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ZTF-identified HW Virginis Systems

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Abstract

We present 46 HW Virginis Post-Common Envelope Binary Systems identified by the Zwicky Transient Facility, 26 of which appear to be new discoveries. Through the application of the Box Least-Squares Algorithm to ZTF data, we searched a data set of 17,473 systems for periodicity and phase-folded all of the ZTF lightcurves of the objects at their best period. Through visual analysis of these phase-folded lightcurves, we identified the 46 HW Vir Systems.

1. Introduction

HW Virginis (HW Vir) systems are Post Common Envelope Binaries (Schaffenroth et al. 2019) consisting of a hot subluminous dwarf star (Heber 2016) and an M dwarf companion star (Ivanova et al. 2013). All data from this project were taken on the Samuel Oschin Schmidt 48 inch telescope of the Zwicky Transient Facility (ZTF) at Palomar Observatory in Southern California (Bellm et al. 2019) (Graham et al. 2019). This survey has a decl. limit of −30°, a 47 deg^2 field of view, and has a 5σ limiting magnitude at about 20.6 for *r*-band and 20.8 in *g*-band (Burdge et al. 2020). Using data from the Gaia hot subdwarf catalog (Geier et al. 2019) and cross-matching it with ZTF data, a list of objects observed by ZTF was created. Through periodicity analysis, we identify 46 HW Vir candidates. This collection of objects can be used as training data for supervised machine learning methods to help create an automated system capable of identifying HW Vir lightcurves.

2. Data Analysis

In order to extract the sample of lightcurves, we cross-matched the catalog of 39,800 hot subdwarfs reported in Geier et al. (2019) with the ZTF DR3 archival lightcurve database, and analyzed all objects with more than 50 5σ detections in individual ZTF-*g* and ZTF-*r* exposures, yielding 17,473 candidates. Due to its speed, we used a graphics processing unit implementation of the BLS algorithm (Kovács et al. 2002) to determine the best period for each object, and visually inspected all 4572 of the phase-folded lightcurves in the sample with best periods falling between 1 hr and 10 days in order to identify the HW Vir candidates.

3. Results

We include a machine-readable table containing our data from our 46 HW Vir systems. We crossmatched our data with the EREBOS survey, which contains 161 HW Vir, (Schaffenroth et al. 2019) to find that 26 of our HW Vir appear to be newly discovered systems. Our galactic coordinate plot of these systems' locations shows the 46 HW Vir to be generally concentrated between galactic longitudes of −20° and 20° (see Figure 1). The median orbital period of the systems identified in this work is roughly 0.16 days (3.8 hr), which is quite short. Objects with periods this short will interact, and many will evolve into mass-transferring cataclysmic variables.

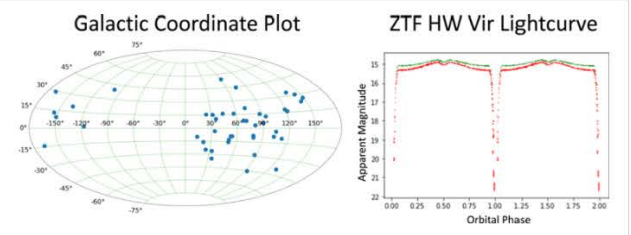

Figure 1. Panel A: The 46 ZTF-identified HW Vir systems in galactic coordinates. The Gaia positional, periods, and mean magnitudes are available as the Data behind this panel of the Figure. Panel B: An example of a ZTF-identified HW Vir lightcurve.

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ZTF is a project led by PI S. R. Kulkarni at Caltech, and includes IPAC; WIS, Israel; OKC, Sweden; JSI/UMd, USA; UW, USA; DESY, Germany; NRC, Taiwan; UW Milwaukee, USA; and LANL USA. ZTF acknowledges the generous support of the NSF under AST MSIP Grant No 1440341. We thank the Caltech Summer Research Connections program for high-school students, under which Josie Enenstein did her research work. This work is based on observations obtained with the Samuel Oschin 48 inch Telescope at the Palomar Observatory.

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