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Controlling uncertainties of the IAM dispersive unitary extension of EFTs

Effective Field Theories (EFTs) constructed, in the spirit of Chiral Perturbation Theory (ChPT), as derivative expansions in powers of momentum, are a controllable approximation to strong dynamics as long as the energy of the interacting particles remains small. However, deviations quickly build up due to the energy–polynomial expansion not respecting unitarity. This limits their predictive power towards new physics at a higher scale if small separations from the Standard Model are found at the LHC or elsewhere. Unitarized chiral perturbation theory techniques have been devised to extend the reach of the EFT to regimes where partial waves are saturating unitarity, but their uncertainties have hitherto not really been addressed: they are often successful in describing hadron data a posteriori, but their predictive power in the face of new physics has not been well delimited. Here we take one of the best known of them, the Inverse Amplitude Method (IAM), and we attempt to quantify the systematic uncertainties introduced by the method. We compare its hadron ChPT and its electroweak sector Higgs EFT applications. We find that the uncertainty of the IAM at the mass of the first resonance encountered in a partial–wave is of the same order of the starting uncertainty of the EFT at threshold energies, so that its unitarized extension should a priori expected to be reasonably successful provided a check for so-called CDD poles (zeroes of the partial wave amplitude) is carried out and, if they appear near the resonance region, the IAM is adequately modified to take them into account.

Primary authors: SALAS-BERNÁRDEZ, Alexandre (Universidad Complutense de Madrid); LLANES-ESTRADA, Felipe J.; OLLER, José Antonio (Universidad de Murcia)

Presenter: SALAS-BERNÁRDEZ, Alexandre (Universidad Complutense de Madrid)