

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

Thursday 20 November 2025 16:00 (1 hour)

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.

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