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Inverse Bubble from broken Supersimmetry

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A cosmological inverse first-order phase transition is an endothermic event in which bubbles of the new phase expand by absorbing latent heat and pulling the surrounding plasma inward—opposite to the usual (exothermic) outward flow. Such behaviour was thought possible only during a reheating phase, when the cosmic temperature rises. We show it can emerge naturally while the Universe cools. In an O'Raifeartaigh model that breaks supersymmetry and R-symmetry, the transition along the pseudomodulus is inverse in a part of the parameter space. By solving the hydrodynamics, without approximations, we identify the general criterion to distinguish the PT nature—the sign of the generalized pseudo-trace of the energy–momentum tensor—which cleanly separates inverse from direct transitions. This establishes endothermic phase transitions as a realistic ingredient of early-Universe dynamics and furnishes a concrete SUSY example for broader model building. Work is now underway to compute the associated stochastic-gravitational-wave spectrum, with the goal of distinguishing inverse from direct transitions in upcoming observations.

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