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Cover all your Bases: Asymptotic Distributions of the Profile Likelihood Ratio in Quadratic Wilson Coefficient Fits

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In high energy physics, often effective field theories (EFTs) are used to parameterise the possible ways in which new physics at some high-energy interaction scale Λ_{EFT} may indirectly modify differential cross sections or branching fractions. To constrain the EFT parameter space, profile likelihood ratio (PLR) are used to perform frequentist hypothesis tests and calculate confidence levels of Wilson coefficients. Key to this is to know the expected distribution of the PLR under all reasonable parameter hypotheses. A common practice is to assume that the PRL follows an asymptotic form following Wilks' theorem. However, this approach is not always correct and in fact the asymptotic distribution of the PLR does not follow χ^2 distribution when the EFT parameterisation is not dominated by a linear Wilson coefficient. In this presentation, we explain when and why the PLR may not be assumed to follow a χ^2 distribution. We provide the correct asymptotic distribution for an EFT fit dominated by a quadratic parameter dependence and discuss the generalisation to cases with (i) significant linear and quadratic dependencies and (ii) multiple parameters.

In-person participation

Yes

Primary authors: FRY, Daniel (University of Bonn); PERSSON, Eric (University of Bonn); BERNLOCHNER, Florian (University of Bonn); MENARY, Stephen (University of Manchester)

Presenter: BERNLOCHNER, Florian (University of Bonn)

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