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(α, n) measurements at University of Notre Dame and AZURE2 R-matrix analyses

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Improved (α, n) cross section measurements are needed for a range of applications such as nuclear astrophysics, neutrino physics, geophysics, nuclear energy, and weapons research. While they are sometimes focused on different energy regions, all benefit from a improved measurements over a wide energy range. The connection is further strengthened through the use of R-matrix analysis for the evaluation of the data in all cases. The shared desire for an improved characterization of the cross sections makes it clear that a comprehensive R-matrix analysis will be the most consistent method, as opposed to piecemeal ones, that sample only a fraction of the data and energy range.

At the University of Notre Dame we have pursued an improvement (α, n) cross section evaluation both by making new experimental measurements and R-matrix analyses. In this talk I will give an overview of several (α, n) experimental projects that are planned or underway, with a focus on the $^{13}\mathrm{C}(\alpha, n)^{16}\mathrm{O}$ reaction. These new measurements focus on thin target, high energy resolution, differential measurements of partial cross sections using neutron and secondary γ-ray spectroscopy, the type of data most directly implemented into an R-matrix analysis. On the R-matrix side, I'll discuss efforts to construct an analysis of the $^{17}\mathrm{O}$ system using the code AZURE2, and new methods of performing Bayesian uncertainty analysis to determine probability distributions for observables and to calculate covariance matrices for fit parameters.

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