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T. Liolios, K. Langanke, W. Wiescher

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Screening effects on resonant thermonuclear reaction rates

T. Liolios¹, K. Langanke¹, W. Wiescher²

¹Institut for Fysik og Astronomi, Aarhus Universitet, DK 8000 Aarhus C, Denmark

²Department of Physics, University of Notre Dame, IN 46556, USA

Abstract

The reaction rate of several astrophysically important nuclear reactions is dominated by the contribution of narrow resonances at the astrophysically most effective energies. In the stellar plasma the partial width of the resonances in the entrance channel is modified due to screening corrections. This effect, so far ignored in stellar reaction network calculations, reduces the conventional Salpeterscreening enhancement of the reaction rate. We derive analytical screening correction factors for the contributions of narrow resonances to the stellar reaction rate and discuss the effects for $^{14}\text{C}(\alpha, \gamma)^{18}\text{O}$, $^{15}\text{O}(\alpha, \gamma)^{19}\text{Ne}$ and other reactions of relevance to explosive hydrogen burning.