

Proposal for K2 Campaign 1
A search for transiting exoplanets around cool white dwarfs

Team members: *R. Alonso (PI) , C. Allende-Prieto, V. Béjar, J.A. Belmonte, H.J. Deeg, S. Hoyer, P. Klagyivik, N. Lodieu, P. Montañés, G. Nowak, E. Pallé, J.A. Pérez-Prieto*

Affiliations: *Instituto de Astrofísica de Canarias / Departamento de Astrofísica Universidad de La Laguna, Tenerife, Spain*

Scientific justification:

The more than 1000 confirmed exoplanets include objects around young stars, pulsars, and in multiple stellar and planetary configurations (e.g. Doyle et al. 11, Lissauer et al. 11). A few circumbinary exoplanets have been found both by timing of Post-common eclipsing binaries, which include a white dwarf (WD) component, (Qian et al. 09, Beuermann et al. 10), and with the Kepler mission (e.g., Doyle et al. 11). The expensive efforts of several radial velocity teams around the world in the last decades (HARPS, HIRES, AAT, SOPHIE, FIES, ...), and the space missions (Kepler, CoRoT, MOST), are contributing to determine how frequent planetary systems as our own are in the Universe.

Most of the previous searches were focussed on main sequence solar-type stars, and a few on lower mass stars (M stars) or intermediate mass/evolved stars. We want to propose a program to extend the previous efforts, looking for transiting Earths in the habitable zones around WDs. The idea was suggested by Agol (11), and made more attractive recently with the claims of Loeb & Maoz (13), that if a planet of this kind is found in the next years, it could be searched for biomarkers in its atmosphere with JWST. This is due to the much more favorable size ratios of WD-Earth vs. Sun-Earth, and the fact that the WD spectra have few features, thus making it easier to recognise spectral lines when the atmosphere of the planet is partially occulting the WD. We note that current exoplanets found in or close to the habitable zones of their stars can not be searched for biomarkers with current instrumentation nor JWST, and will have to wait at least more than a decade until this is feasible (Snellen et al. 13).

Our team has started in summer 2013 an intensive follow-up of a list of 700 cool white dwarfs ($T_{\text{eff}} < 7000$ K), using ground-based 1-m class telescopes. We want to use K2 to observe the targets in our compiled sample that fall inside the FOV (ranging from one to about a dozen objects depending on the pointing), aiming to sample longer periods and smaller transiting objects. This effort will conclude with a determination of the frequency of terrestrial planets in short-period orbits around white dwarfs, and the potential detection of terrestrial planets with a relatively easy-to-characterise atmosphere.

Proposal for Campaign 1:

Observations in a 1-min cadence mode of the targets provided in the XLS file. These are the targets that might be observable around the proposed coordinates. For campaign 1, we are proposing 5 targets that fall inside the proposed K2FoV (flag = 2), plus 11 that returned a flag = 1, and are thus worth proposing. The expected precisions (estimated to about 1.2% per minute exposure from Figure 12 of Howell et al. 14, on a $M_{\text{kep}}=16$ target) would allow the detection of transiting objects with radii larger than 500 km for stars $M_{\text{kep}} < 15$, the detection of Moon-size objects around $M_{\text{kep}} < 17$, and the detection of Earth-sized planets in all our sample. As the expected transit duration are typically < 2 min, we request 1-min cadence observations.

References:

Agol 11, ApJ, 731, 31

Beuermann et al. 10, A&A, 521, 60

Doyle et al. 11, Science, 333, 1602

Howell et al. 14, arXiv: 1402.5163

Lissauer et al. 11, Nature, 470, 53

Loeb & Maoz 13, MNRAS, 432, 11

Qian et al. 09, ApJ, 706, 96

Snellen et al. 13, ApJ, 764, 182