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Investigation of excited states in ^{15}O at AGATA and Felsenkeller

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The CNO cycle plays a key role in the nucleosynthesis of massive stars and their energy production. The $^{14}\mathrm{N}(\mathrm{p},\gamma)^{15}\mathrm{O}$ reaction is the slowest in this cycle and, therefore, controls the speed of the entire cycle, influencing the synthesis of carbon, nitrogen, oxygen and fluorine. However, investigating the reaction at astrophysically relevant energies is challenging. The total reaction rate is dominated by two resonances: at $E_\mathrm{r} = 259\,\mathrm{keV}$ and at $E_\mathrm{r} = -504\,\mathrm{keV}$.

While the first resonance is well understood, the impact of the subtreshold state on the $^{14}\mathrm{N}(\mathrm{p},\gamma)^{15}\mathrm{O}$ reaction remains unclear and difficult to measure experimentally. In this work, we focus on investigating the lifetime, sub-fs range, of the $E_x = 6.793\,\mathrm{MeV}$ state in ^{15}O to constrain the response width and therefore, its impact on the $^{14}\mathrm{N}(\mathrm{p},\gamma)^{15}\mathrm{O}$ reaction. The experimental study was conducted in two separate campaigns at the Legnaro National Institute for Nuclear Physics in Italy (INFN), using the AGATA+SAURON array, and at the shallow-underground Felsenkeller laboratory in Germany. The Felsenkeller measurements were performed using $14.5\,\mathrm{MeV}$ and $16.9\,\mathrm{MeV}$ oxygen beams provided by the external source, which impinged on ^{3}He targets. A description of the setup, target stability tests, and preliminary analysis of both campaigns will be presented.

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