HAO Colloquium Series
(Refreshments served)

Speaker: **Kyle Augustson, University of Colorado/JILA**

Time: **1:30–2:30 pm**

Date: **Wednesday, May 15, 2013**

Location: **CG1-2126**

Title: **A Solar-Stellar Connection: Dynamo Action and Differential Rotation in F-type Stars**

Abstract:

Magnetic activity and differential rotation are commonly observed features on main-sequence F-type stars. We seek to make contact with such observations and to provide a self-consistent picture of how differential rotation and magnetic fields arise in the interiors of these stars, the 3-D MHD analastic spherical harmonic (ASH) code is employed to simulate global-scale convection and dynamo processes in a 1.2 and 1.3M$\odot$ F-Type stars over a range of rotation rates. The simulations are carried out in spherical shells that encompass most of the convection zone and a portion of the stably stratified radiative zone below it, allowing the exploration the effects a stable zone has upon the morphology of the global-scale magnetic fields and upon the nature of the global-scale flows. The scaling of the mean flows and thermal state with rotation rate and mass are examined and linked to fundamental parameters of the simulations. Indeed, it is found that the differential rotation becomes much stronger with more rapid rotation and larger mass. Accompanying the growing differential rotation is a significant latitudinal temperature contrast, with amplitudes of 1000 K or higher in the most rapidly rotating cases. On the other hand, the meridional circulations become much weaker with more rapid rotation and with higher mass. Finally, we will speculate on the nature of the shear flows closer to the surface that are not resolved

in these global scale models. In our magnetic simulation, dynamo action occurs with a high degree of time variation in the 1.2M$_\odot$ star rotating at 20 $\Omega_\odot$, with the polarity of the mean field reversing on a timescale of about 1600 days. Between reversals the magnetic energy rises and falls with a fairly regular period, with three magnetic energy cycles required to complete a reversal. The magnetic energy cycles and polarity reversals arise due to a linking of the polar-slip instability in the stable region and dynamo action present in the convection zone. For the more slowly rotating case (10 $\Omega_\odot$), persistent wreaths of magnetism are established and maintained by dynamo action. Compared to their hydrodynamic progenitors, the dynamo states here involve a marked reduction in the exhibited latitudinal differential rotation, which also vary during the course of a cycle.