The Solar Twin Planet Search

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It is now well established that stellar photospheric compositions are a fossil record of the protostellar environments in which planets form. High-precision stellar spectroscopy of planet-hosting stars is therefore a valuable source of information about chemical conditions for planet formation. Our large-scale program aims to investigate this connection between stellar composition and planet presence through the analysis of 19 elements in 88 solar twin stars. We are simultaneously conducting a search for planets around these stars through an ongoing four-year radial velocity survey with HARPS. Our study will combine the uniquely high degree of precision in stellar abundance achievable for solar twins and the sensitivity of the HARPS instrument to probe potential correlations between planet occurrence and stellar abundances at a new level of detail.

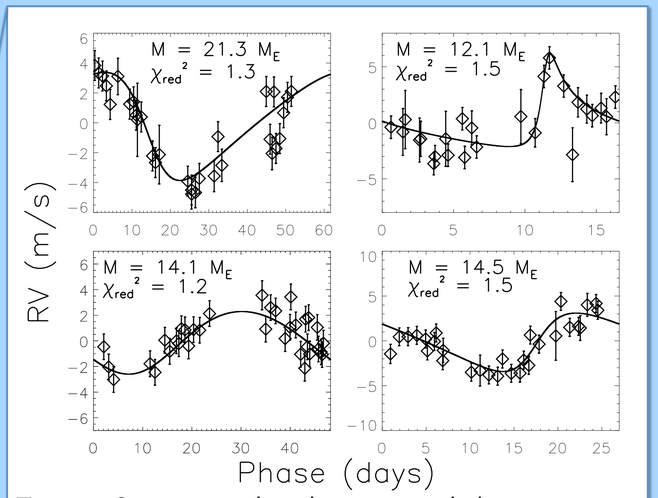

Figure 3. Example planet candidates in our HARPS sample.

HARPS Planet Survey

We are currently monitoring the radial velocities of 61 solar twins from our sample with the HARPS spectrograph. Our Large Program on HARPS consists of 88 nights over 4 years. Using the 1 m/s instrumental precision of HARPS, we aim to characterize the planetary systems of these solar twins down to super-Earths on short periods, ice giants at intermediate periods, and gas giants at long periods. Several planet candidates have been identified and will be presented in future publications (Figure 3).

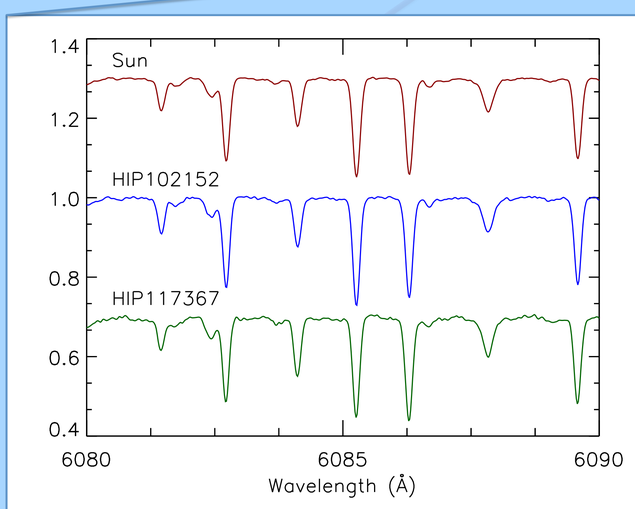

Figure 1. Example spectra of the Sun (red) and two solar twins.

High-Precision Stellar Abundances

Solar twins are spectroscopically near-identical to the Sun (Figure 1), making them ideally suited for abundance analysis at precisions as high as 0.01 dex. Past studies have shown a trend in elemental abundance with condensation temperature in the Sun relative to the average solar twin, possibly indicative of past planet formation (Meléndez et al. 2009). We will greatly increase the sample size of such measurements by deriving abundances [X/Fe] for 19 elements in 88 solar twins (Figure 2).

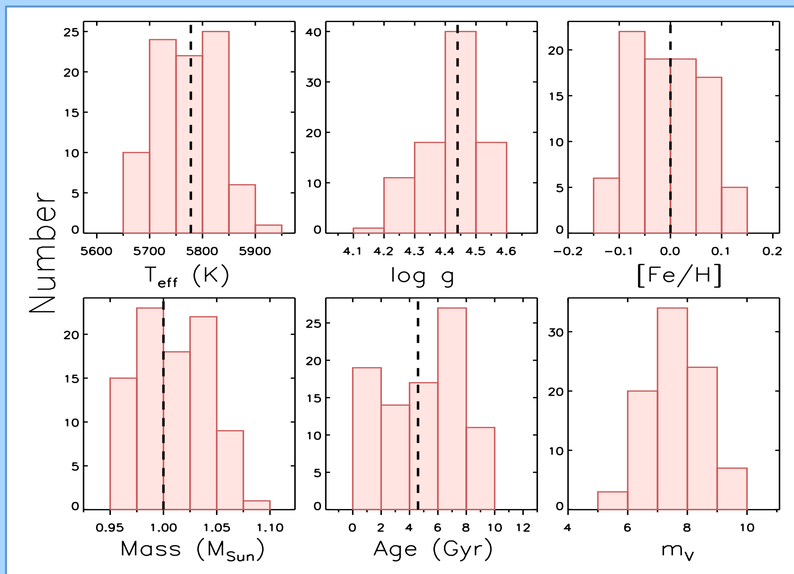

Figure 2. Properties of the 88 solar twins in our abundance analysis sample. Dashed lines represent the canonical solar values.

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References

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