



The Beginnings and Ends of Double White Dwarfs

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Limits from Gaia on the population of collisional-triple SN Ia progenitors

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The collisional-triple SN Ia progenitor model posits that SNe Ia result from head-on collisions of binary white dwarfs (WDs), driven by dynamical perturbations by the tertiary stars in mild-hierarchical triple systems. To reproduce the Galactic SN Ia rate, some 30-55 per cent of all WDs would need to be in triple systems of a specific architecture. We test this scenario by searching the Gaia DR2 database for the postulated progenitor triples. Within a volume out to 120 pc, we search around Gaia-resolved double WDs with projected separations up to 300 au, for physical tertiary companions at projected separations out to 3000 au. At 120 pc, Gaia can detect faint low-mass tertiaries down to the bottom of the main sequence and to the coolest WDs. Around 27 double WDs, we identify zero tertiaries at such separations, setting a 95 per cent confidence upper limit of 11 per cent on the fraction of binary WDs that are part of mild hierarchical triples of the kind required by the model. To further explore the triple landscape, we search Gaia DR2 for tertiaries within 3000 au of unresolved double-WD candidates with separations of ~ 0.1 -1 au, identified via radial-velocity variations in the SPY survey. We identify such wide tertiaries around four (i.e. 9%) among the 44 double-WD candidates in this sample. As only a fraction (likely ~ 10 per cent) of all WDs are in < 300 au WD binaries, the potential collisional-triple progenitor population appears to be at least an order of magnitude (and likely several) smaller than required by the model.

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