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Gravitational Waves from Sound Waves

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First-order phase transitions in the early universe can produce a stochastic background of gravitational waves (GWs), where sound waves in the plasma are expected to be the dominant source in the absence of extreme supercooling. A precise prediction of the GW spectrum therefore requires a careful treatment of the plasma dynamics. In this work we investigate three key effects: inverse hydrodynamics, the role of cosmic expansion, and the impact of time-varying bubble wall velocities. We perform a systematic analysis of these effects on the GW signal and demonstrate how they alter both the amplitude and spectral shape. Our results provide a step toward more accurate GW templates for cosmological phase transitions, which will be crucial for interpreting data from upcoming GW observatories.

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