Accretion-induced variability in compact interacting binaries with K2

S. Scaringi[1,2], P. Groot[3], C. Knigge[4], E. Koerding[3], T. Maccarone[5], P. Uttley[6]

[1]K.U. Leuven, Leuven, Belgium, [2]Max Planck Institute for Extraterrestrial Physics, Garching, Germany, [3]Radboud University Nijmegen, Nijmegen, The Netherlands, [4]University of Southampton, Southampton, U.K., [5]Texas Tech University, Lubbock, U.S.A., [6]University of Amsterdam, Amsterdam, The Netherlands.

One of the greatest advantages of the re-purposed mission will be related to variability studies (both periodic and aperiodic) of accreting compact objects, including white dwarfs, neutron stars, and both stellar-mass and supermassive black holes at the center of galaxies. Arguably, the most suited systems to study accretion-driven variability with the K2 mission are cataclysmic variables (CVs), where a white dwarf accretes material from an accretion disk formed via roche-lobe overflow of a secondary star. This is because these systems have brighter apparent magnitudes than the other classes of accreting objects and their intrinsic variability timescales range from seconds to months.

With this short proposal, we ask to observe:

- 11 CVs obtained from the Ritter & Kolb 2003 catalog, in short cadence (SC) mode, including 1 intermediate polar.
- 2 double-degenerate WD pairs (also obtained from the Ritter & Kolb 2003 catalog), one of which has an orbital period of 12.75 minutes, in SC mode.
- 1 spectroscopically identified CV from the Palomar Transient Factory (Paul Groot, priv. comm.), in long cadence mode (LC).

These CVs will form the basis for both periodic and aperiodic variability analysis. Specifically, we will seek to characterize the outbursting properties of the whole sample by applying similar methods to those already used on *Kepler* data by Cannizzo et al 2012, Kato et al. 2013 and Scaringi et al. 2013 (and references therein), by quantifying the outburst durations, length, and brightness as a function of where they appear relative to the superoutbursts. Additionally, the broad-band variability properties (flickering) will be analyzed using the same tools as those used on the *Kepler* lightcurve of MV Lyrae (Scaringi et al. 2012a, Scaringi et al. 2012b), which will result in the characterization of the rms-flux relations present in the variability as well as the power-spectral density (PSD) shapes. This will include both phenomenological as well as theoretical fitting of the PSDs, where we will seek to obtain the characteristic frequencies of potential quasi-periodic oscillations, as well as the high-frequency breaks in the PSDs. Furthermore, we will seek to apply the physical model used in Scaringi 2014 to infer accretion disk parameters for the sample, such as the scale height, size and viscosity parameter of the inner-most accretion disk region. This same model has also been used to study the X-ray flickering behavior of X-ray binaries (XRBs), and the new K2 dataset will allow the first comprehensive comparison between the already known XRB results to a sample of CVs. One system of particular interest in the sample (V418 Gem) is a known intermediate polar: a CV with a magnetic WD displaying spin modulations. As no such system has ever been discovered in the original *Kepler* field, the K2 observations will provide the best ever lightcurve for such a system, and we will determine whether the WD is spinning down as expected from the work of Norton et al. 2008, and be able to compare these results to X-ray observations of accreting, spinning, neutron stars.

Two objects in our sample are double-degenerate white dwarf pair systems, and for these we will seek to study the periodic variability. In particular, one of these systems (J0651+2844) is known to display an orbital period of 12.75 minutes, with an orbital period shrinking rate consistent with gravitational wave losses (Hermes et al. 2012). With the K2 data we will seek to confirm this result, and possibly improve on the 30% uncertainty on their result, as well as study tidal-induced periodic modulations.

Finally, one objects (PTJ061125.08+225116.9) is requested in LC mode as it possess a fainter apparent magnitude, and we will seek to better understand it's long-timescale behavior and characterize the recurrence of outbursts within the system.

All objects (except PTJ061125.08+225116.9) in the proposed target list have m_V magnitudes brighter than 19.1. The attached K2 target list has them arranged in order of priority. We request all objects in SC mode, except the last one in the list which requires LC mode.

References

•Ritter & Kolb 2003, A&A, 404, 301 •Cannizzo et al. 2012, AJ, 747, 117 •Osaki & Kato 2013, PASJ, 65, 95 •Scaringi et al. 2013, MNRASL, 435, 68 •Scaringi et al. 2012a, MNRAS, 421, 2854, •Scaringi 2012b, MNRAS, 427, 3396 •Scaringi 2014, MNRAS, 438, 1233 •Norton et al. 2008, ApJ, 672, 524 •Hermes et al. 2012, ApJL, 757, 21