Name: G. Fritz Benedict
Email: fritz@astro.as.utexas.edu
Institution: University of Texas
Title: Reduced Proper Motion Diagrams and Kepler Astrometry
Type: Poster
Session: Characterizing Transiting Planets

Abstract: In transit work it is useful to know the luminosity class of a host star when estimating the size of the companion. This requires a distance, ideally provided by a measurement of parallax. With simple centroiding unaware of point spread function (PSF) structure the season to season Kepler astrometry required for parallaxes presently yields positions with average errors exceeding 50 milliseconds of arc (mas). Yet distance is a desirable piece of information. Reduced proper motion diagrams may provide such an estimate. The concept is simple: proper motion becomes a proxy for distance. Statistically, the nearer any star is to us, the more likely it is to have a larger proper motion. The reduced proper motion diagram consists of the proper motion converted to a magnitude-like parameter plotted against color. The reduced proper motion diagram is thus analogous to an HR diagram. While some nearby stars might have low proper motions, typically giant and dwarf stars are easily separated. The more precise the proper
motions, the better the discrimination between stellar luminosity classes.

Near the center of the Kepler focal plane (Channel 41), using positional normal points (generated by a home-built first-moment centroiding algorithm) from the optimum aperture image files acquired during three available quarters of Season 3, we obtain positions with an average 1-σ error of 3.5 mas. We utilize UCAC4 proper motions with an average error of 4 mas yr-1 as prior information informing our Kepler astrometric modeling, and obtain final proper motions with an average error of 1.1 mas/yr. As a further test we carry out a similar study of a field more distant from the Kepler focal plane center (three quarters of Season 3, Channel 26). Using a mix of optimum aperture and full aperture positions (depending on crowding) we obtain positions with an average error of 7.3 mas and proper motions with average error 2.4 mas/yr, again incorporating UCAC4 proper motions as priors. The degradation in astrometric precision is likely due to significant changes in the PSF over the Kepler field of view, and demonstrates the need for more sophisticated centroiding that is PSF-aware.