UNLOCKING NEW DISCOVERY SPACE IN THE MICRO- AND MEGA-FLARE REGIMES ON LOW MASS STARS

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Low mass stars with strong magnetic fields often exhibit energetic outbursts known as flares. Flares are believed to be caused by magnetic reconnection events in the coronae of these magnetically active stars. They occur on timescales of seconds to days, and span more than eight orders of magnitude in emitted energy. We propose to use the NASA Kepler satellite to monitor six low mass M dwarf stars at short (1 minute) cadence for two months each. The sample includes both early and late type M dwarfs, with both very active and relatively inactive magnetic fields. These data will improve the time sampling and duration of flare monitoring observations on this class of stars by more than a factor of 10, providing significantly improved sensitivity to both micro-flares (low energy) and mega-flares (high energy). These data will enable us to (a) sample equal energy flares across the M spectral sequence and therefore test the hypothesis that later type stars produce flares at a much higher rate but lower average energy compared to earlier type stars; (b) characterize the morphology of flare light curves, which are used to constrain the origin of flare emission; (c) provide the first investigation of the correlation between flare rates and underlying starspot coverage; and (d) determine the flaring properties of (relatively) inactive M dwarfs. A robust understanding of flares, including the morphology of their light curves and the rate at which flares of different energy occur is central to the understanding of the magnetic properties of cool stars. In addition, characterizing flare rates, energies and light curves is important for the interpretation of transient signals in surveys such as LSST and Pan-STARRS, and to predict the radiation environment of the habitable zones of exoplanets.