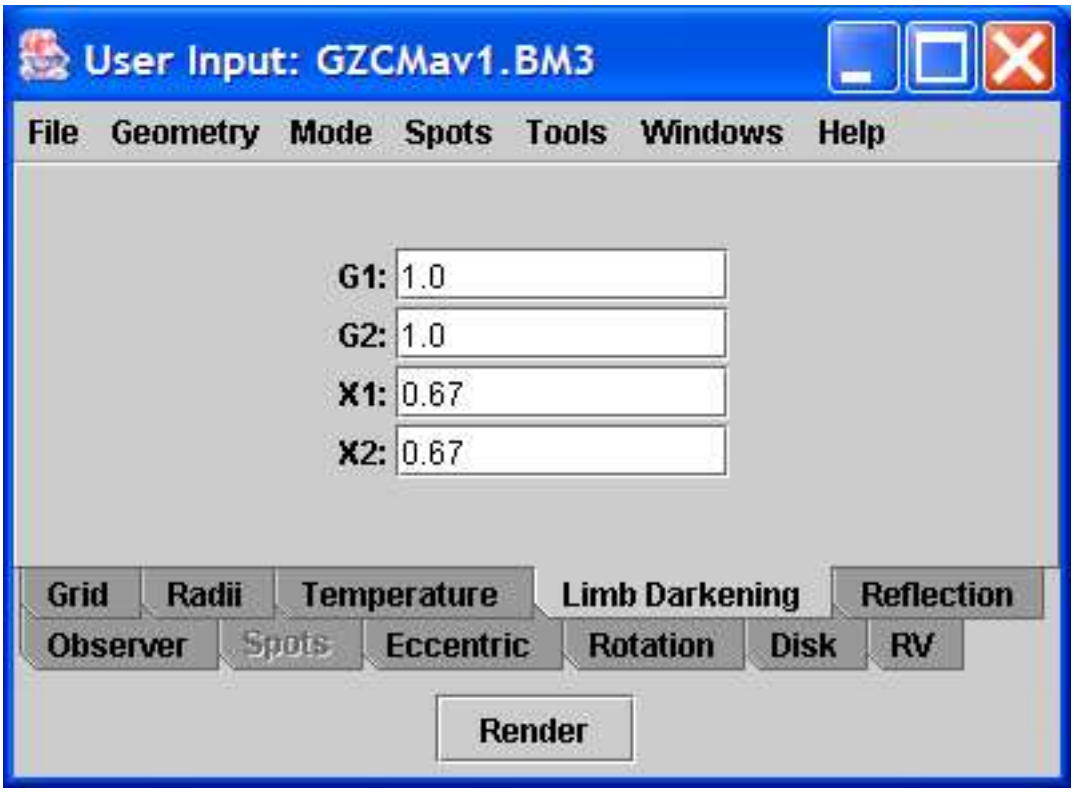
Binary Maker 3

Gravity Brightening



Gravity Brightening and **Limb Darkening** inputs

Von Zeipel (1924) proved that for totally radiative stars the surface flux was directly proportional to the value of the gravitational acceleration (g) at the stellar surface. (The gravitational acceleration is $-\nabla \Omega$.) The equation used to determine the local temperature T_{local} on the surface of the stars is:

$$T_{local} = T_{eff}\left(\left(\frac{g}{g_n}\right)^{\alpha}\right)^{0.25}$$

where T_{eff} is the mean surface effective temperature of the star, g is the local gravity at a specific surface area element and g_n is the value of g at the poles. The ***Gravity Brightening Exponent*** α is 1.00 for radiative stars and according to Lucy (1967) is 0.32 for convective

stars. It is also wavelength independent. The approximate temperature demarcation for radiative and convective stars is 7200º K.

Limb Darkening

Limb darkening is the diminishing of the brightness of a star's surface as one looks away from its center, towards the edge of the disk (or limb). This is caused by the fact that stars are hotter the deeper into them you go, and when you are looking towards the center of their disk, your line of sight protrudes most deeply into their photospheres. When you look towards the edge of the disk your line of sight does not venture as deeply below the surface of the star, and hence the temperature you see is less and the gas gives off less light.

Binary Maker 3 uses the linear limb darkening law.The coefficient x is used in the linear limb darkening equation

$$I(\theta) = I(0^{\circ})(1 - x - x\cos\theta)$$

where θis the angle measured between your line of sight and the surface normal of a particular surface area element. When you are looking straight at the center of the star $\theta = 0^{\circ}$ and the outer limb of the disk is at $\theta = 90^{\circ}$. These values are wavelength and temperature dependent and theoretical values must be looked up in tables because most light curves do not yield trustworthy values. The extensive linear limb darkening tables of Van Hamme (1993) for particular bandpass filters can be found here and are also reproduced in the Appendix of the **User Manual**. The tables of Al Naimiy (1978) contain the values most commonly cited prior to Van Hamme's and can be found here and are also reproduced in the **User Manual** Appendix.