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New Gravitational Probes of Dark Matter

Despite decades of searching, the strongest evidence for dark matter remains gravitational. It is thus worthwhile to consider the extent to which gravitational probes can discriminate between models of cold dark matter. With this in mind, in this talk I will discuss the early universe origins and late universe observables of "superfluid" dark matter. Despite having only gravitational couplings to the standard model, this scenario provides a suite of complimentary observable signatures. A concrete model realization is SU(2) gauge theory with two massless quarks: At finite particle number density and low temperature, the dark quarks condense and form a superfluid, the collective excitations of which behave as cold dark matter. The associated early universe production of gravitational waves can be probed by the CMB, while halo substructure in the form of vortices and disk-like bound states leaves a characteristic imprint on strong gravitational lensing. Talk based on arXiv:1801.07255 and arXiv:1901.03694.

Author: Dr MCDONOUGH, Evan (Brown University)

Presenter: Dr MCDONOUGH, Evan (Brown University)

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