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# Neutron Sources in Stars

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About half of the heavy elements in nature are created at the end of core helium burning in massive stars (weak $s$-process) and during the AGB phase of low-mass stars (main $s$-process). These astrophysical environments have been identified as $s$-process sites because reactions are available that produce neutrons on an appropriate time scale and quantity. The $^{13}\mathrm{C}(\alpha,\mathrm{n})^{16}\mathrm{O}$ reaction is thought to serve as the primary source for the main $s$-process while the $^{22}\mathrm{Ne}(\alpha,\mathrm{n})^{25}\mathrm{Mg}$ reaction does so for the weak $s$-process. In addition, reactions such as $^{17,18}\mathrm{O}(\alpha,\mathrm{n})^{20,21}\mathrm{Ne}$ and $^{25,26}\mathrm{Mg}(\alpha,\mathrm{n})^{28,29}\mathrm{Si}$ act as secondary sources that counteract neutron poisons. First generation stars may also be a sight for this type of nuecleosyntheis through the $^{10,11}\mathrm{B}(\alpha,\mathrm{n})^{13,14}\mathrm{N}$ reactions. Yet because of the needed cross sections are at low energies where they are very small, it makes them extremely challenging to measure directly in the laboratory. Compounded with the challenges of neutron detection, the uncertainties of most of these reactions remain some of the largest contributors to stellar model calculations. However, it is a very exciting time because, several new measurements have made rapid progress in reducing these uncertainties. In this talk, I will review the present state of uncertainties in light of these new measurements.

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