

K2 and M35: Opening the Window on Precision Light Curves of Low Mass Main Sequence Stars of Known Age and Metallicity

J. Stauffer, L. Hillenbrand, A. Cody, L. Rebull, D. Soderblom, D. Barrado, D. Ciardi

High precision time series photometry of open cluster members provides a unique window into the evolution of stellar angular momentum and activity. Not only can starspot-related variability be used to infer rotation rates and their dependence on mass and age, but it is also useful for assessing the diversity of stellar magnetic properties. Our 40-day monitoring campaign of 200 weak-lined T Tauri members of the ~ 2 Myr NGC 2264 cluster with *CoRoT* (Cody et al. 2014) recently revealed that (a) shape evolution (and hence spot geometry) can change on \sim week timescales in young, low mass stars; (b) a significant fraction of such stars display complex non-sinusoidal light curves; and (c) a population of multi-periodic light curves exists, possibly due to differential rotation—examples of which are shown in the figure below. This study was made possible by the exquisite sensitivity, continuity, and long duration of *CoRoT* observations—an observational set-up that can now only be reproduced with the *Kepler* telescope. Using K2 to survey a set of open clusters near enough and young enough to characterize the evolution of dynamo-induced variability for low mass, main sequence stars would revolutionize this field.

We propose to set the stage for such a study by obtaining light curves of low mass, main sequence members of the young open cluster M35 (NGC 2168) during K2 Campaign 00. M35 has an age of order 150 Myr and is about 850 pc from the Sun (distance modulus about 10.4). We have assembled a target list of ~ 600 probable members of the cluster, with $13 < V < 18$, drawn from McNamara & Sekiguchi (1986), Geller et al. (2010), and Barrado et al. (2001) and encompassing spectral types from F0 to K5. While these data would motivate a wide range of future studies, we would intend to use them primarily for four related projects: (a) investigate spot morphology and evolution on low mass stars as a function of mass and age; (b) search for evidence of differential rotation, and comparison to low mass stars in NGC 2264; (c) determine the degree of bias in ground based rotation period surveys against the most slowly rotating, or least spotted, or most pole-on members; and (d) lay a foundation for K2 observations of stars in other nearby open clusters (Pleiades, Praesepe, M67) and star-forming regions (Upper Sco) to optimize the establishment of fiducials for stellar variability studies at a wide range of ages and masses.

The program we envision can not be done using ground-based data, because those data have insufficient signal-to-noise and time sampling. K2, on the other hand, is expected to produce light curves of 80 day duration, 30 minute samples, 80 ppm accuracy for bright stars—providing an invaluable archive of main sequence stellar variability in M35 over a range of masses at a well-determined age and metallicity. While not all targets may be amenable to K2 selection, our program benefits from as large a sample as possible, with a minimum sample size of order 50 (which would allow at least a pilot study). Our existing, well-characterized *CoRoT* data enable useful results (and papers) to be derived from comparison of the M35 (150 Myr) and NGC 2264 (2 Myr) data, even if K2 is not funded beyond Field 00.

