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Fast & rigorous constraints on chiral three-nucleon forces from few-body observables

We explore the constraints on the three-nucleon force (3NF) of chiral effective field theory (χEFT) that are provided by bound-state observables in the A = 3 and A = 4 sectors. Our statistically rigorous analysis incorporates experimental error, computational method uncertainty, and the un- certainty due to truncation of the χEFT expansion at next-to-next-to-leading order. A consistent solution for the 3H binding energy, the 4He binding energy and radius, and the 3H β-decay rate can only be obtained if χEFT truncation errors are included in the analysis. All of these except the β-decay rate give essentially degenerate constraints on the 3NF low-energy constants, so it is crucial for estimating these parameters. We use eigenvector continuation for fast and accurate emulation of No-Core Shell Model calculations of the considered few-nucleon observables. This facilitates sam- pling of the posterior probability distribution, allowing us to also determine the distributions of the hyperparameters that quantify the truncation error. We find a χEFT expansion parameter of Q = 0.33 ± 0.06 for these observables.

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