Planet Formation mini-course

Assignment 2

Due: Wednesday, June 13

1. A power-law size distribution, $dn \propto r^{-q}$, can only apply between some minimum and maximum radii $r_{\min}$ and $r_{\max}$. Assuming $r_{\min} \ll r_{\max}$, for what values of q is most of the mass in the largest particles? Most of the total number of particles? Most of the cross-sectional area?

2. A typical extrasolar planet system has a Jupiter-mass planet at semi-major axis $a \sim 0.1$ AU. Would you expect such a system to have an Oort comet cloud, assuming it was formed in the same way as the solar system cloud? If not, why not?

3. If new comets are produced mainly by the influence of the Galactic tide on comets in the Oort cloud, what signature would you expect to see in the distribution of aphelion directions of new comets?

4. The "Pioneer anomaly" is an unexplained acceleration in the Pioneer 10 and 11 spacecraft, directed towards the Sun, of magnitude $a \simeq 10^{-7}$ cm s^{-2}. Suppose that this additional acceleration is real, and continues out to some distance r_0 from the Sun; that is, the anomalous acceleration is $\mathbf{a} = -a\hat{\mathbf{r}}$ for $r < r_0$ and zero for $r > r_0$. What limit on r_0 can you set from the properties of new comets?

5. Read Oort, J. H. 1950, BAN 11, 91