

## SYNERGIES TOWARDS THE FUTURE STANDARD MODEL

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### Probing $A \rightarrow ZH$ vs. $H \rightarrow ZA$ using top-quark spin correlations at the (HL-)LHC

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We propose angular observables sensitive to top-quark spin correlations to distinguish between the pseudoscalar  $A \rightarrow ZH$  and the scalar  $H \rightarrow ZA$  signals (where  $A$  and  $H$  denote CP-odd and CP-even Higgs bosons, respectively) in  $Zt\bar{t}$  final states at the HL-LHC. Current searches performed by ATLAS and CMS are insensitive to the CP nature of BSM scalar states in the case of identical production cross sections. In the context of the CP-conserving two-Higgs-doublet model, we demonstrate that, for a benchmark scenario with masses of 800 and 600 GeV, angular variables sensitive to top-quark spin correlations can differentiate between the two scenarios, even when the production rates are identical. These searches are of great interest in probing parameter space regions that predict a strong first-order electroweak phase transition.

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