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Real scalar phase transitions: bubble nucleation, nonperturbatively

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In the Standard Model the electroweak phase transition is a crossover, but in many beyond the Standard Model theories the transition is of first order. Strong first order PTs could produce gravitational waves that might be detectable by the Laser Interferometer Space Antenna (LISA). Perturbation theory is commonly used to estimate the parameters that enter the calculation of gravitational wave spectra. However, perturbation theory is known to run into the infrared problem in the regime we are interested in and furthermore it is important to test the reliability of existing results. Here I will discuss our recent results where we studied a real singlet scalar model with a tree level potential barrier and performed nonperturbative simulations to determine the bubble nucleation rate. Our preliminary results show that higher orders in perturbation theory are necessary, and we expect our findings to allow calibration of the systematic uncertainty in perturbative results.

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