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Book of Abstracts

Contents

Comprehensive new evaluation of the 8Be system	1
Recent Developments in AZURE2: Enhanced R-Matrix Analysis with Application to the 7Be Compound System	1
Continued progress on the ^{15}N system	1
A new python-based phenomenological R-matrix code	2
The improved evaluation of the $n+9\text{Be}$ system	2
The improved evaluation of the $n+16\text{O}$ system	2
Differential cross-section measurement of the $^{14}\text{N}(n, p)^{14}\text{C}$ reaction in the 0.1-6.0 MeV energy region	3
2025-ENSDF Evaluation of ^{17}O	3
R-matrix based evaluation with GENEUS_R: current status of application to $n+\text{Be-9}$ and $p+\text{Li-6}$	3

Day 1 / 1

Comprehensive new evaluation of the ^8Be system

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Updates from ongoing work for the new evaluation of the ^8Be system using EDA code will be presented.

Day 3 / 2

Recent Developments in AZURE2: Enhanced R-Matrix Analysis with Application to the ^7Be Compound System

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AZURE2 has undergone significant enhancements to improve its analytical capabilities and uncertainty quantification. This presentation will describe recent upgrades implemented in the code and demonstrate their application to updated analyses of the ^7Be compound system.

Key developments include the implementation of energy shift parameters for systematic treatment of data uncertainties, enabling more rigorous handling of experimental energy calibration effects. The Coulomb wavefunction calculations have been substantially improved to enhance numerical accuracy and stability across a broader range of reaction conditions. The possibility of using the infinitely thick target data was added in the code. A significant methodological advancement is the integration of a preliminary Markov Chain Monte Carlo (MCMC) sampling capabilities alongside new frequentist minimization algorithms. Finally, progress is being made on the addition of a hybrid potential model.

These upgrades are demonstrated through an updated R-matrix fit of the ^7Be compound system, which incorporates the enhanced treatment of systematic uncertainties and improved wavefunctions, alongside the $^{12}\text{C}(p,\gamma)^{13}\text{N}$ and $^{13}\text{C}(\alpha,n)^{16}\text{O}$ examples. The enhanced AZURE2 framework represents a substantial step forward in R-matrix analysis capabilities, offering the nuclear physics community improved tools for precise reaction rate determinations and uncertainty quantification.

Day 1 / 3

Continued progress on the ^{15}N system

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Previous work has been performed to fit $^{14}\text{N}+n$, $^{14}\text{C}+p$ and $^{11}\text{B}+\alpha$ data for the ^{15}N system up to about 2 MeV above their respective thresholds, which are similar in energy. This past work found that there were apparent discrepancies in the fitting, especially with the $^{11}\text{B}(\alpha,n)^{14}\text{N}$ and $^{14}\text{N}(n,p)^{14}\text{C}$ data sets. By implementing energy shifts, resolution effects, improved handling of the Coulomb functions near thresholds and increase in code speed, some of these apparent discrepancies were

resolved. However, other discrepancies, including some rather large normalization factors for the data and some data with very small uncertainties, are still resulting in conflicting results.

Day 3 / 4

A new python-based phenomenological R-matrix code

Author: Edward Simpson¹

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We have recently begun developing a new phenomenological R-matrix code with the aims of exploring (a) how to optimize the evaluator's use of the code, and (b) how to integrate machine learning approaches to assist with R-matrix analysis.

We use the Wigner-Eisbun parameterization of the R-matrix [1], with a user-adjustable boundary condition [2]. The data included in the calculation can be filtered using a flexible system, similar to the data segments used in AZURE [3], with calculations performed only for the currently selected subset of data. The entire calculation object can be serialized and saved to (or loaded from) a compressed JSON format file. This includes the particle pairs and channels, the R-matrix pole parameters, the data sets being analysed, and all the required Coulomb wave functions (which then only need to be calculated once).

The code is written in python and can be used interactively via jupyter notebooks. A graphical user interface has been written to allow editing of the R-matrix pole energies and widths, with real-time updates to the calculations and plotting of the results. The use of python means the calculations can be very easily scripted to add, edit and remove poles. This allows, for example, easy generation of training data for machine-learning-based models such as convolutional neural networks.

We will give an overview of the code, its design, preliminary results and benchmarking, and future plans.

[1] A. M. Lane and R. G. Thomas, Rev. Mod. Phys. 30, 257 (1958)

[2] F. C. Barker, Aus. J. Phys 25, 341 (1972)

[3] R. E. Azuma, Phys. Rev. C 81, 045805 (2010)

Day 3 / 5

The improved evaluation of the n+9Be system

Author: Zhenpeng Chen^{None}

The global fitting for n+9Be system using RAC have been reported in 2022. In recent years, the improved Global fitting of the Reduced R-Matrix theory for n+9Be system has been carried out using the RAC. More detailed fitting for the cross section of the 9Be(n, tot) has been conducted. New measurement data of the differential cross sections for the 9Be(n, el) from China have been added into the fitting. Thus, the evaluation of the 9Be(n, 2n) have been improved.

Day 2 / 6

The improved evaluation of the n+16O system

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In recent years, the improved global fitting of the Reduced R-Matrix theory for n+¹⁶O system has been carried out using the RAC. The cross sections for the ¹⁶O(n, α)¹³C reaction in the 6.8-11.7 MeV neutron energy region have been measured recently, which have been added into the fitting. In addition, the measured data for the ¹⁶O(n, α)¹³C reaction of Lee et al. have been also added into the fitting. The evaluation of the ¹⁶O(n, α)¹³C reaction have been improved.

Day 1 / 7

Differential cross-section measurement of the ¹⁴N(n, p)¹⁴C reaction in the 0.1-6.0 MeV energy region

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Accurate cross sections and differential cross sections of the ¹⁴N(n, p)¹⁴C reaction are of significant importance for research in Boron Neutron Capture Therapy as well as astrophysical element synthesis. From the last century to the present, several measurements have been conducted, and cross sections have been obtained. However, on one hand, present experimental measurements show considerable discrepancies in the keV neutron energy region; on the other hand, there is a severe lack of differential cross sections for the ¹⁴N(n, p)¹⁴C reaction across the entire energy spectrum, with a shortage of measurement results. Based on the Back-n white neutron beamline at China Spallation Neutron Source, this research utilized wide-spectrum neutrons and employed charged particle detectors for experimental measurements. Through simulation and multiple beam test experiments, the experimental conditions and methods were explored, and a successful 400-hour beam time experiment was conducted. For the first time internationally, the differential cross sections of the ¹⁴N(n, p)¹⁴C reaction in the 0.1-6.0 MeV neutron energy range was measured, and differential cross sections as low as 0.1mb in the 0.1-0.45 MeV neutron energy range were provided, which are expected to clarify the discrepancies in previous measurements and different evaluation databases in this energy region.

Day 2 / 8

2025-ENSDF Evaluation of ¹⁷O

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The 2021-ENSDF evaluation of ¹⁷O was updated in 2025 as part of $A = 17$ mass evaluation, which is in progress. I will briefly present the changes with an emphasis on the astrophysical region of interest.

Day 2 / 9

R-matrix based evaluation with GENEUS_R: current status of application to n+Be-9 and p-Li-6

Author: Helmut Leeb^{None}