Searching for binary star candidates with a white dwarf component in the Gaia DR3

George Thomas

University of Leicester

Obtaining large samples of spatially unresolved double degenerates (DDs) from photometric catalogues like Gaia DR3 is challenging because the cooling curves of single and binary white dwarfs overlap on colour-colour diagrams. This is also true for the elusive type 1a supernova progenitors (SNIa) which, according to the DD channel of SNIa detonation, consist of a pair of closely orbiting white dwarfs whose total mass is constrained by the Chandrasekhar limit of $1.4M_{\odot}$. However, C/O core DDs with low mass constituents will be over-luminous compared to their single counterparts, which makes it possible to select DD candidates from Gaias high precision parallax and photometry data. According to the white dwarf mass distribution, single white dwarfs are relatively few in number at masses below $0.45M_{\odot}$. Therefore, any white dwarfs that lie above the corresponding cooling curve on the H-R diagram are likely to be double white dwarf systems. The population of SNIa progenitor candidates can be constrained by a binary cooling curve corresponding to equal mass constituents of $0.7M_{\odot}$. White dwarf binaries that lie above this line on the H-R diagram are unlikely to have masses that are consistent with the Chandrasekhar limit. Additional constraints on DD candidates can be considered by appealing to the Gaia astrometric error statistics, like the renormalized unit weight error (RUWE), which may be large for unresolved astrometric binaries. Using these constraints in the search for DDs may significantly reduce the amount of telescope observation time required to identify these objects compared to blind surveys, such as the Type Ia Supernova Progenitor Survey (SPY). The DR3 binary catalogues will also provide useful information on the photometric properties of DDs, as these will serve as references for white dwarf binaries in DR3. We intend to select a large sample of white dwarfs from DR3 with astrometric and photometric cuts that are carefully designed to put a heavy bias on DD systems. We will then follow up on this catalogue with multi-epoch spectroscopy to obtain the orbital periods of any confirmed double degenerates, with an eye to identify SNIa progenitors.