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Resonances and the non-linear effective theory

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Direct searches for New Physics states have given so far negative results. There is a mass gap between SM fields and possible new states. The observed SM symmetry pattern and this mass gap justifies the use of electroweak effective Lagrangians. Implications of new, higher scales can be analyzed through next-to-leading order corrections to the Higgs Effective Theory, HEFT (also denoted as EW Effective Theory or EW Chiral Lagrangian). There are three main ingredients in our present analysis: 1st, an approximate chiral symmetry which spontaneously breaks down into custodial symmetry, as it occurs in the SM; 2nd,a non-linear realization of the EW symmetry breaking with a singlet Higgs and an assumed strongly-coupled UV-completion; 3rd, a high-energy Lagrangian which incorporates a set of new heavy states in addition to the SM degrees of freedom. We consider spin 0, 1/2 and 1 resonances, allowing for new possible coloured states. By integrating out these heavy resonances, we study the pattern of low-energy constants among the light fields. We then perform a phenomenological analysis of the low-energy constants and find that resonances with masses in the few TeV range are perfectly compatible with current experimental constraints on the low-energy parameters. The analysis of LHC diboson production through vector boson scattering (VBS) and Drell-Yan (DY) mechanisms shows that resonances in the 1.5 - 3 TeV range can easily and naturally evade all present experimental bounds: within this framework, future runs and higher luminosities will be required to be able to separate these resonances from the SM background. In the last part, we will quickly discuss possible scenarios with new physics heavy states around the TeV scale which do not couple directly to the SM fermions, only indirectly via the SM bosonic sector. This leads to an important suppression of the fermionic operators in the low-energy HEFT (bilinear and four-fermion operators) in comparison with the purely bosonic ones. This naturally suppresses VBS and DY, while leaving an imprint in SM boson measurements accessible to future experimental runs (e.g., the oblique S parameter).

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