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Uncertainty quantification in Nuclear Reactions

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Nuclear reactions are one of the most versatile probes to study nuclei from which an array of properties can be extracted, as well as astrophysical information. Reaction models needed in the interpretation of the data often rely on nucleon-nucleus effective interactions that depend on a number of parameters, typically constrained by elastic scattering data. It is important to quantify the uncertainties associated with the observables produced by these models. In this presentation, we discuss a systematic comparative study made between the standard frequentist approach and the Bayesian approach when applied to nuclear reactions [1]. We find that the Bayesian approach produces larger confidence intervals than the standard chi2 minimization approach and that the standard method underestimates the error, particularly for the higher confidence levels. We also explore different avenues with the aim of reducing the uncertainties.

[1] G. King, A. Lovell, L. Neufcourt, F.M. Nunes, Phys. Rev. Lett 122, 232502 (2019).