Short cadence observations of cataclysmic variables with K2

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Short-cadence *Kepler* observations of accreting white dwarfs (specifically cataclysmic variables, CVs) have already had a major impact by showing that at least one of these systems exhibits the same rms-flux relation that also characterises the stochastic flickering variability of accreting neutron stars and black holes. Here, we propose to obtain SC observations of three additional accreting WDs in the K2 FoV. Two of these are eclipsing disk-accretors, while the third harbours a magnetic WD that accretes via its poles. These observations will allow us to (i) test if the rms-flux relation is seen in *all* disk-accreting CVs; (ii) measure long-term disk radius variations in the eclipsing systems; (iii) determine the spin ephemeris – including the spin period derivative – of the magnetic accretor; (iv) detect the Doppler-induced orbital variations in the spin period, which in turn will allow us to determine the inclination of the system. In detail, the systems are:

Field 2, U Sco & V893 Sco: Both these systems are eclipsing CVs with orbital periods of 29.5 hours and 1.8 hours respectively. The high-frequency variability studies of these systems will allow us to isolate the source of flickering as a function of orbital phase, which in turn will constrain the emitting region driving the flickering. Additionally, while a a study of rms-flux variations was carried out on MV Lyrae in the first *Kepler* mission (Scaringi et al. 2012, MNRAS, 4321, 2854, see Fig. 1), we need to know if similar rms-flux relations are common to all CVs. Furthermore, following the eclipse depth vs. out-of-eclipse flux for these systems will allow us to track accretion disk radius changes during outbursts, similarly to what has been done in Scaringi et al. 2013 (MNRAS, 435, 68) and Ramsay et al. 2013 (MNRAS, 425, 1479), see Fig. 1. Determining disk radius changes during outbursts allows us to probe mass transfer rate variations, which in turn can be used to test accretion disk theory.

Field 3, FO Aqr: The intermediate polar (IP, orbital period 4.8 hours, spin period 1254s) would be the first to be observed with *Kepler*ṠC observations will allow us to carry out a heretofore impossible study of short term variations in spin up/spin down rates in an IP (already know to exist on long time scales, Patterson et al 1998, PASP, 110, 414.). Furthermore, by measuring the Doppler effect on the spin period though many orbital cycles, a measurement only possible with *Kepler* we will measure the inclination (and possibly the eccentricity and mass ratio) of the binary system. The Doppler effect is small, requiring the 3 months of continuous coverage, but will appear as a side lobe of the spin period, as shown in the simulation in Fig. 1.

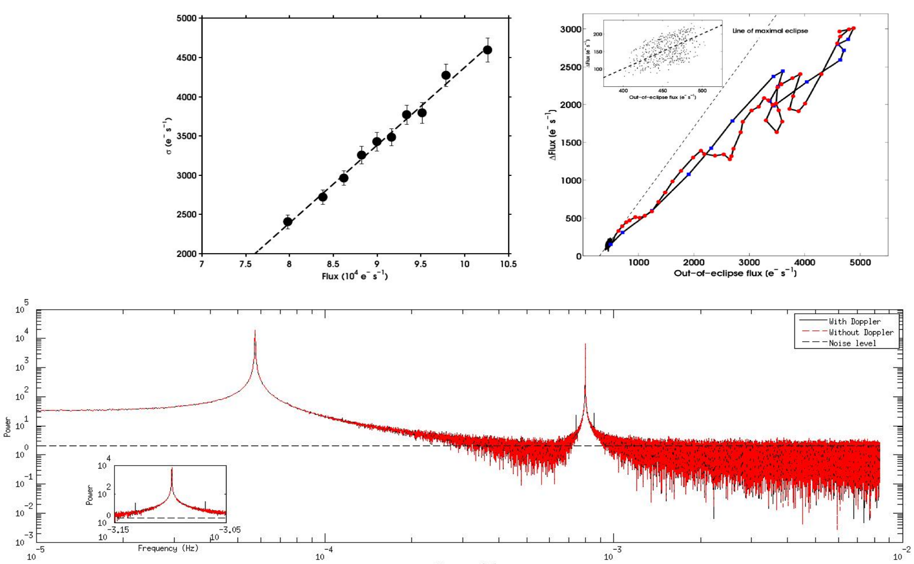

Figure 1: Top-left: rms-flux relation obtained from 5 days of SC data on MV Lyrae. Top-right: The eclipse depth in KIS J1927 as a function of out-of-eclipse light obtained with LC data. Marked in black dots are measurements in quiescence, blue squares are outburst rise and red circles are outburst decay cycles. The thick black line joins consecutive cycles. Any deviations from the "line of maximal eclipse" suggest a disk radius increase relative to quiescence. Part of the "hooks" in the curve are due to imprecise eclipse depth measurements caused by the LC sampling. The SC data we request will allow us to improve on this and constrain the increase in accretion disk size as the systems go through outbursts. Bottom: Simulations for 3 months of SC data of FO Aqr, with and without Doppler effect applied to the spin period. The estimated noise level is shown with the dashed black line. We will be able to detect the side-lobes on the spin frequency, which is a clear signature of the Doppler effect.