ECLIPSING BINARIES IN THE OLD OPEN CLUSTER NGC 6791

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We propose 73 photometrically-selected targets with V < 16.6 within 12' of the center of the old, metal-rich open cluster NGC 6791 for Kepler 30-min sequence observations. The goal is to detect eclipsing binaries suitable for determining the masses of the components, through future observations of radial velocities with large ground-based telescopes, and possibly of orbits with SIM. Our targets are giants and subgiants, not main-sequence stars, in order to reduce confusion in the Kepler field and to provide feasible targets for spectroscopy. Towards the center of the cluster, the high stellar densities dramatically increase crowding and cause binaries to be more readily perturbed. Consequently we are including many targets in the outer regions of the cluster, those which fall on the cluster color-magnitude and color-color diagrams defined by the inner members. We need a large target sample to isolate favorable binaries, as some stars will be non-members, only half of the members will be in binaries, many of these will have merged, and only a few of those remaining are useful. Suitable binary systems must not be triple, and should include a giant and a main-sequence turnoff star so that both components can be detected spectroscopically. The components must not have previously exchanged or lost mass. Binary periods must be nearly a year to a few years, so the orientation must be nearly edge-on and the eccentricity will be finite. We expect the proposed observations to yield at least two non-interacting binaries from which both component masses can be obtained. For such binaries, eclipse depths of 10% over a day or more are expected, and are readily apparent from applying standard filters to the pipeline light curves. Radial-velocity curves will be based on echelle spectroscopy analyzed with IRAF, as we have done in our decade-long survey of the brightest NGC 6791 giants with the Lick Hamilton echelle. The effective temperature, gravity, and metallicity of each of the stellar components will be found from theoretical spectral calculations, which now match such strong-lined stars reasonably well thanks to an updated list of line parameters. This work should stringently constrain comparisons of observed color-magnitude diagrams to produce meaningful cluster parameters. Such constraints would have major significance for the validation or refinement of stellar evolutionary tracks at high metallicity, and the derivation of age and metallicity from broadband colors of both individual stars and integrated spectra of old elliptical galaxies, for which NGC 6791 is a critical template.