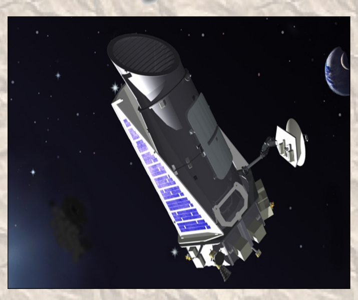

Characterization of the Stellar Population in the *Kepler* field: Putting *Kepler's* Small Planets into a Galactic Context

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ABSTRACT:

The center of the *Kepler* field is located 10 degrees off the galactic plane and thus represents a different stellar population than the immediate solar neighborhood (Figure 1). In order to set the population of small *Kepler* planets into a Galactic context, we need to characterize the stellar population in the *Kepler* field.

We will perform a large-scale spectroscopic survey of the stars in the *Kepler* field, using the wide field Visible Integral-field Replicable Unit Spectrograph (VIRUS) at the Hobby-Eberly Telescope. With VIRUS, we have the unique capability to obtain tens of thousands of spectra of *Kepler* field stars in a very efficient way. VIRUS is an array of Integral-Field-Unit spectrographs with a total of >30,000 fibers (Figure 2) that covers a area of 67 square arcminutes in a single 20-minute exposure. The goal of this investigation is to use VIRUS to obtain spectra (Figure 3) for more than 50,000 stars, down to 16th magnitude, in the *Kepler* field. We will use the existing tools, that were developed to analyze VIRUS data on a large scale, to determine stellar parameters, such as effective temperature, metallicity (including α-element abundances), surface gravity and radial velocity (Figure 4). VIRUS will come online in Summer 2014.

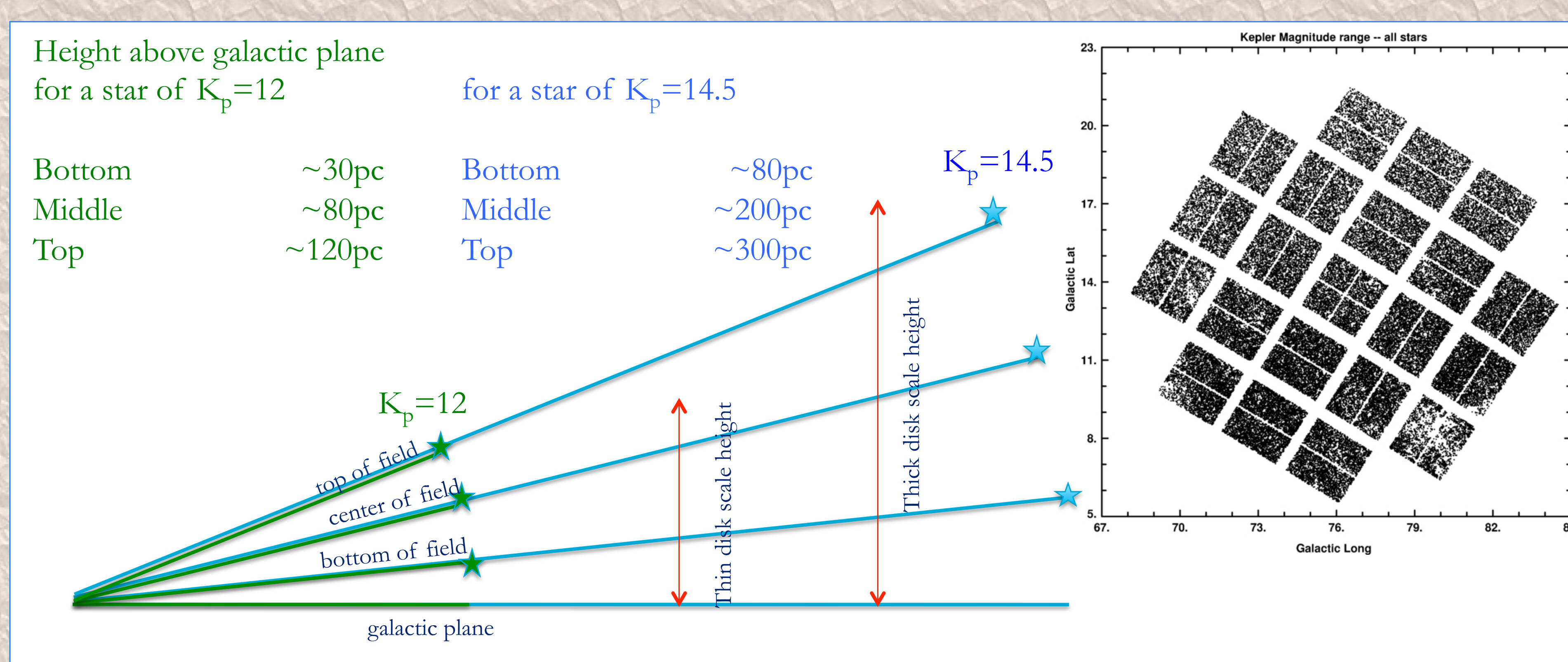

Figure 1: The *Kepler* field is **not** in the galactic plane. The field has a different mixture of thin- and thick-disk stars than does the solar neighborhood, and this mixture changes significantly across the field and with stellar magnitude and luminosity. The top of the field is at a height comparable to the thin-disk scale height (100-150pc) for stars of K_p=12 and it is comparable to the thick-disk scale height (300-500pc) for stars of K_p=14.5. (Figure of *Kepler* field from Gilliland et al. 2011)

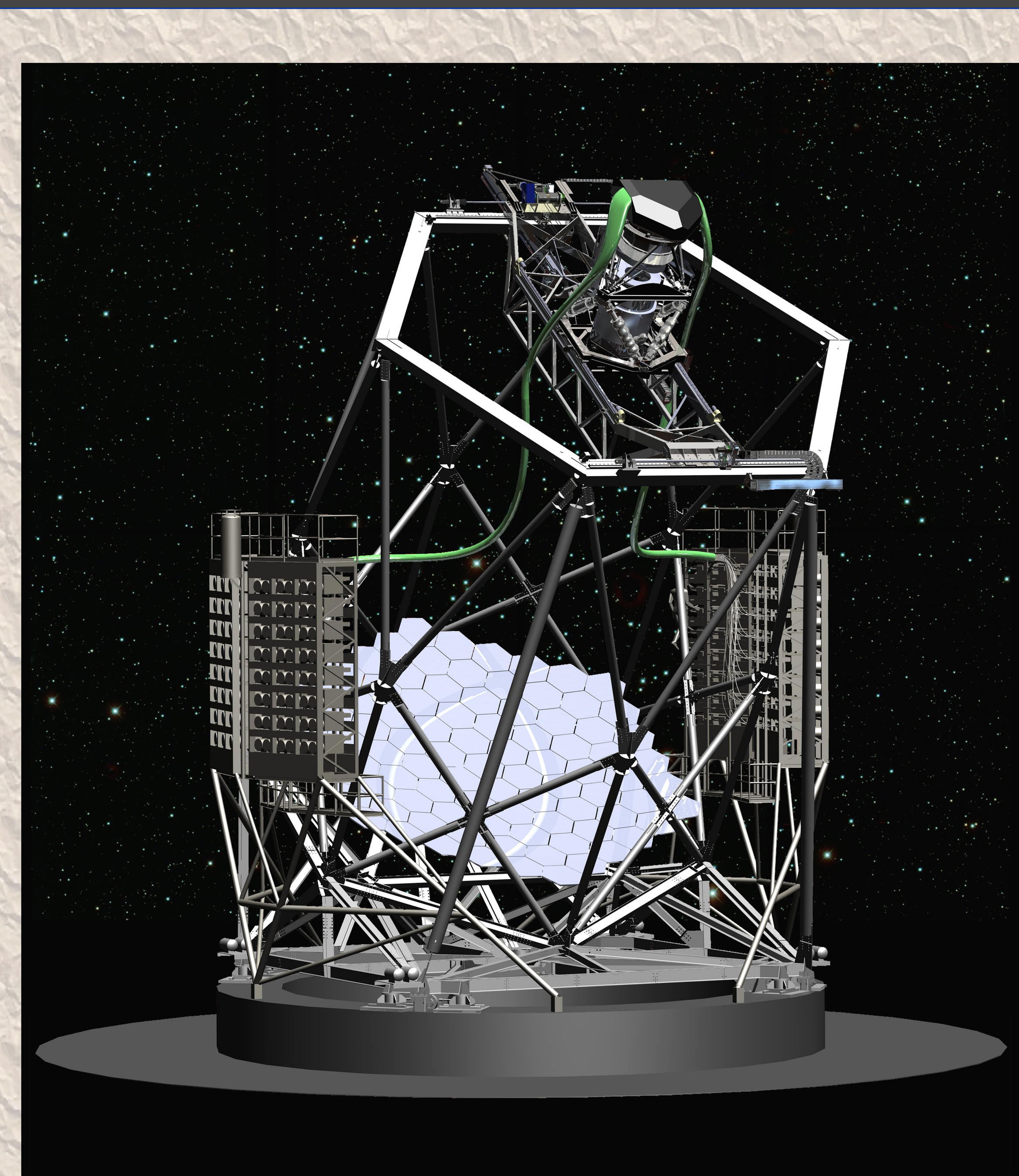

Figure 2: Artist's conception of the upgraded Hobby-Eberly Telescope with the VIRUS spectrographs that are contained in the curved gray "saddlebags" on the side of the telescope. The VIRUS array receives light from the top-end of the telescope via two fiber bundles (in green).

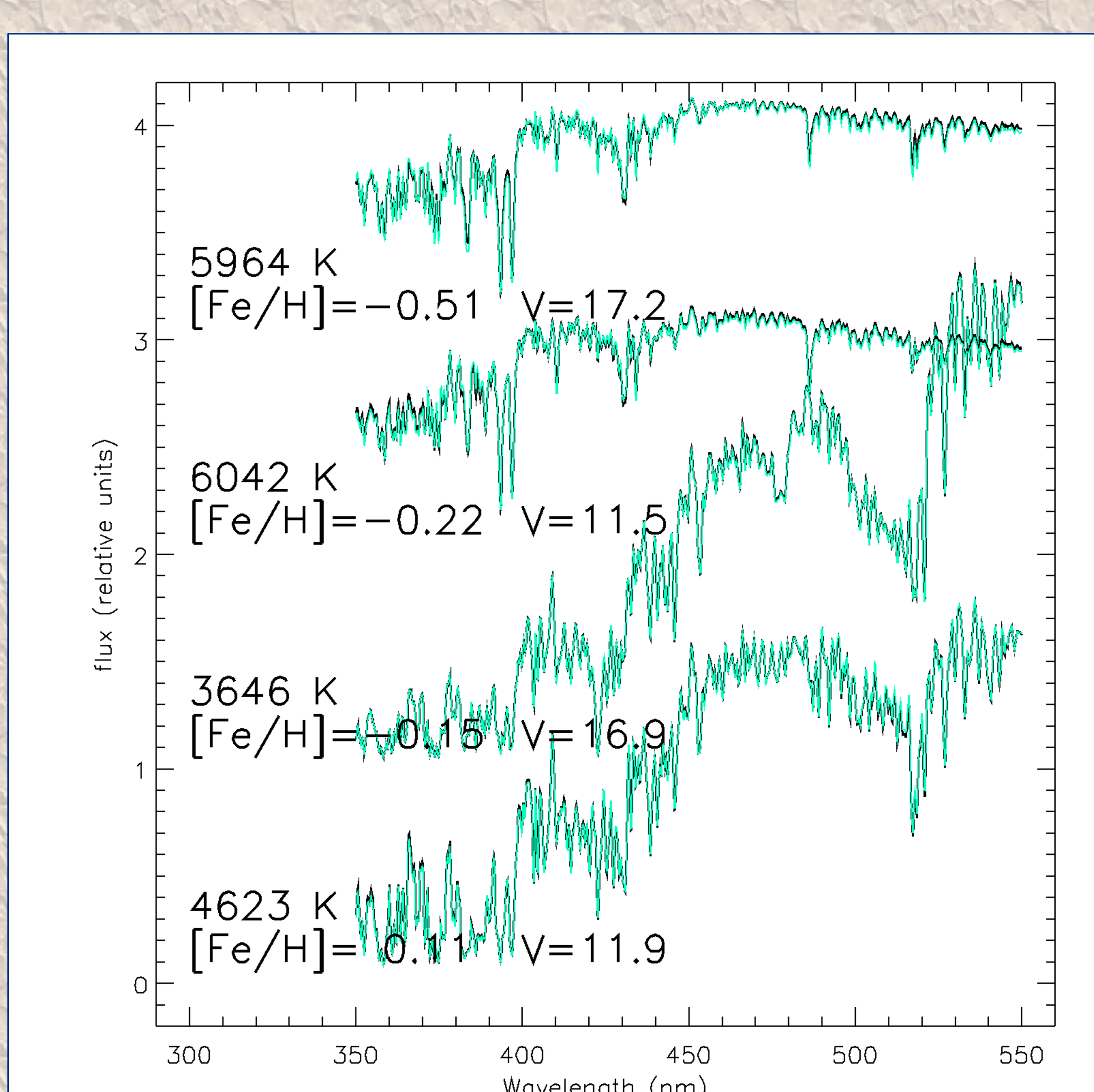

Figure 3: Four synthetic spectra created for the simulations of VIRUS observations of stars in the magnitude range of the *Kepler* field. The appropriate photon- and systematic noise was used for these data. The best-fit models are also displayed as light gray (green) lines.

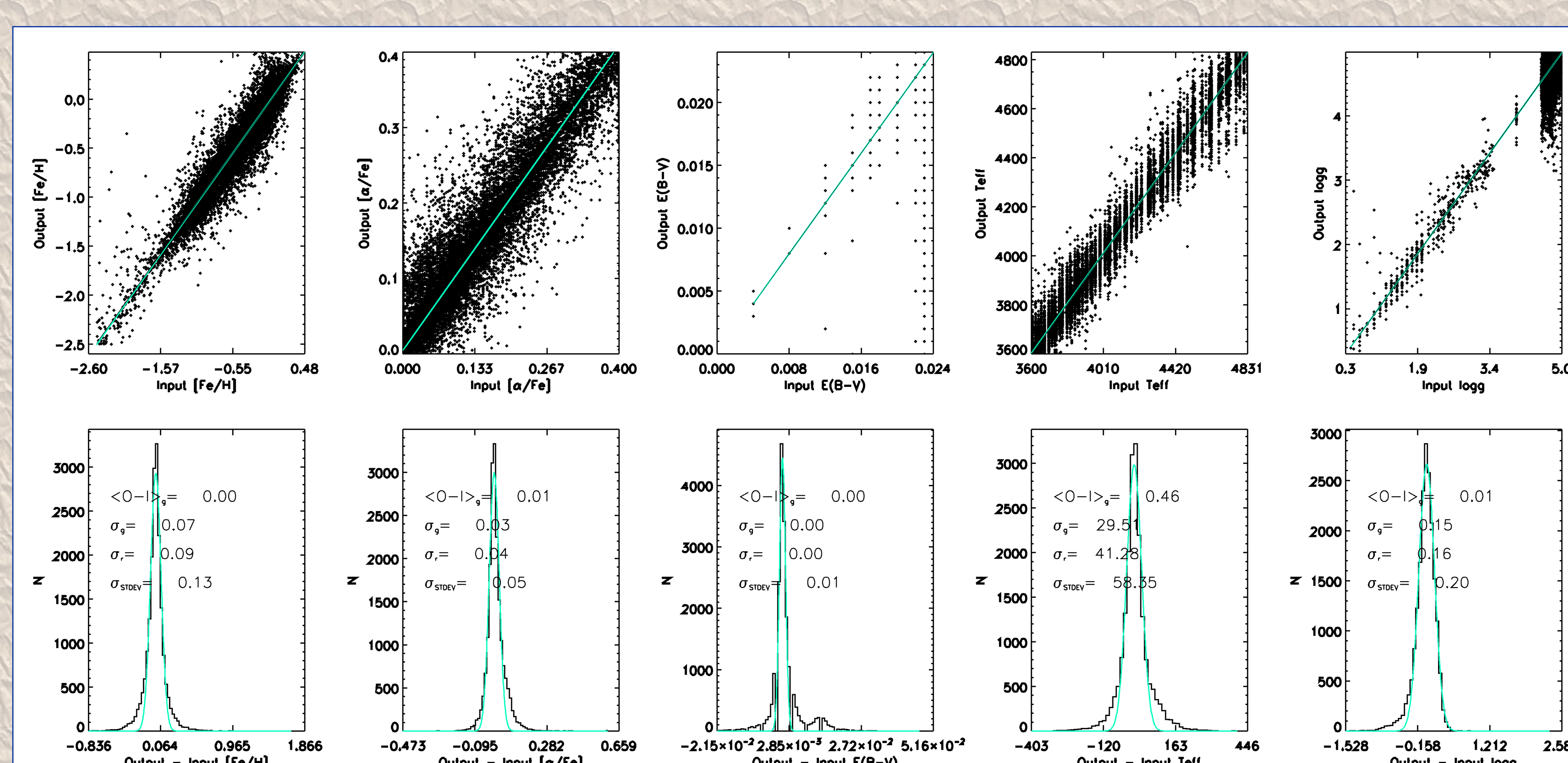

Figure 4: Comparison between input parameters and their recovered values after using the *FERRE* code. The upper row shows the correlation of the recovered parameters (diamonds) to the input values in [Fe/H], [α/Fe], B-V, T_{eff} and log g. The lower panel shows the distribution of the parameters. This demonstrates that for stars down to V = 22, the uncertainties are typically 0.1-0.2 dex in [Fe/H] and [α/Fe], 100 K in T_{eff} and 0.2 dex in log g. The stars in the *Kepler* field are several magnitudes brighter and we can therefore expect much smaller uncertainties for the *Kepler* stars

Project goal: With the VIRUS survey data, we can determine the underlying stellar context of the planet population that *Kepler* is finding. We can distinguish between members of the thick- and thin-disk of the Galaxy and even find possible halo stars. As the ultimate goal we will compute η_{Earth} for different stellar populations and use this to extrapolate η_{Earth} to different regions of the Galaxy and the Milky Way as a whole.

Acknowledgement: M. Endl is supported by NASA's *Kepler* Mission Participating Scientist Program