Short timescale variations in Cataclysmic Variables

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This proposal continues our campaign to monitor Cataclysmic Variables (CVs) in the K2 fields. The unique capability of K2 to provide uninterrupted, high precision, high cadence photometry over long baselines will provide a library of diverse and representative lightcurves for the the study of accretion disc phenomena.
CVs consist of a white dwarf accreting from a late type main sequence star, usually via an accretion disc. These accretion discs are subject to a thermal instability which cause quasi-periodic outbursts on timescales of weeks to decades, but the onset of the outburst and the induced variability have much shorter timescales (seconds–hours). Short cadence Kepler observations of V1504 Cyg and V344 Lyr offered unprecedented insight into the origin of these outbursts, as well as the associated brightness oscillations (superhumps) observed in CV lightcurves (Wood et al 2011 ApJ 741, 105; Osaki & Kato 2013 PASJ 65, 50). The Kepler field also revealed eclipsing CVs (Scaringi et al 2013 MNRAS 435L 68; Ramsay et al 2012 MNRAS 425 1479) (timescale seconds–minutes) and rapid (seconds) accretion flickering (Scaringi et al 2013 MNRAS 421 2854). Due to the unpredictable effect of weather it is impossible to probe such a wide range of variability timescales using ground-based observations.

We propose *short cadence observations* of the three CVs brighter than 19 mag that fall onto the K2 detectors in Field 1, in order to investigate the variability of their stellar components in quiescence.
QZ Vir (previously known as T Leo): A number of past observations suggest that this short period CV (P_{orb} = 85 min) hosts a weakly magnetic white dwarf (WD). In such a CV, the inner accretion disc is disrupted by the WD magnetosphere and the gas is channelled along the field lines directly onto the magnetic poles of the WD. The 414s periodicity in the X-ray lightcurve of this CV (**Fig.1**) is interpreted as an accretion hot spot, rotating into and out of view on the WD spin period. Short cadence is essential to resolve the 414s spin period and to investigate the poorly understood interaction between the magnetosphere and inner truncated disc.
RZ Leo: In most CVs the accretion disc dominates the optical luminosity, but the spectrum of RZ Leo (**Fig.2**) clearly show both the white dwarf and the donor star. This is indicative of a low accretion rate, a notion also supported by the long outburst interval in this system (∼decade). Its orbital period of P_{orb} = 110 minutes places it near the lower edge of the period gap, suggesting that the mass transfer has only recently resumed after the system evolved through the period gap as a detached binary. It provides us with an opportunity to study the variability of the stellar components, e.g. the WD spin (as above), possible WD pulsations (e.g. Gänsicke et al 2006 MNRAS 365 969), and the frequency and strength of stellar flares on the M-dwarf. The magnetic activity of the M-dwarf will provide important constraints on the amount of residual magnetic braking which drives the evolution below the period gap. These flares, as well as the spin- and pulsation periods of the WD occur on timescales of minutes, so short cadence observations are essential. We have HST and X-shooter observations available of of RZ Leo, which will provide precise stellar parameters to complement the K2 data.
TW Vir provides the perfect comparison for the RZ Leo observations. With a P_{orb} = 263 min, it is situated above the period gap, where the donor star magnetic field is the dominant angular momentum loss mechanism.

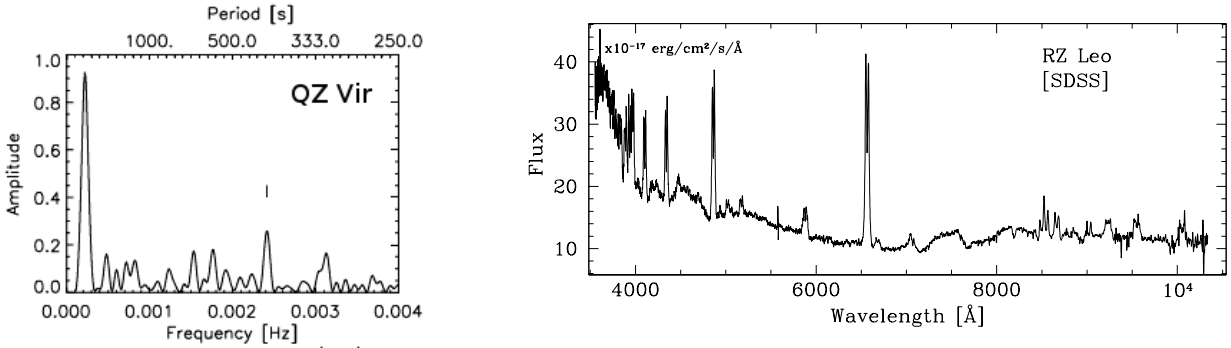

Fig.1 (Left) X-ray power spectrum of QZ Vir, showing a 414s periodicity in addition to the 85min orbital period signal. This is attributed to an accretion hotspot on a weakly magnetic white dwarf (figure from Vrielmann et al 2004, A&A 419 673). **Fig.2** (Right) SDSS spectrum of RZ Leo. Both the white dwarf and the donor star are visible in the spectrum, indicating that the disc is faint and the accretion rate low. It provides us with an opportunity to study the variability of the stellar components in a quiescent CV.