KIC 4552982: asteroseismology and outbursts in the longest-ever light curve of a ZZ Ceti

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Abstract

Around 97% of all stellar evolution will conclude at the white dwarf stage, and further evolution is essentially just a cooling process. While white dwarfs cool through certain temperature ranges, their conditions can be right to support partial ionization zones in their atmospheres for their main atmospheric constituent, enabling convective driving of nonradial oscillations. Between effective temperatures of _˜ 12,270 K to 10,850 K, white dwarfs with hydrogen atmospheres pulsate and appear photometrically variable as ZZ Cetis. The tools of asteroseismology allow us, through Fourier analysis of time-series photometry, to catch a glimpse of the extreme conditions of their compact interiors. Precision asteroseismology requires extended monitoring of pulsators with limited interruptions. The Kepler light curve for KIC 4552982, at 1.5 years of nearly continuous coverage, is a record breaker in this respect. We present the results of our analysis of these data, including the observed frequencies of oscillation, mode identifications from our models, and asteroseismic inferences about the interior structure and rotation of the star. Furthermore, the light curve for KIC 4552982 revealed sporadic brightness increases of 1-8 % that last for 5-10 hours and recur with a characteristic timescale of 2.5 days. We also characterize and discuss this exciting phenomenon, which is unlike anything ever before studied in a white dwarf light curve.

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