Rapid variability of accreting compact objects in K2 Field 2

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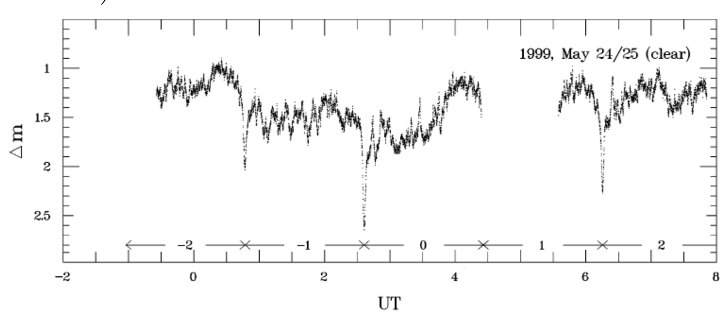
Following on from our Field 0 and 1 requests, we propose to monitor the Cataclysmic Variables (CVs) and Low-mass X-ray binaries in Field 2. (The only Field 3 target that meets this broad description is FO Aqr, the first magnetic accreting white dwarf in any of the Kepler/K2 fields so far. It is the subject of a separate proposal.) Accreting compact objects display variability on a wide range of timescales, due to accretion flickering (seconds), eclipses (minutes), the orbital period (hours) and accretion disc precession (days). Due to weather constraints it is impossible to probe such a wide range of variability timescales using ground-based observations. Here we propose here to monitor two accreting white dwarfs and one accreting neutron star in Field 2 in *short cadence mode* in order to resolve the rapid variability in their lightcurves.

U Sco, supernova progenitor? Nova eruptions occur as a result of thermonuclear burning of accreted material on the surface of an accreting white dwarf. Classical novae are thought to occur every $\sim 10^4 - 10^5$ years in a given system, but for a small handful of CVs, known as 'recurrent novae', these eruptions occur on timescales of decades. U Sco has the shortest recurrence period of the known recurrent novae, ~ 8 yr. It is also eclipsing, making it particularly suited for parameter studies. Thoroughgood et al 2001 (MNRAS 327, 1323) measure the mass of the white dwarf in U Sco to be $1.55 \pm 0.24 M_\odot$, implying that it is one of the best Type Ia supernovae candidates known.

V893 Sco, eclipsing dwarf nova. Apart from eclipses, small amplitude dwarf nova outbursts and flickering, the lightcurve of this CV (Fig 1) also displays strong, rapid oscillations on timescales of 2–15 min (Bruch 2014, A&A in press, arXiv1404.2902). The origin of these oscillations is uncertain. Some dwarf novae display coherent, temporary brightness modulations after an outburst, known as dwarf nova oscillations (DNOs). DNOs are thought to be generated by accretion onto a weakly magnetic white dwarf with a freely moving equatorial belt (Warner & Woudt 2002 MNRAS 335 84) but V893 Sco, unusually, also displays these modulations during quiescence (Pretorius et al 2006 MNRAS 368 361). Short cadence K2 observations will give an unprecedented view into the origin of these oscillations.

V818 Sco = Sco X-1, the brightest Low mass X-ray binary. Sco X-1 was the first extrasolar X-ray source to be discovered, and is the brightest persistent X-ray source in the sky, apart from the Sun. It consists of a neutron star accreting from a low-mass late-type donor star at a high rate. It has an orbital period of 18.9 hr which is derived from an optical modulation in the light curve due to X-ray heating of the donor star (Fig 2; Hynes & Britt 2012 ApJ 755 66). The rapidly spinning neutron stars in low mass X-ray binaries are gravitational wave emitters, and although the binary parameters are relatively well known for this system, continued monitoring is necessary to achieve the precision required for gravitational wave searches with Advanced LIGO (Galloway et al 2014 ApJ 781 14).



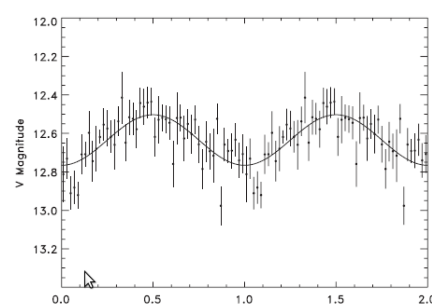


Fig.1 (Left) Optical light curve of V893 Sco showing eclipses and flickering. The high cadence, uninterrupted K2 lightcurves will resolve the quiescent DNO signal from the stochastic flikering variability (figure from Bruch 2000 PASP 112 237) **Fig.2** (Right) Optical modulation in the lightcurve of V818 Sco, the optical counterpart of Sco X-1 (figure from Hynes & Britt 2012)