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# Indirect Measurement of the $^{27}\mathrm{Al}(p,\alpha)^{24}\mathrm{Mg}$ and $^{27}\mathrm{Al}(p,\gamma)^{28}\mathrm{Si}$ Cross Sections and Astrophysical Implications

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The abundance of $^{26}$Al carries a special role in astrophysics, since it probes active nucleosynthesis in the Milky Way and constrains the Galactic core-collapse supernovae rate.
It is estimated through the detection of the 1809 keV $\gamma$-line and from the superabundance of $^{26}$Mg in comparison with $^{24}$Mg in meteorites. For this reason, high precision is necessary also in the investigation of the stable $^{27}$Al and $^{24}$Mg.
These nuclei also enter the so-called MgAl cycle playing an important role in the production of Al and Mg. Recently, high-resolution stellar surveys have shown that the Mg-Al anti-correlation in red-giant stars in globular clusters may hide the existence of multiple stellar populations.
The common thread running through these astrophysical scenarios is the $^{27}$Al(p,$\alpha$)$^{24}$Mg and $^{27}\mathrm{Al}(p,\gamma)^{28}\mathrm{Si}$ reactions, which are the main $^{27}$Al destruction channels.
Since available spectroscopic data and reaction rates show large uncertainties owing to the vanishingly small cross section at astrophysical energies, we have applied the Trojan Horse Method to the $d(^{27}\mathrm{Al},\alpha^{24}\mathrm{Mg})n$ reaction.
This has allowed us to extract important information on the $^{27}\mathrm{Al}(p,\alpha)^{24}\mathrm{Mg}$ and $^{27}\mathrm{Al}(p,\gamma)^{28}\mathrm{Si}$ cross sections in the energy region of interest for astrophysics, not accessible to direct measurements.
In particular, the indirect measurement made it possible to assess the contribution of the 84~keV resonance and to lower upper limits on the strength of nearby resonances, with important impact for astrophysics, especially for massive-star nucleosynthesis.

## Funding Agency

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