STARSPOT ROTATIONAL MODULATION ON X-RAY-SELECTED LATE-TYPE STARS: K2–FIELD 00

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Scientific Goals: Measure the rotation periods, differential rotation patterns , and the distribution, migration, and growth/decay of large dark photospheric starspot groups for a magnetically-active sample of F-G-K-M dwarf stars in K2 Field 00.

Scientific Background: Rapidly rotating stars have strong surface magnetic fields that manifest themselves as large photospheric starspots (readily observable by K2) and strong high-temperature X-ray and UV emission. Stars rotate quickly either because they are young (either single or binary stars) or, if older, because they are close binaries where tidal forces prevent magnetic spin-down. Modeling and understanding the distribution of starspots on active stars provides important clues regarding the generation of stellar magnetic fields via dynamo processes.

K2 Target Selection: Stars were selected based on prior detection of coronal X-ray emission, which is a robust indicator of stellar magnetic activity and likely starspot rotational modulation. Optical counterparts with accurate coordinates and photometry in SIMBAD were identified for X-ray sources from ROSAT (All-Sky Survey Bright Source and Faint Source Catalogs and all pointed observations: coincident to ≤ 30 arcsec), XMM (Slew Survey and all pointed observations; coincident to ≤ 10 arcsec), and Chandra (ACIS pointed observations; coincident to ≤ 5 arcsec). X-ray selection eliminates almost all evolved K-M giants. Searches were within 7.5 degrees radius of α=06:47:00.0; δ=+21:22:47.0 – some targets will be lost to CCD gaps. Wide (few arcsec) double stars were discarded, because of problems establishing pixel masks and with subsequent data analysis.

115 K2 targets were identified — the first 7 are all very bright (V$\leq$8.0) and would require a vast pixel investment. These stars are listed in priority order, discard as necessary. Targets 8-27 are all known periodic variable stars and are certain to provide extremely valuable K2 light-curves. This second group are listed in order of brightness (V= 8.0-12.8). The third set of stars (Targets 28-115) are listed in RA order. Overall this sample provides a diverse group of targets including known RS CVn and BY Dra binaries, one W UMa contact binary, one β Lyrae system, three Classical Cepheids, one S star, one early B star (for possible modulation) and a known planet host (Target 2).

Number 1 Pixel-hogging Target: the number 1 target of this proposal is the well-known active binary OU Gem (V=6.76, d=14.7 pc). The K3 and K5 dwarf components orbit with a 6.99 day period but this unusual system is so young ($\sim$ 250 Myr) that the rotation is non-synchronous (P_{rot} = 7.36 d). The masses, radii, and orbital and rotational inclinations (which differ) are accurately measured (Gleboki & Stawikowski, 1995, Acta Ast, 45, 725), which makes starspot modeling much simpler. No similar bright system was available in the original *Kepler* Field.

Description of the Observations: Long (30 min) cadence observations are requested for all the targets. A $\sim$75 day interval is well matched to the expected few day to two week rotation periods.

Supporting Observations: Simultaneous optical echelle spectra will be obtained for a number of the brighter targets using the APO (New Mexico) 3.5m echelle (R=32,000) and the NOT (Canary Islands) FIES echelle (R= 60,000), most likely in April 2014.

Data Analysis: Our current *Kepler* data analysis and starspot modeling tools should be directly applicable to K2 data. Variability amplitudes are typically a few %, so are well within the K2 capabilities. However, we need as much precision as possible to follow the behavior of individual starspot groups. A suitable investigative team is available from our on-going *Kepler* GO collaboration.