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Darkogenesis via Supercooled Phase Transition

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We discuss the intriguing possibility that the recently reported nano-Hz gravitational wave signal by Pulsar Timing Array (PTA) experiments is sourced by a strong first-order phase transition in a dark sector. The phase transition has to be strongly supercooled to explain the signal amplitude. However, such strong supercooling exponentially dilutes away any pre-existing baryon asymmetry and dark matter, calling for a new paradigm of their productions. We then develop a mechanism of cold darkogenesis that generates a dark asymmetry during the phase transition from the textured dark SU(2) Higgs field. This dark asymmetry is transferred to the visible sector via neutron portal interactions, resulting in the observed baryon asymmetry. Furthermore, the mechanism naturally leads to the correct abundance of asymmetric dark matter. Collider searches for mono-jets and dark matter direct detection experiments can dictate the viability of the model. We also discuss another scenario of darkogenesis where the number asymmetry is generated from the decay of a mother particle produced via parametric resonance during the phase transition induced due to its coupling to the order parameter scalar. It is shown that the correct baryon asymmetry and dark matter abundance can be realized for a dark phase transition at O(1) GeV. The scenario will be tested further in neutron-antineutron oscillation experiments.

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