Astronomy 423 Homework Set 6

Due: Wednesday, Mar. 22

1. Show that for any source, the visibility function at zero baseline length (u = 0, v=0) is equivalent to the total flux density of the source. Explain why it is difficult for an interferometer to measure the visibility function at zero baseline length.

2. Calibrate your VLA continuum data on L1157 using AIPS. You should use the tutorial handouts (AIPSatUNM.pdf and http://www.phys.unm.edu/~gbtaylor/astr423/AIPStutorial.pdf) which contains some local information about running AIPS and some excerpts from the AIPS cookbook. If needed you can also consult the VLA calibrator manual (https://science.nrao.edu/facilities/vla/observing/callist) and the AIPS cookbook (http://www.aips.nrao.edu/cook.html). I have already loaded the data for you, applied bandpass calibration, and averaged up the channels within each IF. Your job is to do the editing, absolute flux and phase calibration, and to make an image. As you go along answer the following questions for these 5 GHz observations:

a) Inspect the data with LISTR optyp 'scan'. How much time on source did you obtain? Estimate the efficiency of the observing as the ratio of total time on L1157 to the total time on all sources and calibrators at 5 GHz. Do you see any way the efficiency could be improved if we were to observe again?

b) Run UVPLT to show the (u,v) coverage on your target source for all 5 IFs. Use LWPLA to convert this plot to a PDF file that you can print out and turn in as part of this homework.

c) Use UVPLT to make a plot of amplitude vs (u,v) distance on 3C48 for any one of the 5 IFs in stokes 'RR'. What is the approximate total flux density of 3C48?

d) Check for bad data with UVPLT and TVFLG. Can you find any bad data? Describe the time(s) and antenna(s) or IF(s) affected. In TVFLG you should look at amplitudes, and rms of amplitude. Watch out for low visibilities which can be tricky to spot.

e) Use UVPLT to make a plot of amplitude vs (u,v) distance on J2148+6107. Based on the visibility data what do you expect this source to look like?

f) Run CALIB on J2148+6107 with phase-only (solmode='p') and 10 second integrations to clean up the phase. Put the results in SN table 1. How many good solutions did CALIB report? If CALIB fails on more than 5% of solutions then go back to (d).

g) Use CALRD to read in a model of 3C48 at C band. Then use that image as input to CALIB and clean up the phases on 3C48. Add results to SN 1. How many good solutions did CALIB report?

h) Use CLCAL to apply the phase calibration and create a new CL table 2. Use SNPLT to plot up the phase solutions in CL table 2. Print the solutions for IF 1, stokes 'RR', antennas 9, 10 and 11 on a single page. Don't print hardcopy solutions for every IF and every antenna!

i) Run SETJY on 3C48 with opcode 'calc' to set the IF flux densities. What flux density does SETJY report for IF 1?
j) Run CALIB on 3C48 (using the model again) to make SN table 2 using solmode 'A&P' and solint 1 minute. How many good solutions?
k) Run CALIB on J2148+6107 to add gain solutions to SN table 2. How many good solutions?
l) Run GETJY to derive flux densities for J2148+6107. What flux density do you get for IF 1? Do you get reasonable flux densities for all IFs?
m) Run CLCAL to apply the gain calibration and create new CL table 3.
n) Make an image (Stokes I) of L1157 using IMAGR. See anything? What peak flux density to you get in the image? Take a screen capture or make a contour plot of your image using task CNTR and turn that in as part of this assignment.
o) Compute the thermal noise in mJy/beam using either the equation in the VLA OSS, or the VLA sensitivity calculator. Compare that to the measured rms noise in a box off the source (you can find it using TVWIN and IMEAN) in the image you made in the previous step.