Probing the Planetary Population of High-Mass Stars

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To date most planet searches have been confined to stars of spectral type F and later, as hotter stars have fewer spectral lines and tend to be rapidly rotating, making radial velocity observations difficult. By observing a sample of A and early F stars, K2 can help to expand the number of known planets around stars with masses $\sim 1.5 - 2.5 M_\odot$. To date this population has been probed largely through radial velocity surveys of subgiant stars in this mass range (e.g., Johnson et al., 2011), but the actual masses of these subgiants have been debated (Lloyd, 2011). During its primary mission, *Kepler* also discovered a handful of planets around A-type stars (Kepler-13 Ab, Mislis & Hodgkin, 2012, KOI-972 b and c, Christiansen et al. 2014, in prep), plus several planet candidates which are pending validation. K2 observations of main sequence A stars will complement radial velocity observations, as *Kepler* is sensitive to smaller planets than these radial velocity surveys and will be able to probe close-in planets that may already have been engulfed by the subgiants.

We propose to observe a sample of A and early F stars using long cadence during K2 Campaigns 2 and 3. While any planet candidates in our sample will not be amenable to follow-up using standard radial velocity techiniques, we have been using Doppler tomography (an extension of the Rossiter-McLaughlin effect to rapidly rotating stars, where the spectral line distortion during transit is spectroscopically resolved) to validate *Kepler* prime mission planet candidates, and additionally measure the spin-orbit misalignment of these candidates (Johnson et al. 2014, submitted). We expect to use these same techiniques on any candidates found in our K2 sample.

We selected our sample using the catalog of Pickles & Depagne (2010), who fit spectral templates to Tycho 2 and 2MASS photometry. We chose A and early F-type dwarfs, and rejected stars with large proper motions in order to exclude foreground white dwarfs. We restricted our target list to the magnitude range $8 < V < 12.5$ so that any candidates that are found will be bright enough for Doppler tomographic follow-up using the 9.2m Hobby-Eberly Telescope at McDonald Observatory or the 9.2m Southern African Large Telescope, but are faint enough that they will not require a large number of detector pixels on *Kepler*.

Once this sample had been selected, we ranked the relative quality of the targets using a figure of merit (FOM) modified from one used for radial velocity Rossiter-McLaughlin observations. Specifically, $\mathrm{FOM} = v\sin i (1/R_*)^2 10^{-0.2(V-10)}$, which incorporates the favorablility of high $v\sin i$, bright stars (via a $1/\sqrt{\mathrm{flux}}$ signal-to-noise term) and large transit depth (R_p is unkown, but the depth is always $\propto 1/R_*^2$). We take average $v\sin i$ and R_* values as a function of $B - V$ from Appendix B of Gray (2005) and interpolate to the $B - V$ of each star to obtain the FOM.

Using the k2fov tool, we find 48 viable targets for Campaign 2 and 62 for Campaign 3. The included target lists are ranked in order of FOM.

References

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