ACTIVITY CYCLES AND STARSPOT EVOLUTION ON LATE-TYPE STARS IN THE KEPLER FIELD (CYCLE 4)

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Starspots on late-type stars are a direct manifestation of the photospheric emergence of strong dynamo-generated magnetic fields and are excellent tracers of the magnetic field distribution during both the life-times of individual starspot groups and over the course of magnetic activity cycles. We propose to extend our Cycles 1/2/3 projects of 30 minute cadence Kepler photometry, in which we are investigating how activity phenomena such as the growth, migration, and decay of starspots, differential rotation, activity cycles, and flaring operate on single and binary stars with a wide range of mass (and hence convection zone depth). Our existing Kepler data shows a rich variety of photometric variability including starspot rotational modulation, pulsations (both simple and very complex), flaring, and eclipses. Our proposed Cycle 4 sample of 325 late-type stars was selected based on our GALEX FUV/NUV imaging of the Kepler field (first 220 stars in Target List), the first half of our XMM Large Project X-ray survey of 1 sq. degree of the field (next 35 targets), and stars being observed in our optical MMT and WHT multi-object spectroscopy programs (final 70 targets). Accurate measurements of starspot distributions and spot filling-factor maps can be obtained from the Kepler photometry using our newly-developed and successfully verified light-curve inversion methods that fully utilize the powerful diagnostic capabilities of Kepler time series data. We directly fit for the differential rotation that is easily measured from Kepler data, and this provides well determined starspot positions in both longitude and latitude. A full suite of supporting high resolution optical echelle spectroscopy is being obtained, using the MMT and Apache Point Observatory telescopes (in the SW USA) and the NOT and WHT telescopes (on the Canary Islands), to accurately determine the stellar parameters, including effective temperature, surface gravity, and projected rotational velocity, to identify stars that are spectroscopic or eclipsing binaries and measure their radial velocity curves, and to measure molecular bands (TiO, MgH) that provide an independent absolute measurement of the total starspot coverage and spot temperatures. Our supporting X-ray imaging commenced in 2011 with an XMM Large Project and simultaneous HST UV spectroscopy/Chandra X-ray imaging of several Kepler targets is scheduled during 2012. Our sample includes stars for which Doppler imaging, both conventional and magnetic, is feasible using current technology.