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Singlet-Catalyzed Electroweak Phase Transitions in the 100 TeV Frontier (12' + 3')

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We study the prospects for probing a gauge singlet scalar-driven strong first order electroweak phase transition with a future proton-proton collider in the 100 TeV range. Singlet-Higgs mixing enables resonantly-enhanced di-Higgs production, potentially aiding discovery prospects. We perform Monte Carlo scans of the parameter space to identify regions associated with a strong first-order electroweak phase transition, analyze the corresponding di-Higgs signal, and select a set of benchmark points that span the range of di-Higgs signal strengths. For the bbBar+diphoton and the 4tau final states, we investigate discovery prospects for each benchmark point for the high luminosity phase of the Large Hadron Collider and for a future collider with center-of-mass energy of 50, 100 or 200 TeV. We find that any of these future collider scenarios could significantly extend the reach beyond that of the high luminosity LHC, and that with center-of-mass energy of 100 TeV (200 TeV) and 30/ab, the full region of parameter space favorable to strong first order electroweak phase transitions is almost fully (fully) discoverable.

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