ECLIPSING BINARIES AND THE SPATIAL EXTENT OF THE OLD OPEN CLUSTER NGC 6791

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We propose long-cadence Kepler observations for 160 targets selected photometrically to be giant or subgiant members of the old, metal-rich open cluster NGC 6791. 130 were observed in Cycle 3, to detect eclipsing binaries among evolved stars. Thirty more will establish the full spatial extent of the cluster. The primary goal is to detect eclipsing binaries suitable for determining the masses of the components, through future ground-based observations of radial velocities. This will constrain comparisons of the cluster color-magnitude diagram at evolved stages, and the influence binaries have on it. 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 should 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 one to a few years, the orientation must be nearly edge-on, and the eccentricity will be finite but should not be large. Because giant radii are large, many targets are needed. From this sample we expect to detect roughly a half-dozen binaries from which meaningful masses can be obtained. Kepler is already looking at many targets near the cluster center, where proper motions provide membership information. Our thrust here is the outer regions of the cluster, to increase the binary sample and mitigate against possible binary interactions at high cluster density and large stellar radii. By including dozens of stars farther than 10' from the cluster center, whose g-r vs. g-K colors are consistent with those of cluster members, we can begin to assess the extent to which Galactic interaction has expanded the cluster and/or altered binary distributions. As all are rather bright giants, their light-curve oscillation frequencies should be low enough to be detectable in long-cadence curves of a few months' duration. Follow-up ground-based high-resolution spectra will derive stellar and binary parameters and confirm cluster membership, as well as define the primary velocity curve, the secondary velocity offset, and the system period. This should stringently constrain comparisons of observed color-magnitude diagrams to produce meaningful cluster parameters. Such constraints would have major significance for the derivation of age and metallicity from the broadband colors and integrated spectra of old elliptical galaxies, for which NGC 6791 is a critical resolved template.