The non-explosive stellar merging origin of the ultra-massive carbon-rich white dwarfs

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We have investigated the origin of a sub-class of carbon-polluted white dwarfs (DQ) originally identified as the "hot DQ" white dwarfs. These objects are relatively hot ($10\,000 \leq T_{\rm eff} \leq 25\,000\,{\rm K}$), have markedly higher carbon abundance (C-enriched) and are more massive ($M \geq 0.8\,{\rm M}_{\odot}$) than ordinary DQs, and display high space velocities. Hence, despite their young appearance, their kinematic properties are those of an old white dwarf population. The way out of this dilemma is to assume that they formed via the merging of two white dwarfs. In this paper we examine the observed characteristics of this population of "C-enriched" DQ white dwarfs and confirm that nearly half of the 63 known objects have kinematic properties consistent with those of the Galactic thick disk or halo. We have also conducted population synthesis studies and found that the merging hypothesis is indeed compatible with observations. Studies of this sub-class of white dwarfs have important implications for our understanding of Type Ia Supernovae (SNeIa), commonly used to determine the expansion history of the universe, since the same formation channel applies to both kind of objects. Hence probing the properties of these white dwarfs that failed to explode may yield important constraints to the modelling of the mechanisms leading to a thermonuclear runaway.