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Equation of State of the Universe after a First Order Phase Transition

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Cosmological first-order phase transitions are caused by a scalar field that tunnels to a new vacuum state, triggering the nucleation and expansion of bubbles. In scenarios where the scalar field interacts only weakly with the surrounding plasma, the assumption of instantaneous reheating after the transition breaks down. As a result, the evolution of the universe may become dominated by oscillations of the scalar field. Such scenarios are often presumed to result in a phase of matter domination. In this talk, I examine this assumption using results from lattice simulations that track the scalar field's energy distribution over time. By analyzing the system's equation of state after the transition, I will show that it depends on the mean bubble separation, with large separations leading to sizable deviations from matter domination. These insights carry significant implications for the universe's later evolution and potentially the production of dark matter.

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