

**Homework No. 6**

**Due: Wednesday, March 11, 2009**

**The Crab Pulsar**

**(1) Get the data. (5 points)**

Padi Boyd was kind enough to send unpublished data of the variability of the Crab pulsar, obtained with the High Speed Photometer aboard the Hubble Space Telescope. Go to the class web page and download (1) the data, (2) the description of the data, and (3) the binned data. The original data is mostly zeros, and the file that was sent had only the non-zero entries. I've taken a portion of the data and binned it into millisecond bins, and outputted the binned data, with zeros for the time bins that had no photons detected. About 153 photons of the total 2239 she sent were in the output binned data.

Make a plot of the light curve for the Crab pulsar.

**(2) Use your power spectrum program to find the period (10 points).**

Attach a plot of the power spectrum. Hint: the period is about 33 msec.

In general, the lowest frequency spike corresponds to the fundamental frequency of the light curve. What is the explanation of the other prominent spikes?

**(3) Conditions on the surface of the NS (10 points).** Neutron stars generally have masses of about 3 solar masses and radii of the order of 10 km. Assume such a mass and radius and use the period to answer the following.

- a. What is the linear speed of a point on the equator of the star? What percentage is this of the speed of light?
- b. What is the centripetal force necessary to keep the material of the surface near the equator in place in orbit around the center? What is the gravitational force at the surface of the object, and how does that compare?

**(4) Make a phased light curve of the Crab, using all the data. (20 points).**

Attach a plot of the phased light curve, and the code you wrote to generate it.