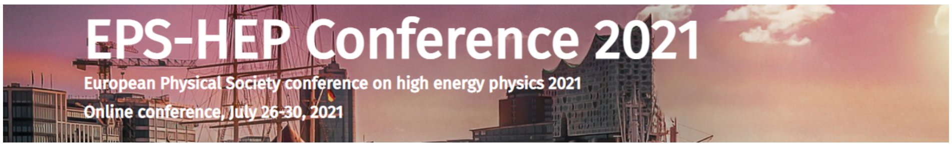

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Cosmological bubble friction in local equilibrium

Thursday 29 July 2021 16:30 (20 minutes)

In first-order cosmological phase transitions, the asymptotic velocity of expanding bubbles is of crucial relevance for predicting observables like the spectrum of stochastic gravitational waves, or for establishing the viability of mechanisms explaining fundamental properties of the universe such as the observed baryon asymmetry. In these dynamic phase transitions, it is generally accepted that subluminal bubble expansion requires out-of-equilibrium interactions with the plasma which are captured by friction terms in the equations of motion for the scalar field. This has been disputed in works pointing out subluminal velocities in local equilibrium arising either from hydrodynamic effects in deflagrations or from the entropy change across the bubble wall in general situations. We argue that both effects are related and can be understood from the conservation of the entropy of the degrees of freedom in local equilibrium, leading to subluminal speeds for both deflagrations and detonations. The friction effect arises from the background field dependence of the entropy density in the plasma, and can be accounted for by simply imposing local conservation of stress-energy and including field dependent thermal contributions to the effective potential. We illustrate this with explicit calculations of dynamic and static bubbles for a first-order electroweak transition in a Standard Model extension with additional scalar fields.

First author

Carlos Tamarit

Email

carlos.tamarit@tum.de

Collaboration / Activity

Technical University of Munich

Primary authors: TAMARIT, Carlos (Technische Universität München); Prof. SPANNOWSKY, Michael (IPPP Durham); Mr BALAJI, Shyam (Sydney University)

Presenter: TAMARIT, Carlos (Technische Universität München)

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