

White Dwarf Binaries across the H-R Diagram

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We created the APOGEE-GALEX-Gaia catalog to study white dwarf (WD) binaries. This database aims to create a minimally biased sample of WD binary systems identified from a combination of GALEX, Gaia, and APOGEE data to increase the number of WD binaries with orbital parameters and chemical compositions. We identify 3414 sources as WD binary candidates, with non-degenerate companions of spectral types between F and M, including main-sequence stars, main-sequence binaries, subgiants, sub-subgiants, red giants, and red clump stars. Among our findings are (a) a total of 1806 systems having inferred WD radii $R < 25 R_{\oplus}$, which constitute a more reliable group of WD binary candidates within the main sample; (b) a difference in the metallicity distribution function between WD binary candidates and the control sample of most luminous giants ($M_H < -3.0$); (c) the existence of a population of sub-subgiants with WD companions; (d) evidence for shorter periods in binaries that contain WDs compared to those that do not, as shown by the cumulative distributions of APOGEE radial velocity shifts; (e) evidence for systemic orbital evolution in a sample of 252 WD binaries with orbital periods, based on differences in the period distribution between systems with red clump, main-sequence binary, and sub-subgiant companions and systems with main-sequence or red giant companions; and (f) evidence for chemical enrichment during common envelope (CE) evolution, shown by lower metallicities in wide WD binary candidates ($P > 100$ days) compared to post-CE ($P < 100$ days) WD binary candidates.

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