

NUCLEAR SEMINAR SERIES

Prof. Daniel Phillips

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Monday, January 27

4:00 pm - Rm 184 NSH

Bayesian Methods for Fusion Reactions with Light Nuclei

In this talk I will present three analyses that use Bayesian methods to perform evaluations of low-energy fusion cross sections. Two of these analyses were carried out in the framework of an Effective Field Theory for weakly-bound few-body systems ("Halo EFT"). I will begin by providing an introduction to the description of nuclear reactions in this theory. I will then discuss our application of Halo EFT to the reaction $3\text{He}(\alpha,\gamma)7\text{Be}^*$. We used Bayesian methods and Monte Carlo sampling, as well as the expression for the S-factor obtained at next-to-leading order in the EFT, to perform the extrapolation of higher-energy data to solar energies. This yields a markedly smaller uncertainty to previous evaluations, as well as significant constraints on 3He - 4He scattering parameters. I will then summarize a parallel (and earlier) analysis we did of $7\text{Be}(p,\gamma)8\text{B}^+$, which also resulted in a significantly reduced uncertainty compared to previous evaluations.

In the second half of my talk I will move from the EFT framework to ongoing work on Bayesian R-matrix analysis of the fusion reaction $3\text{H}(d,n)\alpha^+$. I will show how examination of the multi-dimensional posterior for the parameters in the R-matrix fit reveals degeneracies in the parameter space. I will also discuss how the Bayesian framework and sampling methodology facilitates the incorporation of additional ("nuisance") parameters that can be used to check for the presence of experimental uncertainties that were not reported in the original publications.

*X. Zhang, K. M. Nollett, D. R. Phillips, J. Phys. G., to appear (2020), arXiv:1909.07287.

†X. Zhang, K. M. Nollett, D. R. Phillips, Phys. Lett. B 571, 535 (2015); Phys. Rev. C 98, 034616 (2018).

^R. S. de Souza, S. R. Boston, A. Coc, C. Iliadis, Phys. Rev. C 99, 0146919 (2019); D. Odell, C. R. Brune, D. R. Phillips, in preparation.



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