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Bubble wall dynamics and the electroweak phase transition

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The early Universe provides a unique environment to explore fundamental physics, offering extreme conditions that allow theoretical models to be tested at energy scales far beyond the reach of current and future accelerators. Among the various cosmological phenomena, first-order phase transitions play a prominent role as they may have left a variety of experimentally accessible signatures. A first order phase transition proceeds through a process of nucleation, growth and merger of bubbles of true vacuum in a false vacuum background. The dynamics of this process is governed by the density perturbations generated by the propagation of the bubble wall. A precise determination of this dynamics, and in particular of the wall expansion velocity and width, is crucial to assess the experimental signatures of the transition. In this talk, I will report on recent advances in the quantitative theoretical description of bubble dynamics. Adopting typical benchmark models, I will present numerical results for the bubble wall velocity and the plasma and fields profiles that describe the phase transition dynamics, as well as results for some of the cosmological relics of the transitions, namely the gravitational wave spectrum and baryogenesis.

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