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Direct capture cross section and low-energy resonances in the $^{22}\text{Ne}(p,\gamma)^{23}\text{Na}$ reaction

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The $^{22}\text{Ne}(p,\gamma)^{23}\text{Na}$ reaction takes part in the neon-sodium cycle of hydrogen burning and may affect the observed anti-correlation between sodium and oxygen abundances in globular cluster stars. Its rate is controlled by a number of low-energy resonances and a slowly varying non-resonant component. Three new resonances at $E_p = 156.2$, 189.5 , and 259.7 keV, respectively, have recently been observed and confirmed. However, significant uncertainty remains due to the off-resonant process and two hypothetical resonances at $E_p = 71$ and 105 keV, respectively. Here, new data with unprecedented high luminosity and low background on these aspects of the $^{22}\text{Ne}(p,\gamma)^{23}\text{Na}$ reaction are reported. Stringent upper limits are placed on the two hypothetical resonances, ruling them out for astrophysical purposes. The off-resonant yield has been measured at unprecedented low energy, constraining the contributions from a sub-threshold resonance and the direct capture process. The $^{22}\text{Ne}(p,\gamma)^{23}\text{Na}$ reaction rate, which used to be the most uncertain rate of the neon-sodium cycle, is now the best-known rate.

Selected session

Nuclear Astrophysics

Primary author: FERRARO, Federico (GE)

Presenter: FERRARO, Federico (GE)

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