

It is interesting to note that in the case of elastic DM scattering cross-sections  $\sigma_n \sim 10^{-43} \text{ cm}^2$  evade the WD bounds [58]. It is unlikely that observations of WDs much cooler than those in M4 will be made as the low luminosity cut-off has been observed, and the luminosity of WDs is limited by the age of the Universe. Therefore it is unlikely that limits from WDs will ever compete with direct detection limits for weak-scale elastic DM.

However WDs constitute unique DM probes for three reasons:

- The large escape velocity enables in-falling DM particles to easily overcome inelastic splittings and leads to large energy transfers in scattering.
- The low mass of carbon gives WDs sensitivity to light DM scenarios, where most direct detection experiments lose sensitivity.
- Limits from capture in the Sun arise due to neutrino annihilation products and are therefore insensitive to DM annihilating to  $e^+e^-$ ,  $\mu^+\mu^-$ ,  $\gamma\gamma$ , light hadrons or gluons. It is specifically this scenario where limits from WDs are strongest.

We have only considered iDM capture in this work,

however numerous possibilities exist for future study of DM capture in WDs. Examples would include DM with mass splittings of the order a few MeV or DM which scatters through a light mediator,  $m_\phi \sim \text{MeV}$ , which could be enhanced in WDs through the propagator  $1/(q^2 - m_\phi^2)$ .

Finally we note that if DM were to be discovered in future experiments, and details of the DM-nucleon cross-section and annihilation products were to be established, then cold WDs could be used to determine an upper limit on the DM density within M4, thus giving clues as to the formation of globular clusters.

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