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Distinctive Gravitational Signature of Dark Matter in Neutron Stars

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Neutron stars (NSs), especially during their proto-neutron star (PNS) phase, offer a unique setting to probe non-annihilating dark matter (DM). We model the thermal and structural evolution of PNSs admixed with asymmetric DM using a two-fluid formalism where DM interacts with baryons only through gravity, considering both fermionic and bosonic candidates. Our results show a clear thermal imprint: a DM core compresses and heats baryonic matter, while an extended DM halo provides external support, leading to relative cooling. This signature contrasts with the role of exotic baryons, which soften the equation of state and lower the core temperature. The effect is strongest during deleptonization and the neutrino-transparent phases, influencing supernova neutrino light curves and young pulsar cooling. These findings highlight a novel, testable discriminator for DM in NSs, offering multi-messenger pathways to constrain DM properties.

Altas energias

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