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Leptogenesis and Dark Matter Through Relativistic Bubble Walls with Observable Gravitational Waves

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We study a scenario where both dark matter (DM) and heavy right-handed neutrino (RHN) responsible for leptogenesis acquire masses by crossing the relativistic bubble walls formed as a result of a supercooled first order phase transition (FOPT) above electroweak scale. This leads to a large out-of-equilibrium abundance of RHN inside the bubble sufficient to produce the required lepton asymmetry. A classical conformal symmetry ensures the origin of mass via FOPT induced by a singlet scalar while also ensuring supercooling leading to enhanced gravitational wave (GW) amplitude within the sensitivity of present and future GW detectors. A minimal scenario with three RHN, one inert scalar doublet and one singlet scalar as additional fields beyond the standard model (BSM) is sufficient to realize this possibility which also favors inert RHN dark matter over inert scalar doublet. While low scale leptogenesis scenario can be probed at future GW detectors like LISA, a sufficiently high scale leptogenesis scenario can be constrained from LIGO-VIRGO data as well. We further show that the simultaneous requirement of satisfying baryon asymmetry and dark matter relic significantly restricts the mass spectrum of BSM particles.

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