Matching of experimental and statistical-model thermonuclear reaction rates at high temperatures

JOSEPH NEWTON, University of North Carolina at Chapel Hill, RICHARD LONGLAND, CHRISTIAN ILIADIS — Reliable reaction rates at high stellar temperatures are necessary for the study of advanced stellar burning stages, supernovae and x-ray bursts. We suggest a new procedure for extrapolating experimental thermonuclear reaction rates to these higher temperatures ($T > 1$ GK) using statistical model (Hauser-Feshbach) results. Current, generally accepted, procedures involve the use of the Gamow peak, which has been shown to be unreliable for narrow resonances at high stellar temperatures [1].

Our new approach defines the effective thermonuclear energy range (ETER) by using the 8th, 50th and 92nd percentiles of the cumulative distribution of fractional resonant reaction contributions. The ETER is then used to define a reliable temperature for matching experimental rates to Hauser-Feshbach rates. The resulting matching temperature is often well above the previous result using the Gamow peak concept. Our new method should provide more accurate extrapolated rates since Hauser-Feshbach rates are more reliable at higher temperatures. These ideas are applied to 21 ($p,\gamma$), ($p,\alpha$) and ($\alpha,\gamma$) reactions on a range of $A = 20-40$ target nuclei and results will be presented.