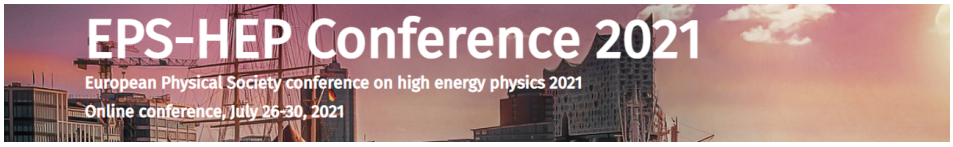

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A hybrid simulation of gravitational wave production in first-order phase transitions

Monday 26 July 2021 14:15 (20 minutes)

The LISA telescope will provide the first opportunity to probe the scenario of a first-order phase transition happening close to the electroweak scale. In thermal transitions, the main contribution to the GW spectrum comes from the sound waves propagating through the plasma. Current estimates of the GW spectrum are based on numerical simulations of a scalar field interacting with the plasma or on analytical approximations – the so-called sound shell model. In this work we present a novel setup to calculate the GW spectra from sound waves. We use a hybrid method that uses a 1d simulation (with spherical symmetry) to evolve the velocity and enthalpy profiles of a single bubble after collision and embed it in a 3d realization of multiple bubble collisions, assuming linear superposition of the velocity and enthalpy. The main advantage of our method compared to 3d hydrodynamic simulations is that it does not require to resolve the scale of bubble wall thickness. This makes our simulations more economical and the only two relevant physical length scales that enter are the bubble size and the fluid shell thickness (that are in turn enclosed by the box size and the grid spacing). The reduced costs allow for extensive parameter studies and we provide a parametrization of the final GW spectrum as a function of the wall velocity and the fluid kinetic energy.

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Collaboration / Activity

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