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Lattice study of singlet-assisted electroweak phase transition

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In this study, we use lattice to reveal nonperturbative information of the electroweak phase transition in the real-singlet extension of the Standard Model, based on the 2-loop 3D EFT framework.

Importantly, the new information is that the lattice determines the true nature of the electroweak phase transition, capable to identify it as the first order type or not, an important qualitative behavior to which perturbation theory is blind. In scenarios where perturbation theory implies a weakly first order phase transition, lattice is always more reliable than the perturbation theory. In this regime, the symmetry-breaking transition may be crossover rather than a true phase transition. On the other hand, for strong transitions, both methods yield quantitatively close results, particularly when 2-loop perturbation theory is used.

This nonperturbative framework holds potential for other Higgs-sector extensions of the SM. Besides, by holding two powerful tools, 2-loop perturbation scanning and lattice, we will explore associated phenomenology in the future.

Primary authors: XIA, Guotao (TDLI, SJTU); Dr NIMIE, Lauri; Prof. RAMSEY-MUSOLF, Michael J.

Presenter: XIA, Guotao (TDLI, SJTU)

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