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New realisation of light thermal dark matter with enhanced detection prospects

Light dark matter (DM) with mass around the GeV scale faces weaker bounds from direct detection experiments. If DM couples strongly to a light mediator, it is possible to have observable direct detection rate. However, this also leads to a thermally under-abundant DM relic due to efficient annihilation into light mediators. We propose a novel scenario
where a first-order phase transition (FOPT) occurring at MeV scale can restore GeV scale DM relic by changing the mediator mass sharply at the nucleation temperature. The MeV scale FOPT predicts stochastic gravitational waves with nano-Hz frequencies within reach of pulsar timing array (PTA) based experiments like NANOGrav. In addition to enhancing direct detection rate, the light mediator can also give rise to the required DM self-interactions necessary to solve the small scale structure issues of cold dark matter. The existence of light scalar mediator and its mixing with the Higgs keep the scenario verifiable at different particle physics experiments.

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