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Strong First-Order Electroweak Phase Transition in the Type-I two-Higgs doublet model via multi-step transitions

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We investigate strong first-order electroweak phase transitions in the Type-I two-Higgs-doublet model's inverted Higgs scenario (where the 125 Giga-electron Volt Higgs boson is the heavier CP-even scalar), motivated by its potential for electroweak baryogenesis. A comprehensive parameter scan, incorporating current theoretical and experimental constraints (including flavor, Higgs, and electroweak data), identifies physically viable regions. We analyze the characteristics of single and multi-step strong phase transitions using computational tools like BSMPT. Crucially, the known correlation between the vacuum uplifting measure and phase transition strength found in single-step transitions vanishes for multi-step pathways in this scenario. We characterize distinct phenomenological features (such as Higgs masses and mixing parameters) of points enabling strong transitions, noting their dependence on the specific transition history. Associated gravitational waves, predominantly sourced by sound waves, are evaluated for detection by future interferometers like LISA.

Presenter: SONG, Jeonghyeon (Konkuk U)

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