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Enhancement of first-order phase transitions through a mass-acquiring scalar field

Phase transitions in the early Universe give rise to effective masses for massless fields in the symmetry-broken phase. We use the lattice simulations to investigate the impact of a spectator scalar field with mass generation on the dynamics of first-order phase transitions and the generation of gravitational waves. In addition to the well-known friction effects, we identify a novel effect that significantly enhances the strength of first-order phase transitions. The amplitude of the mass-acquiring field is highly suppressed in the true vacuum bubbles, resulting in additional release of vacuum energy that concentrate on the bubble walls. We also establish an analytical method to explain our numerical results.

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