Consultants’Meeting on International Nuclear Data Evaluation Network for Light Elements (INDEN-LE)

Monday 18 November 2024 - Friday 22 November 2024

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Book of Abstracts

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Application of calculations in the 7Be system and further progress with the 17O system

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I'll discuss the state of my progress with the Test 2 fit for the 7Be system and my ideas for moving forward to test 3. I'll also discuss its use in a publication this past year on the a proposed threshold resonance in the ^{6}Li(p,γ) reaction. I'll also discuss R-matrix fitting of the ^{17}O system, in particular progress with producing a revised reaction rate for the ^{13}C(α,n) reaction and a new campaign of (α,n) measurements on light nuclei up to 8 MeV.

Presentations II / 2

Uncertainty Estimation for R-matrix Evaluations

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In nuclear astrophysics, the accurate determination of nuclear reaction cross sections at astrophysical energies is critical for understanding stellar evolution and nucleosynthesis. This study focuses on the ^{12}C$(p,\gamma)^{13}$N reaction, which takes part in the CNO cycle and is significant for determining the ^{12}C/^{13}C ratio in stellar interiors. Data from various studies, including recent LUNA measurements, reveal high discrepancies in cross section values, underscoring the need for robust fitting approaches. Utilizing the R-matrix theory, we compare different frequentist and Bayesian methodologies for estimating reaction cross sections and their uncertainties. The analysis evaluates the strengths and weaknesses of different statistical techniques, highlighting the importance of systematic uncertainty treatment and the estimate of covariance matrix estimation to enhance the reliability and reproducibility of uncertainty estimates in nuclear astrophysics.

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Systematically evaluate Be7 using Reduced R-matrix theory

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This report will briefly present the evaluation results of Be7, which focuses on how to make an evaluation database file for elastic scattering of charged particles, which includes the differential cross sections and their corresponding covariance matrices. We looked at three formats. The first is the tabular evaluation data, using 90 energy points and 180 angles, the advantage is that there is no interpolation at the time of invocation. The downside is that the file is particularly large, with hundreds of thousands of lines. The second scheme is to give the polynomial fit coefficient of the correlation coefficient and its covariance. It is to fit the angular distribution of the correlation coefficient of each pair of energies by a polynomial and obtain the polynomial coefficient and the corresponding covariance. Relative to the first method, the file size can be reduced by about 20 times. The disadvantage is that the error propagation formula is used to reconstruct the cross section and its covariance matrix. The third scheme is to give the polynomial fitting coefficients of the excitation functions and their covariances. It is to fit the excitation function with 180 angles and its covariance by polynomial, and obtain the polynomial coefficient and the corresponding covariance. Compared with the second method, the size of the file can be reduced by about 10 times. The disadvantage is that the error propagation formula is used to reconstruct the cross section and its covariance matrix. However, the construction formula is very simple and the calculation is very small. We present these recommendations for expert review.

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R-matrix analysis of n+natCl reactions relevant to criticality safety benchmarks and molten-salt reactor designs

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Presentations II / 5

R-matrix analysis of 8Be system

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An accurate understanding of charged-particle induced reactions is important for both astrophysics and nuclear applications. Prompted by recent experimental measurements, an improved R-matrix analysis of the 8Be system is performed. This analysis is compared to existing ENDF evaluation, and discrepancies are discussed. Uncertainties in the R-matrix parameters and experimental cross sections are inferred using a Bayesian analysis method. The results of this work will be presented and discussed.

Presentations II / 6

BRICK and beyond: Bayesian analyses of low-energy 3He-4He data using R-matrix and Effective Field Theory

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I will report on an R-matrix analysis of the recent low-energy data set of Paneru et al., together with older low-energy data and capture data, that uses the Bayesian R-matrix Inference Code Kit (BRICK).

If time permits I will contrast the R-matrix analysis with ongoing work on the same reactions in an effective field theory that exploits the clustering in this system to develop a systematic expansion for the quantum-mechanical amplitudes.

Presentations II / 7

Review of experimental parameter marginalization methods for the production of covariance matrices

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Nuclear data can be based experimental probes alone, however one could expect to predict extra non-measured quantities by using underlying models. Evaluation of nuclear data thus often consists in aggregating experimental information with theoretical models. The information transfer is performed though comparison between theoretical and empirical quantities of the same nature. One can either turn experimental quantities to be as close as possible of the theoretical model used to further produce the nuclear data of interest, or to add extra layers of the modeling side to make the connection the closest possible to raw independent recorded quantities. This latter case should avoid the occurrence of Peel's Pertinent Puzzle. Extra layers of modeling imply parameters that are not involved in the production of the eventual nuclear data, which possible leads to underestimated uncertainties. Marginalization techniques are then used to somehow transfer the source of uncertainty from these extra "nuisance"parameters on the useful nuclear model parameters. Some of commonly used techniques are reviewed in this presentation.

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Status report on 19F(alpha,n) and 7Be

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The status of the R-matrix analysis of 19F(alpha,n) and plans for 7Be will be given.

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Comments on nuclear structure data

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Evaluation of n+9Be

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Introduction and goals

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