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Limitations and Improvement of the Gamow Window Approximation for Thermonuclear Reaction Rates J. TOKIWA, R.L. KOZUB, Tenn. Tech. U., M.S. SMITH, ORNL, J.P. SCOTT, E.J. LINGERFELT, K. CHAE, ORNL/UT-Knoxville — The knowledge of thermonuclear reaction rates is vital to simulate numerous types of astrophysical events. Standard codes to calculate rates, such as the tools at nucastrodata.org, utilize a Gaussian approximation[1] to estimate the relative energy range (Gamow window) over which the calculation is performed numerically. This approximation fails by returning an energy range that extends to negative values for some reactions involving low Z particles at low temperatures, such as the d$(d,n)^3$He and d(d,p)t reactions, which are important for Big Bang Nucleosynthesis. A new code has been written to numerically determine the energy range for the calculation needed to obtain an accuracy of less than 1% in the reaction rate, based on rate contributions from various energies in the Gamow window at a given temperature. This extends the rate calculation capabilities at nucastrodata.org to include Big Bang Nucleosynthesis. This research is supported by the U. S. Department of Energy under grants DE-AC05-00OR22725 (ORNL) and DE-FG02-96ER40955 (TTU).

[1]See, e.g., C. E. Rolfs and W. S. Rodney, "Cauldrons in the Cosmos," The University of Chicago Press, Chicago (1988), p. 158.

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