Asteroseismic Characterization of 3 G Giant Stars with Precise Radial Velocity Observations

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Scientific Justification

We propose to observe 3 G giants located in field 1 of the Kepler K2 mission which we have monitored with precise radial velocity observations in the past. The stars are drawn from a larger sample of 373 G and K giants stars among which we searched for extrasolar planets (see Frink et al. 2001, PASP 113, 173; Frink et al. 2002, ApJ 576, 478; Reffert et al. 2006, ApJ 652, 661; Mitchell et al. 2013, A&A 555, A87; Trifonov et al. 2014, submitted; Reffert et al. 2014, submitted). The 3 G giants which fall into field 1 do not show any indications for planets. They have spectral types G8-G9 III and apparent V magnitudes between 4.3 and 5.4, so they should not saturate while giving superb S/N.

In Reffert et al. (2014), we identified a strong correlation between giant planet occurrence rate and stellar mass. The giant planet occurrence rate rises with stellar mass up to about $1.9\,M_\odot$ and drops rapidly for masses larger than about 2.5–$3\,M_\odot$. In fact, we do not find any planets for a star with a mass higher than $2.7\,M_\odot$, although we have 113 such stars in our sample, so this is a highly significant (and interesting) result.

The masses of the G and K giant stars in our sample have been obtained via a comparison with evolutionary tracks, taking metallicity into account. However, these masses are notoriously uncertain, because the various tracks lie very close together in this part of the color-magnitude diagram, and even turn around and come back again. In many cases it is thus not possible to reliably determine whether the star is on the red giant branch or on the asymptotic branch, yielding two different masses, and a controversy has arisen about subgiant and giant star masses in current Doppler surveys (Lloyd 2011, ApJ 739, L49; Lloyd 2013, ApJ ; Johnson, Morton & Wright 2013, ApJ 763, 53; Johnson & Wright 2013, arXiv:1307.3441; Schlaufmann & Winn 2013, ApJ 772, 143). An independent, precise determination of the stellar mass such as based on asteroseismology would be highly desirable. It has been demonstrated that it is feasible to obtain those mass measurements for giant stars based on Kepler data (Bedding et al. 2010, ApJ 713, L176; Stello et al. 2013, ApJ 765, L41).

Our goal would thus be to derive asteroseismic masses for those three G giants and compare them to the masses derived via evolutionary tracks, with strong implications for the planet occurrence rate and the planet-metallicity correlation in the high mass regime.

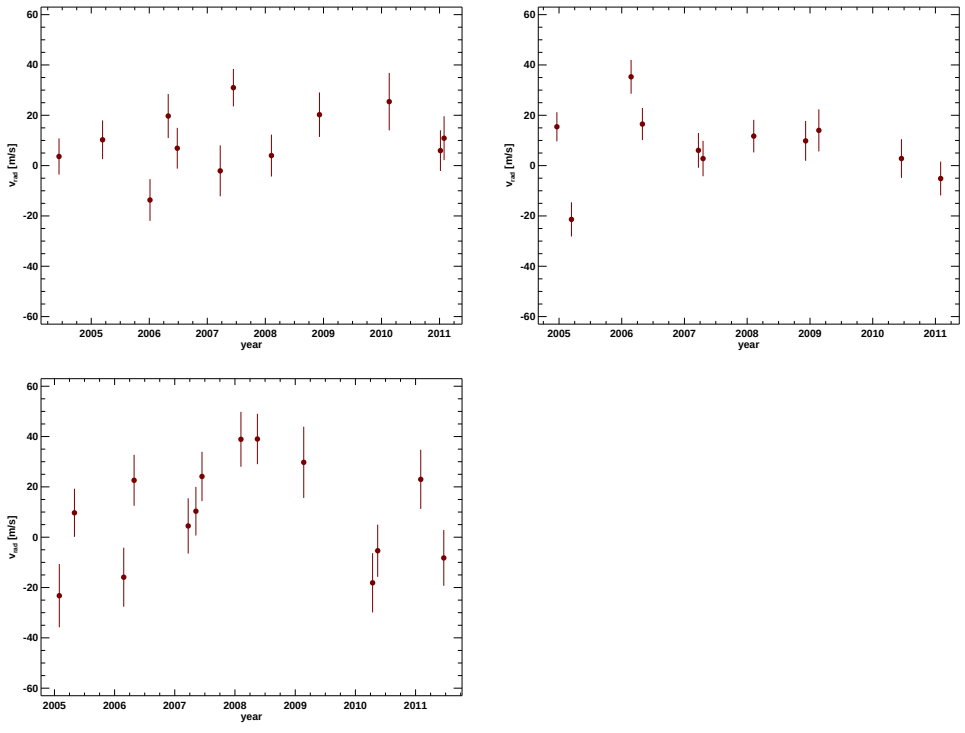

Fig. 1: Precise radial velocity observations of the three suggested G giant targets. The goal of the Kepler observations would be to obtain precise asteroseismic masses, in order to compare those with the ones derived from evolutionary tracks. These masses of planet search targets have a high impact on the planet occurrence rate as a function of mass (and metallicity).