

Short Cadence Observations of Confirmed Pulsating WDs in *K2* Field 1

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Most stars in our Galaxy, including our Sun and essentially all known planet hosts, will end or have already ended their lives as white dwarfs (WDs). WDs at the appropriate temperature to drive pulsations provide us unprecedented insight into their interiors, enabled by matching the periods of observed luminosity variations to well-calibrated theoretical models. Precision asteroseismology of WDs has the tantalizing potential to probe the masses and compositions of their electron-degenerate cores, as well as of their non-degenerate envelopes; to determine their internal rotation profiles; to measure weak magnetic fields; to detect substellar companions; and to even constrain WD crystallization and nuclear reaction rates (see reviews by Winget & Kepler 2008, *ARA&A*, 46, 157 and Fontaine & Brassard 2008, *PASP*, 120, 1043).

Pulsating hydrogen-atmosphere WDs (DAVs) are the most numerous pulsating WDs, but were discovered late in the original *Kepler* mission, the first targeted in Q11 (Hermes et al. 2011, *ApJ*, 741, L16). Only three DAVs were observed longer than one month with *Kepler*, and early analyses show that extended, space-based observations have shed unique light into rotation rates of isolated WDs (Greiss et al. 2014, *MNRAS*, 438, 3086), as well as insight into the mode stability of cooler WDs and a window into an unprecedented flare-like phenomena not seen previously in DAVs (Bell et al. 2014, in prep.). Our intention in *K2* is to recover the science lost due to the reaction wheel failure before most of our DAVs were observed from space; our group was allocated nine SC slots for DAVs in GO Cycle 5.

DAVs vary with 100 – 1400 s periods, thus require **short cadence** targeting. Our targets likely span a range of T_{eff} , overall mass, and envelope mass, all of which can be well constrained with the identification of 8 or more unique, independent pulsation modes. Our *K2* Field 1 observations will thus probe the interiors, including the degenerate cores, of a wide population of stellar remnants representing the diversity of stellar evolution:

PG 1149+057: (EPIC 201806008, $K_p = 15.0$ mag) Confirmed cool DAV ($T_{\text{eff}} = 11,020 \pm 20$ K, $\log g = 8.06 \pm 0.02$) discovered by Voss et al. (2006, *A&A*, 450, 1061) with variability near 1023.5 s (1.05% amplitude).

SDSS J1149–0147: (EPIC 201344364, $K_p = 18.0$ mag) Heretofore unpublished DAV (WD+dM composite spectra with a $T_{\text{eff}} = 10,670 \pm 1000$ K, $\log g = 8.47 \pm 0.09$ WD; Rebassa-Mansergas et al. 2012, *MNRAS*, 419, 806) confirmed from the ground with variability at 1150 s (2.8%). Light curves and Fourier analysis shown in Fig. 1.

WD J1122+0358: (EPIC 201719578, $K_p = 18.2$ mag) Confirmed DAV ($T_{\text{eff}} = 11,700 \pm 150$ K, $\log g = 7.99 \pm 0.08$) discovered by Mukadam et al. (2004, *ApJ*, 607, 982) with periods near 996.1 s (1.8%) and 859.0 s (3.4%).

SDSS J1151+0525: (EPIC 201802933, $K_p = 17.7$ mag) Heretofore unpublished DAV confirmed from the ground with variability near 304.2 s (1.3%), 276.2 s (0.6%), and 199.3 s (0.5%). Light curves and Fourier analysis shown in Fig. 1.

WD J1136–0136: (EPIC 201355934, $K_p = 17.9$ mag) Confirmed DAV ($T_{\text{eff}} = 11,710 \pm 70$ K, $\log g = 7.96 \pm 0.04$) discovered by Castanheira et al. (2010, *MNRAS*, 405, 2561) with low-amplitude variability near 260.8 s (0.25%).

In addition to the above targets, which return 2-flags using *K2*FOV, we include six confirmed pulsating WDs that return 1-flags: **GD 133:** EPIC 201619342, **WD J1125+0345:** EPIC 201706677, **WD J1157+0553:** EPIC 201828246, **WD J1200–0251:** EPIC 201273498, **WD J1106+0115:** EPIC 201547918, and **PG 1159–035:** EPIC 201214472.

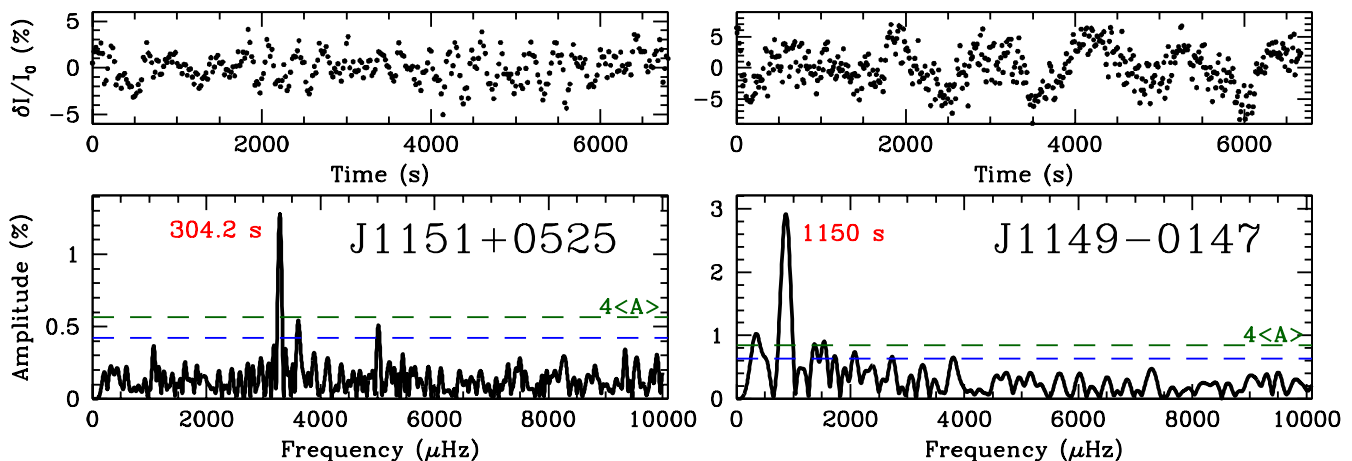


Figure 1: The left panels show the McDonald Observatory discovery light curves and Fourier analysis of J1151+0525. The right panels show the same for the Thai National Telescope light curves of J1149–0147. The $4\langle A \rangle$ line marks 4 times the mean noise level in the FT out to 10000 μHz ; this provides a coarse but conservative assessment of significance.