EXERCISE 2 - Imaging Cygnus A with CASA

AIMS: Make a LOFAR image of Cygnus A using CASA.

DETAILS: The calibration and imaging of LOFAR data will be carried out using Black-Board Self-calibration (BBS), which allows direction dependent gains to be calculated and for the data to be processed over a multi-node cluster. However, for objects that dominate the sky brightness distribution, classic data reduction algorithms can be employed, e.g., AIPS, MIRAD, CASA, DIFMAP. In this exercise, the student will produce an image of the brightest radio galaxy in the LOFAR sky, Cygnus A, using CASA.

LEARNING OBJECTIVES:

1. Inspect NDPPP processed data and flag any remaining outliers.
2. Use CASA to calibrate and produce a flux calibrated image of Cygnus A.
3. Be able to apply these methods to other LOFAR observations.

PROCEDURE: To run CASA,

> use Casa (from login to set up links)

> casapy (starts casapy)

You will now be in the CASA environment.

> tasklist (prints all of the available CASA tasks)

> help <task name> (gives detailed information on task)

> inp <task name> (inspect / edit task parameters)

Note that if you edit the parameter file wrongly then the edit will appear in red.

> go <task name> (run task)

> tget <task name> (recall task parameters - task.last)

DATA: The data set for this task can be found in,

location: /home/mckean/SCHOOL/SB105.MS.dppp

This data set of Cygnus A was taken with the HBA at 135.5 MHz and has a bandwidth of 0.2 MHz, and all four polarization's (XX, YY, YX, XY). The data has been flagged through NDPPP and compressed to a single channel. The total time on-source is 6 hours and the visibility averaging time is 3 seconds. There are 4 remote stations and 18 core-stations (9 actual stations, but with the 'ears' of the core stations split).

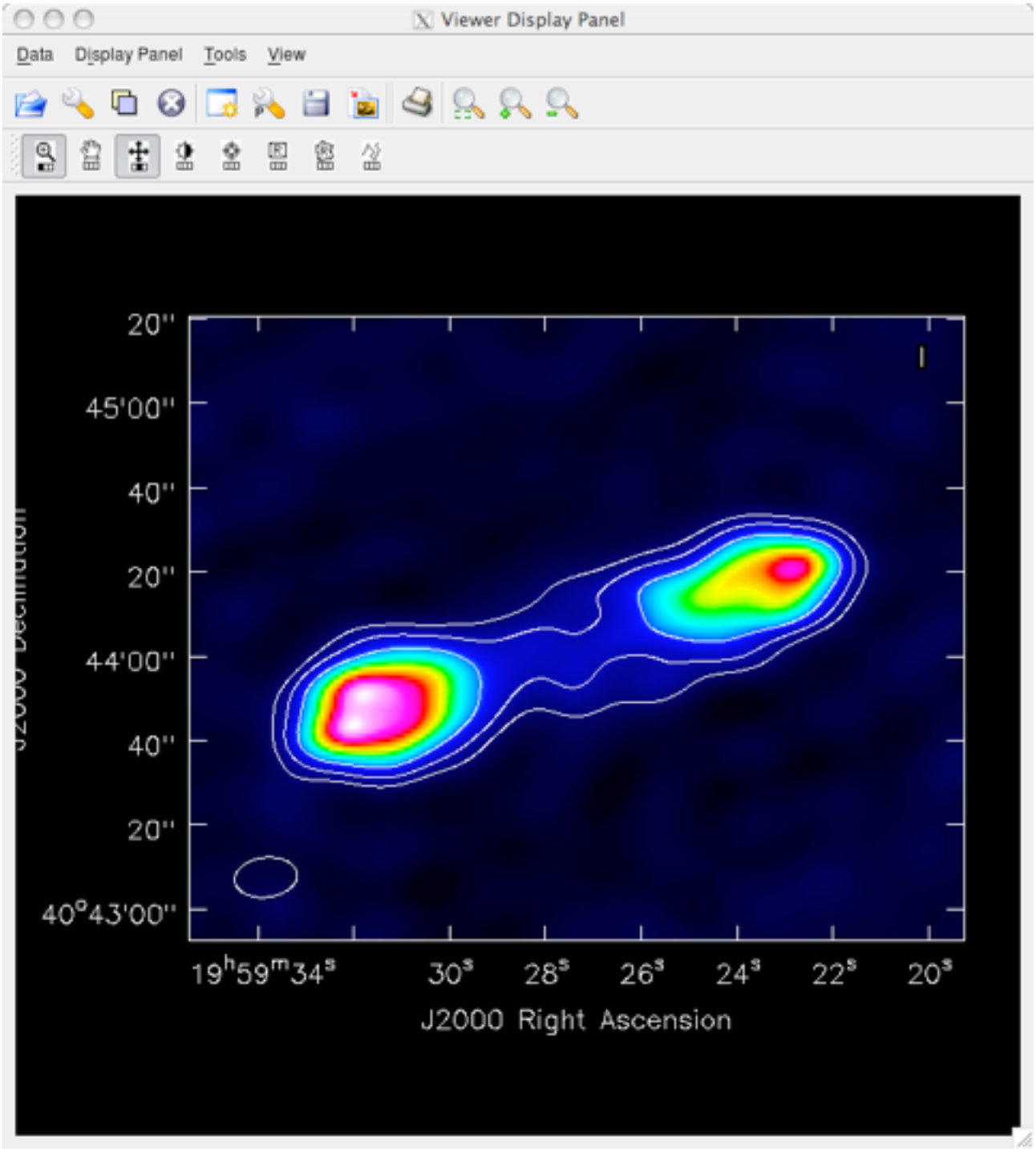
The data is in MEASUREMENT SET format, which is a new standard of data set that is made up of tables and columns. The key information is that the raw data are in the DATA column, the calibrated data are in the CORRECTED column, and the model for the data is kept in the MODEL column. By comparing the CORRECTED and MODEL columns, you can also see the RESIDUAL.

During the calibration process, a VLA 330 MHz image will be used for the initial model. This can be found in,

location: /home/mckean/SCHOOL/Cyg_A-330MHz.model.fits

STEPS:

a. Use msinfo and uvplot to inspect the dataset and remove any bad stations with NDPPP.
b. LISTOBS: task to list the parameters of an observation (printed to your CASA message window).
c. PLOTMS: inspect the data using the CASA plotting routine (AMP v TIME, AMP v UVDIST, etc). There are many plotting options, explore them. You can also flag data with PLOTMS.
d. SETJY: this task can be used to set the flux-scale; given the observing frequency and known spectrum of Cygnus A, you can estimate the flux of Cygnus A at 135 MHz. You can also populate the model column using the model image from the VLA. First import the fits file of Cygnus A at 330 MHz using IMPORTFITS and then run SETJY with the model file you create. Check the model column has been filled using PLOTMS.
e. GAINCAL: this task creates a calibration table for the data by comparing the raw data and model columns in the measurement set. Most of the parameters can be left as the defaults. You must give a name for the output caltable and think about the solution averaging time you want to use for the solutions.
f. PLOTCAL: this task can be used to inspect the solutions and edit poor solutions.
g. APPLYCAL: this task applies the calibration and writes it to the CORRECTED column in the measurement set. Note that gaintable=<what you called caltable>.
h. PLOTMS: plot the corrected data and flag any bad visibilities, baselines or antenna. Plotting the residual column is useful to help identify bad data for complicated sources.
i. CLEAN: this is the main imaging task within CASA for small field imaging. The important parameters to think about are the cell size, imagesize and the weighting. You can clean interactively also.
j. VIEWER: Look at your image using the viewer task.
k. SETJY: Your clean components (file.model) can be used as a new model for the calibration. These are inserted into your measurement set MODEL column using SETJY.
l. GAINCAL, APPLYCAL, CLEAN, SETJY: You can iterate a self-calibration loop by running through the process, editing bad data as you go.


Viewer Display Panel
Data
Display Panel
Tools
View
20''
45'00''
40''
20''
44'00''
40''
20''
40°43'00''
19h59m34s
30s
28s
26s
24s
22s
20s
J2000 Right Ascension