Contribution ID: **157** Type: **Poster**

Bayesian uncertainty analysis of the elastic nucleon-deuteron scattering observables

Friday, 8 April 2022 14:48 (4 minutes)

Model emulation is an important tool for tackling many nuclear physics problems, including an estimation of model parameters. As Bayesian parameter estimation becomes more common in heavy-ion physics, there is a need for an analysis package to facilitate such projects and to reduce efforts duplication. While the Bayesian statistical formalism handles this exists, the Bayesian Analysis of Nuclear Dynamics (BAND) Framework [1] aims to use computational research to transform these theoretical relationships into practical tools and techniques for making reliable computational predictions of complex systems with well-quantified uncertainties. The latter means using Bayesian statistics to increase the modeling accuracy of theoretical predictions and help in experimental design.

In this poster, for the first time, we outline the emulation (Gaussian processes toolset) and calibration components of the BAND framework to estimate theoretical uncertainties. As an example, we focus on the application of Bayesian inference (in particular Bayesian parameter estimation) to quantify uncertainty for the elastic nucleon-deuteron (Nd) scattering calculations at nucleon laboratory energies up to 200 MeV performed within the Faddeev approach. To that end, we use the current chiral effective interactions comprising semilocal momentum-space regularized two- and three-nucleon forces up to the third chiral order developed by the Low Energy Nuclear Physics International Collaboration (LENPIC) [2]. The uncertainties arising from these effective potentials can be quantified within the BAND framework. We also show truncation errors, which give an important contribution to the uncertainty budget. In this case, we use a slightly modified version of the Bayesian approach [3] developed by the BUQEYE Collaboration [4].

1. D.R. Phillips et al., J. Phys. G: Nucl. Part. Phys. 48 072001 (2021). https://bandframework.github.io/
2. P. Maris et al., Phys. Rev. C 103 054001 (2021). http://www.lenpic.org/
3. E. Epelbaum et al. Eur. Phys. J. A 56, 92 (2020).
4. J.A. Melendez et al., Phys. Rev. C 96, 024003 (2017). https://buqeye.github.io/

Primary author: Dr VOLKOTRUB, Yuriy (AGH University of Science and Technology)

Co-authors: Prof. PHILLIPS, Daniel (Ohio University); Prof. NUNES, Filomena (Michigan State University); Prof. VIENS, Frederi (Michigan State University); Dr SÜRER, Özge (Northwestern University); Dr PLUMLEE, Matt (Northwestern University); Dr GIULIANI, Pablo (Michigan State University); Prof. SKIBINSKI, Roman (M. Smoluchowski Institute of Physics, Jagiellonian University); Dr WILD, Stefan (Argonne National Laboratory)

Presenter: Dr VOLKOTRUB, Yuriy (AGH University of Science and Technology)

Session Classification: Poster Session 3 T12_1

Track Classification: New theoretical developments