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Eclipsing binaries are excellent laboratories for the study of stellar evolution and interactions. By combining high resolution spectra taken by the Sloan Digital Sky Survey (SDSS) APO Galactic Evolution Experiment (APOGEE) and the high-precision photometry taken by the Kepler Telescope, close binary stars may be well characterized. We examine a subset of eclipsing binaries listed in the Villanova Kepler Eclipsing Binary Catalog by cross-correlating with the Apogee APOKASC catalog. We found that infrared color magnitude and color-color diagrams, especially the H-K vs J-K diagram, allowed for a relatively clean separation of giants and dwarf stars. Presumably, dominated by the primary star in these eclipsing binaries. A catalog of well characterized eclipsing binaries is presented. In addition, a number of interesting binaries have been identified and progress towards their characterization is reported. This program is supported by SDSS/FAST grant from the Sloan Foundation.

Global Properties of Sample

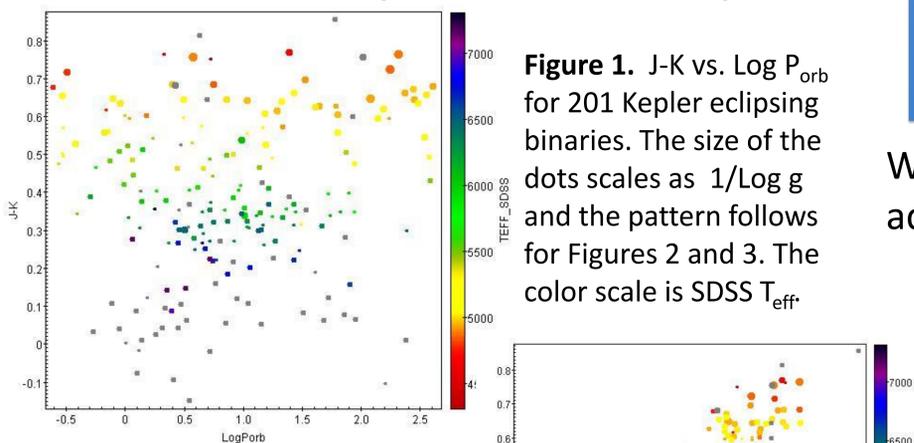


Figure 1. J-K vs. $\text{Log } P_{\text{orb}}$ for 201 Kepler eclipsing binaries. The size of the dots scales as $1/\text{Log } g$ and the pattern follows for Figures 2 and 3. The color scale is SDSS T_{eff} .

Figure 2. A color-color plot for the sample. Dot size indicates star size. The grey dots on the are cases where the SDSS Teff could not be fit.

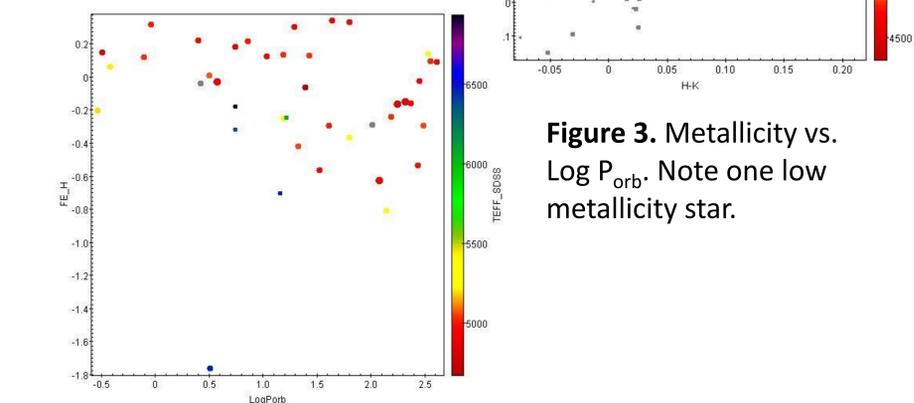


Figure 3. Metallicity vs. $\text{Log } P_{\text{orb}}$. Note one low metallicity star.

Going Forward

As we develop our catalog we anticipate being able to categorize SDSS APOGEE in order to improve understanding of these binaries. This will allow us to focus on cases in need of follow up study. We hope to ultimately find binaries among the APPOGEE / KOI sources

- The link provided takes you to the spectrum of that star.
<http://dr12.sdss3.org/irSpectrumDetail?locid=4263&commiss=0&apogeeid=2M19340328%2B3942410>
- In the system we set up, we use Kepler ID Numbers to distinguish stars.
4660997 Kepler/APOGEE Binary Catalog
- This link will take you to a list of references on the chosen star.
[Simbad](#)
- The table gives information on the specific star that we are looking at.
- The Kepler light curve.
- A possible model of this star.

H-K	J-K	J_MAG_2M	LogPorb	PeriodOrb	TEFF_SDSS	LOGG_FIT	T2/T1	sin i	
0.107	0.467	11.124	-0.249830842	0.5625604	5811	4.9753	0.71097	0.98761	4660997

We intend to model all of the binaries with SDSS APOGEE data in order to determine additional parameters of each binary in the catalog and to identify source confusion.

SDSS APOGEE Spectra

Our merged binary catalog includes links to APOGEE spectral fits, see Figure 4. The SDSS spectral pipeline is able to fit single-star spectral models (red) to the spectra SDSS/APOGEE spectra of many of our sample of eclipsing binaries, but most it does not.

The binary KIC 9181877 yields a great fit, see top panel of Figure 4. From the Kepler Eclipsing Binary Catalog, (Prsa et al 2011, Slawson et al. 2011), this binary consists of twins with $T_2/T_1 = 0.99926$. The APOGEE spectral fit yields $\log g = 3.57$. We suggest that this $\log g$ may not be physical. In the middle panel of figure 7, I the APOGEE spectrum of KIC 7871200 is shown. This spectral fit is poor. This may be expected in this case as the Kepler light curve indicates $T_2/T_1 = 1.047$, so the stars have similar, but not identical luminosities.

In the bottom of Figure 4, the data reduction pipeline found a good single star fit when according to the Kepler Eclipsing Binary Catalog this source is a close binary with a 0.3 day orbital period, KIC 11135978. The spectrum is well fit to a giant. The Kepler light curve model yields a nearly twin binary with $T_2/T_1 = 0.98431$.

Acknowledgments

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References

Prsa et al , 2011, AJ, 141, 83
Slawson et al. 2011 AJ, 142, 160

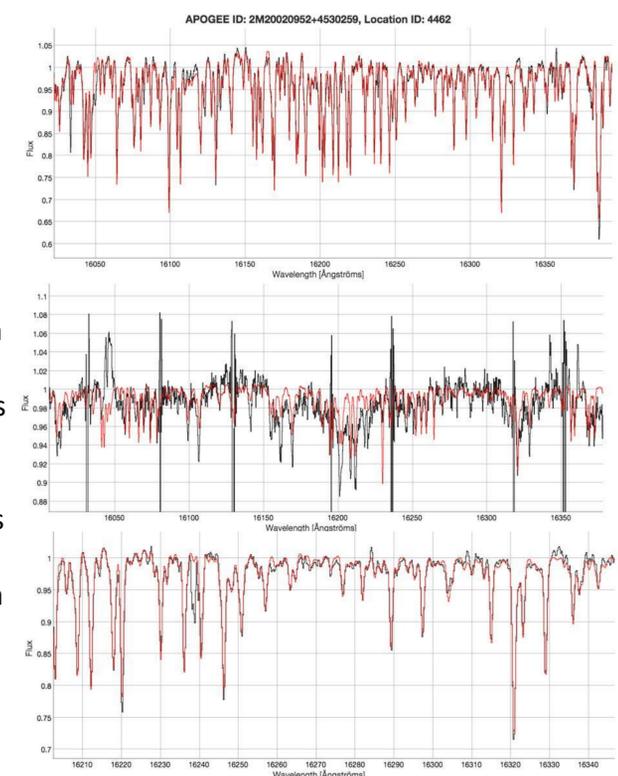


Figure 4. These are example spectra available for stars in the catalog. APOGEE pipeline fits are shown in red. See text for details.