Finding the Lowest Mass Exoplanets with Improved Radial Velocimetry: 2015 Progress Report

Sharon Xuesong Wang

1 Summary of Project and Orignal Plans

Our project is on improving the radial velocity precision...

In our original proposal, our plans include:

(1) removing the RV systematics caused by telluric lines;

(2) validating the calibrator: the iodine atlas;

(3) improving the wavelength-dependent statistical weighting;

(4) improving data reduction and instrument modeling.

We have made significant progress on all fronts, as detailed in the next section.

2 Progress and Achievements

We describe our progress on item (1) in Section 2.1 and in Section 2.2 for items (2) and (4), and our new work described in Section 2.3 address both (3) and (4).

Work described in Section 2.1 and 2.2 will lead to two publications (in prep.), and the work of Section 1.3 is in the form of a new code, written in *Python*, that is made available to the public and will also be presented and documented in peer-reviewed literature.

2.1 Telluric-Free Stellar Templates and Forward Modeling of Telluric Lines

Reduction of power in the periodogram at harmonics of a sidereal year.

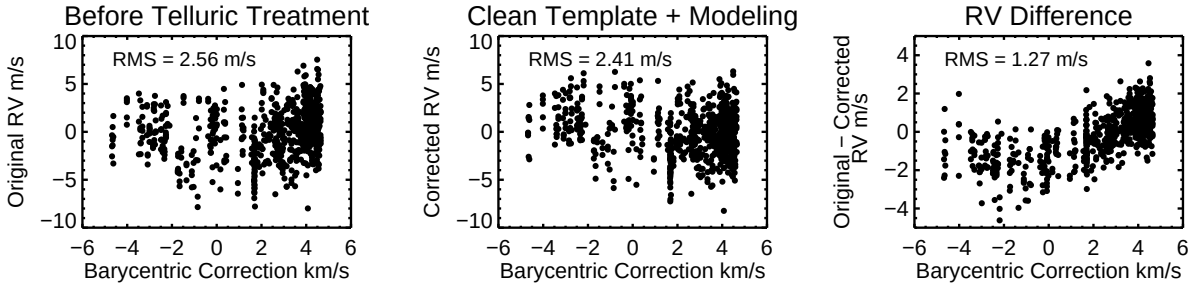

Figure 1: Measured precise radial velocities of a standard star observed with Keck/HIRES as a function of barycentric correction (i.e. Earth's radial velocity away from the target). Our preliminary treatment of telluric lines has removed over 1 m/s systematic noise (panel 3; note the change in scale on y-axis).

2.2 Evidence for Changes of Iodine Calibration Cells and Solutions

2.3 A Better Instrumental Profile Model for Fiber-Fed Spectrograph

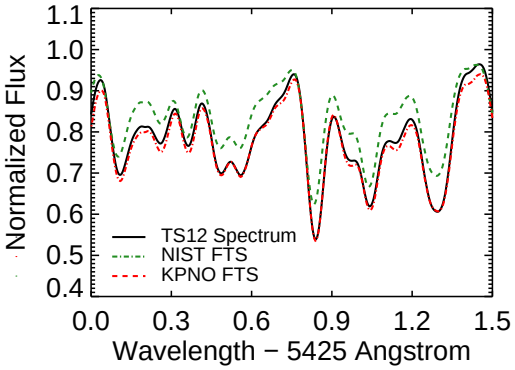

Figure 2: TS12 spectrum vs. NIST FTS vs. KPNO FTS.

2.4 Building the Next-Generation Data Analysis Tools for Future RV Surveys

3 Future Plans

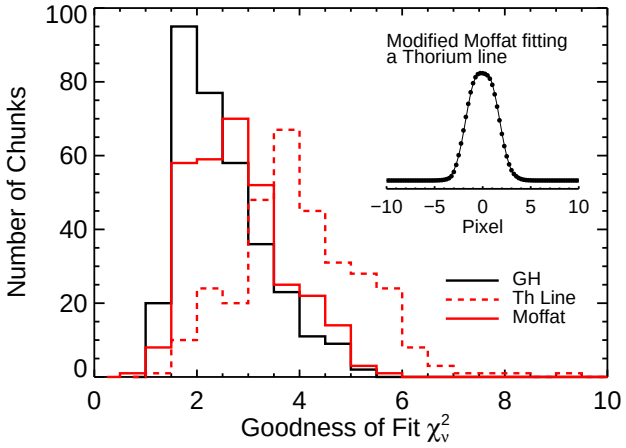

Figure 3: Histogram of goodness of fit, χ^2_ν, values for spectral chunks of a calibration frame. The modified Moffat function (red) performs almost equally well while having only 3 parameters, compared with the complicated 11-parameter GH function (black solid).