User Support

- For informal queries and upfront support: contact your ALMA Regional centre

- For real bugs/ missing functionality/ problems/ questions: Use the CASA helpdesk at my.nrao.edu
  - tickets will be answered by (European) user support specialists
  - they may create a real 'JIRA' ticket if needed

ALMA Data Product

Archive nodes at the OSF, SCO and the ARCs



ALMA Data Product

Getting ALMA data

- Queue based dynamic scheduling
- Raw data passed through multi-tiered quality assurance
- Data proceeds to pipeline and archiving
- Data available from ARC (ESO) within ~2 weeks (TBD)
- Pipeline products (images and calibrated u-v data), raw data, and offline data processing software made available to PIs
    - Pipeline available towards end of construction

f2f Support at the ARCs

ALMA pipeline provides high quality products, but…

- Expert hands-on data reduction help from ARC nodes staff provided on request
  - … for problems and/or complicated observing techniques →local ARC node
  - … for projects related to a particular expertice → specialist ARC node
- The first point of contact for data reduction help is the ESO node in Garching

f2f Support at the ARCs

Italian ARC node located in Bologna

- Expertise: Data Handling/ Grid Technology, Polarimetry, Mosaicing, Surveys
- Contact person Jan Brand
- 6 staff members
- 3 postdoc
- 1 system manager
- Website: www.alma.inaf.it

CASA on the Web

- http://casa.nrao.edu -- CASA Home Page
- Main resource for end users
  - http://my.nrao.edu -- NRAO Services (incl. registration/download of CASA)
- Help Desk/Installation Front; manned by scientists (ALMA, ARC, NAUG, etc) to handle front-line users support.

Casa Documentation

- CASA Analysis cookbook: http://casa.nrao.edu/Doc/Cookbook/casa_cookbook.pdf
- CASA User Reference Manual: http://casa.nrao.edu/docs/casaref/CasaRef.html
- Python: http://python.org/doc (e.g., see Tutorial for novices)
- IPython: http://ipython.scipy.org/moin/Documentation
- matplotlib: http://matplotlib.sourceforge.net/