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Thermal bubble nucleation and effective field theories

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A limiting factor in accurately determining the gravitational wave spectrum from an underlying microphysical model, in addition to the wall speed, is the nucleation rate. I will discuss recent progresses in computing nucleation rates reliably, in particular a high-temperature effective field theory framework. At high-temperatures, there is a well-known hierarchy between the thermal particles and the long-wavelength classical fields, central to wall-speed calculations as well. This scale hierarchy can be leveraged to create an effective statistical description for the nucleating bubbles. This way, one can avoid typical issues encountered in thermal nucleation calculations: double counting, stray imaginary parts, gauge dependence and diverging derivative expansions. It also eases more accurate computations. The framework is especially useful in perturbative symmetry-breaking phase transitions, in which an additional scale hierarchy between the long-wavelength classical fields can occur naturally. Although the computational methods might not be directly relevant to the computation of wall velocities, the broad ideas of length scales may become more important when pushing the computation to higher precision.

Primary author: HIRVONEN, Joonas (University of Helsinki)

Presenter: HIRVONEN, Joonas (University of Helsinki)