

A white dwarf cooling age of 8 Gyr for NGC 6791 from physical separation processes

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Abstract

NGC 6791 is a well studied open cluster that it is so close to us that can be imaged down to very faint luminosities. The main sequence turn-off age (~8 Gyr) and the age derived from the termination of the white dwarf cooling sequence (~6 Gyr) are significantly different. One possible explanation is that as white dwarfs cool, one of the ashes of helium burning, ^{22}Ne , sinks in the deep interior of these stars. At lower temperatures, white dwarfs are expected to crystallise and phase separation of the main constituents of the core of a typical white dwarf, ^{12}C and ^{16}O , is expected to occur. This sequence of events is expected to introduce significant delays in the cooling times but has not hitherto been proven. Here we report that, as theoretically anticipated physical separation processes occur in the cores of white dwarfs, solving the age discrepancy for NGC 6791.