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Cold darkogenesis: Dark matter and baryon asymmetry in light of the PTA signal

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We build upon 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 from a nearly conformal dark sector. The phase transition has to be strongly supercooled to explain the signal amplitude, while the critical temperature has to be in the (GeV) range, as dictated by the peak frequency of the gravitational wave spectrum. However, the resulting 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 ⊠⊠(2)D 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, with self-interaction of the scale that is of the right order to solve the diversity problem in galactic rotation curves. Collider searches for mono-jets and dark matter direct detection experiments can dictate the viability of the model.

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