**(PHY/AST 564; Blackman; Fall 2001) Problem Set 2 Due Oct 18**

**1.** For Massive X-ray Binaries with O,B companions, accretion onto the neutron star usually occurs via graviational capture from a supersonic stellar wind.

a) Calculate the ratio $\dot{M}_{ac}/\dot{M}_{wind}$, the accretion rate into the neturon star disk, over the spherical wind mass loss rate. Your result should be a function of two ratios: $M_{ns}/M_{comp}$, the ratio of the binary component masses, and $v_{rel}^2/v_w^2$, the ratio of the velocity (squared) of NS and the wind over the wind velocity (squared).

Hint: Think about what inequality must be satisfied for material from the wind to be gravitationally trapped the NS as opposed to escaping.

b)For wind velocity of 1000km/s, $M_{comp} = 17M_\odot$, $M_{NS} = M_\odot$ and orbit period 30 days, caculuate the ratio explicitly.

**2.**

a) Calculate and sketch the accretion disk spectrum (flux as function of frequency $\nu$) for two optically thick accretion disks: One with $R_{out}$ =50 $R_{in}$ and one with $R_{out} = 5000R_{in}$. Explain the difference between the two spectra. In each case, show the approximate frequency dependices of the flux for the regimes $\nu << kT(R_{out}/h$, $\nu >> kT(R_{in}/h$, and $kT(R_{out}/h << \nu << kT(R_{in}/h$.

b) Estimate the peak temperatures for WD and NS disks. Why don't we need the actual disk outer radius to make this approximate estimate?

**3.** Suppose that a thin accretion disk orbits a compact object in a binary system and the conditions are favorable to produce emission lines. (For example in a cataclysmic variable, optical-UV spectra show emission lines hydrodgen and helium.) Suppose that the system is an eclipsing binary, and is such that during maximum eclipse, the low mass companion covers exactly 1/2 of the disk around the star and that the binary inclination angle (angle between normal to binary and line of sight) is $> 60^o$. Sketch how a given emission line profile would evolve over the period (e.g. usually of order a day or so) as the accreting white dwarf passes in and out of eclipse.

Hint: Assume you have the spectral resolution to resolve detailed features of the line profile and think about the line profile emitted by material in a disk.