ASTR 257 - Homework 5

Due: June 11 (in my mailbox by 5pm)

1. Figure 1 shows an image of the Cygnus A radio galaxy first discovered by Reber in 1939. This image was taken with the VLA at a wavelength of 6 cm. A couple of example size scales are shown. If you want to resolve the small scale structure evident in this image while also being able to detect the diffuse radio lobes, which VLA configuration should you use? The possible configurations are **A:** $b_{max} = 36.4$ km, $b_{min} = 0.68$ km; **B:** $b_{max} = 11.1$ km, $b_{min} = 0.21$ km; **C:** $b_{max} = 3.4$ km, $b_{min} = 0.035$ km; **D:** $b_{max} = 1.03$ km, $b_{min} = 0.035$ km.

2. Figure 2 shows the log(N)-log(S) of 1.4 GHz radio sources, that is the (log) number of sources per arcsec^2 as a function of source flux.

a. Lets say you can reach a source sensitivity of 1 μJ. Are you confusion limited for VLA in the A configuration? What about the VLA D configuration? Use the solid line in Figure 2.

b. Figure 3 shows the log(N)-log(S) of gamma-ray sources as detected by Fermi-LAT. Lets say you can reach a source sensitivity of 2×10^{-9} photons/cm^2/s. Are you confusion limited for Fermi-LAT at 100 MeV? At 100 GeV?

Note: The other regime in which confusion is a problem in mid and far-IR. The diffraction limit of current space telescopes is large at these wavelengths.

3. Briefly describe how one can detect gamma-rays at 1 GeV and at 1 TeV.

4. Briefly describe the following types of astronomical instruments and their purpose: CCD, bolometer, aperture synthesis telescope, grazing incidence optics, tank of cleaning fluid.

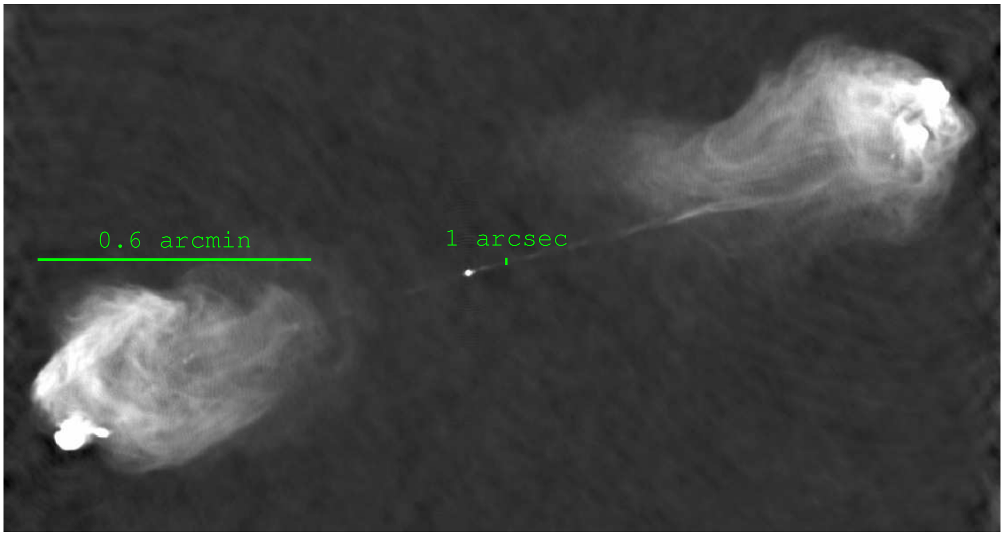

Fig. 1.— VLA image of Cygnus A at $\lambda = 6$cm.

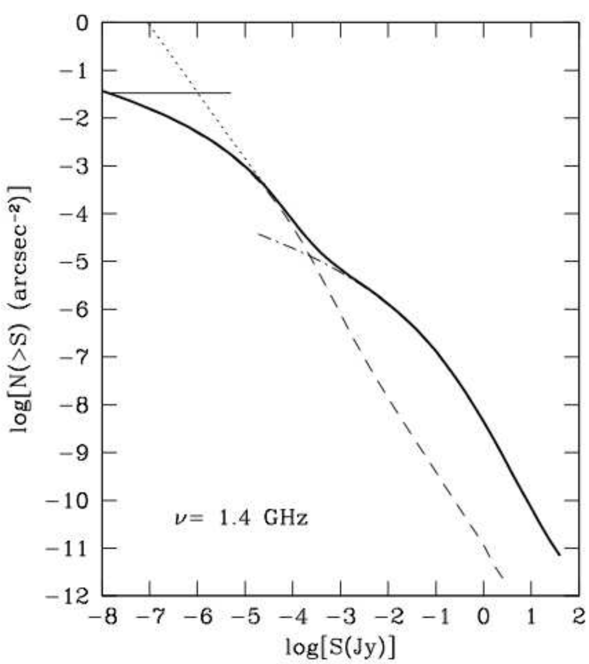

Fig. 2.— Number density of sources at 1.4 GHz as a function of flux.

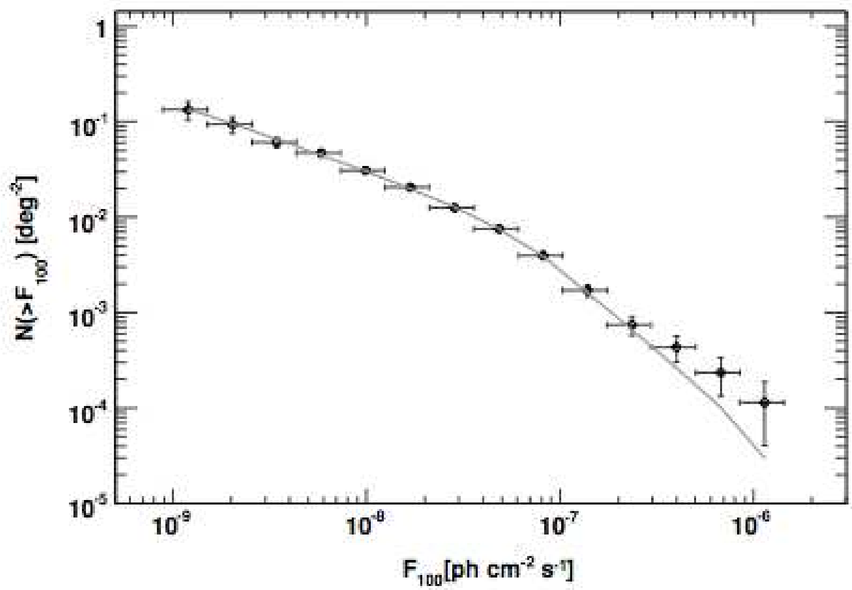

Fig. 3.— Number density of gamma-ray sources as a function of flux.