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Characterising New Resonances at the LHC in EFT: Hints about SU(2) nature in extended scalar sectors

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In theories with extended scalar sectors, e.g. when including a scalar mediator to a dark sector, the lightest new scalar degree of freedom might be accessible at colliders. Going beyond simplified models, such a theory can be described in a gauge-invariant way via an EFT with a non-linearly realised electroweak symmetry. In this generalised HEFT, depending on the SU(2) nature of the new scalar, operators arise at different orders. For instance, while an SU(2) doublet can couple to fermions at dim-4 via a Yukawa-like term, a singlet requires a Higgs insertion to make the coupling term gauge invariant, the operator experiencing an additional suppression. We use dimensional analysis to systematically evaluate expected hierarchies between Wilson coefficients, leading to structural relations between potential LHC observables, such as di-boson resonance, tau pair production or the di-photon channel. Should some hint of a new scalar field be observed, this analysis will help interpret it with respect to possible UV models.

Primary author: HAGER, Maya (Max-Planck Institute fuer Kernphysik, Heidelberg)

Presenter: HAGER, Maya (Max-Planck Institute fuer Kernphysik, Heidelberg)

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