SIMPLIFYING SILICON BURNING: APPLICATION OF QUASI-EQUILIBRIUM TO α NETWORK NUCLEOSYNTHESIS[1]

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While the need for accurate calculation of nucleosynthesis and the resulting rate of thermonuclear energy release within hydrodynamic models of stars and supernovae is clear, the computational expense of these nucleosynthesis calculations often forces a compromise in accuracy to reduce the computational cost. To redress this trade-off of accuracy for speed, we present an improved nuclear network which takes advantage of quasi-equilibrium in order to reduce the number of independent nuclei, and hence the computational cost of nucleosynthesis, without significant reduction in accuracy. In this paper we will discuss the first application of this method — the further reduction in size of the minimal α network. The resultant *QSE-reduced* α network is twice as fast as the conventional α network it replaces and requires the tracking of half as many abundance variables, while accurately estimating the rate of energy generation. Such reduction in cost is particularly necessary for future generation of multi-dimensional models for supernovae.

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