

**HOMEWORK #4**  
**Due date: Feb 18, 2015**

1. If  $\mathbb{N}$  and  $\mathbb{E}$  are the equatorial and ecliptic poles, and  $X$  is the position of the star such that the angle  $\widehat{\mathbb{N}X\mathbb{E}} = 90^\circ$ , show that  $X$  has no precession in right ascension.
2. Val wants to figure out how bad this precession business really is. Help her out by estimating (roughly) by how much did right ascension and declination of the vernal equinox change since the discovery of precession in 120 B.C. Self-help is also required.
3. Rob and Mike are competing in finding a star with the largest change in right ascension and declination due to precession. They do this by simply picking random stars from the catalogs, looking up their epoch 2000.0 coordinates, and "precessing" them to present day. Help them.
4. Connor needs additional 15 minutes to complete this assignment, but he is worried that, due to weather, he'll lose power and he won't be able to see. At what latitude should he go today to gain those 15 minutes of daytime due to refraction?
5. Amanda is talking to Jeff over a romantic dinner for two about the shape of the Sun at sunset. Cole suddenly appears from under the table, and with that typical smile of his, asserts that the shape is an ellipse if only they assumed a simple refraction law  $R = k \tan \zeta$ , and runs away. Jeff and Amanda's dinner is at stake here if they don't figure out the truth behind it.
6. *Extra credit:* Griffin (yep, Griffin! Don't blame me for it, I'm innocent!) challenges everyone to a programming contest: write a program that will provide atmosphere-corrected alt-az and equatorial coordinates for a non-circumpolar star of choice from starrise to starset.