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Bayesian Methods in Nuclear Structure Physics

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The principle of Bayesian inference is used in many different fields of science, e.g. medicine and computer science. The foundation of Bayesian inference lies in Bayes' theorem, which offers a powerful alternative method for data analysis. Nevertheless, Bayesian inference is still rather unpopular in fields like nuclear structure physics, where very sensitive detector systems are needed.

In

-spectroscopy, one of the essential experimental tools of nuclear structure physics, the state-of-the-art detector systems are highly segmented High-Purity Germanium detectors like the Advanced GAMMA Tracking Array AGATA. Due to AGATA's Germanium shell without any Compton-shielding,

-ray tracking algorithms are needed. The mathematical problem these

-ray tracking

algorithms are based on, forms a perfect example case for the benefits of Bayesian inference over standard statistical inference methods.

Using basic terms of probability theory, a short introduction into Bayesian inference is given and essential principles are presented. In addition, a how-to approach of Bayesian inference to the principle of -ray tracking is shown in the form of the Fuzzy Bayes Tracking algorithm. Possible difficulties, as well as benefits of Bayesian inference are elaborated in detail.

Presenter: NAPIRALLA, Philipp