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Gravitational Waves from Feebly Interacting Particles in a First Order Phase Transition

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First order phase transitions are well-motivated and extensively studied sources of gravitational waves (GWs) from the early Universe. The vacuum energy released during such transitions is assumed to be transferred primarily either to the expanding walls of bubbles of true vacuum, whose collisions source GWs, or to the surrounding plasma, producing sound waves and turbulence, which act as GW sources. In this Letter, we study an alternative possibility that has so far not been considered: the released energy gets transferred primarily to feebly interacting particles that do not admit a fluid description but simply free-stream individually. We develop the formalism to study the production of GWs from such configurations, and demonstrate that such GW signals have qualitatively distinct characteristics compared to conventional sources and are potentially observable with near-future GW detectors.

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