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The study of the ^{21}Ne(p,γ)^{22}Na reaction at LUNA

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The $^{21}\mathrm{Ne}$(p,γ)$^{22}\mathrm{Na}$ reaction is expected to be the main producer of the radioactive isotope $^{22}\mathrm{Na}$ ($t_{1/2}$ = 2.602 years) in novae. Novae explosions are the result of a thermonuclear runaway occurring on the surface of a white dwarf accreting material from a less evolved companion star in a close binary system that ejects a significant amount of nuclear-processed material into the interstellar medium. Amongst the isotopes synthesized during such explosions, radioactive nucleus $^{22}\mathrm{Na}$ is specifically produced in white dwarfs made of O and Ne, the progeny of stars with initial mass in the range of 8-10 solar mass. Once produced, $^{22}\mathrm{Na}$ beta decays to an excited state of $^{22}\mathrm{Ne}$, which de-excites by emitting a 1275 keV gamma ray [1]. If detected by satellite telescopes, this signal can provide information on the amount of $^{22}\mathrm{Na}$ produced in novae, and thus place direct constraints on the nucleosynthesis in these explosions.
Predictions of the $^{22}\mathrm{Na}$ abundance in novae strongly depend on the $^{21}\mathrm{Ne}$(p,γ)$^{22}\mathrm{Na}$ reaction rate. In the novae temperature range ($0.2 < T_9 < 0.5$), $^{21}\mathrm{Ne}$(p,γ)$^{22}\mathrm{Na}$ reaction is dominated by resonances at proton beam energies $\mathrm{E_p}$ = 126 and 272 keV [2]. In this contribution, we will report on the direct and precise measurement of the $\mathrm{E_p}$ = 272 keV resonance strength performed at the Laboratory for Underground Nuclear Astrophysics (LUNA) [3] located at Gran Sasso National Laboratory in Italy, benefiting from the low background conditions. The experimental setup, techniques, and results will also be described in detail in the talk.

References:

[1] M. Hernanz *et al.,* ESA Special Publication **588**, 351 (2005).
[2] J. Görres *et al.,* Nuclear Physics A **385**, 57-75 (1982).
[3] M. Aliotta *et al.,* Annual Review of Nuclear and Particle Science **72**, 177-204 (2022).

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