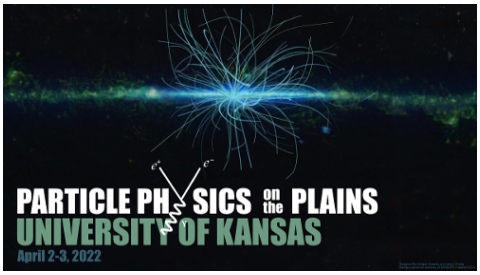

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Strong First-Order Electroweak Phase Transitions in the Standard Model with a Singlet Extension

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A common assumption about the early universe is that it underwent an electroweak phase transition (EWPT). Though the standard model (SM) is able to restore the electroweak symmetry through a smooth cross over PT, we require a strongly first-order PT to ensure electroweak baryogenesis, requiring us to look at new physics beyond the SM. The simplest case to extend the SM is to add a real singlet field, which allows for a first-order EWPTs (FOEPT) to occur.

Starting with the most general higgs+singlet lagrangian, we fixed four of its coupling constants as functions of the three quartics, the singlet and higg's mass and vacuum expectation value, whose range of values had more experimental motivation than the former. We ran a Monte-Carlo scan over these five free parameters, requiring a FOEPT and a PT strength of $\frac{v_c}{T_c} > 1.3$. These points were then passed through the FindBounce package to calculate the nucleation temperature. The resulting parameter space was studied, most notably, we observed the ratio of the triple higgs coupling to the SM value $\left(\kappa = \lambda_3/\lambda_3^{SM}\right)$ take on values between 0.86 and 2.2. The possible values of λ_3 could serve as motivation for future collider experiments to improve sensitivity in this range when looking at the cross sections of $pp \to hh$ versus λ_3.

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