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# Nuclear astrophysics experiments deep underground at LUNA: recent results and next steps at the new 3.5MV facility

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At astrophysical energies the cross sections of nuclear processes are usually very small and cosmogenic background prevents their measurement on the Earth surface. Deep underground in the Gran Sasso Laboratory, crucial reactions involved in hydrogen burning has been measured directly at astrophysical energies by the LUNA (Laboratory for Underground Nuclear Astrophysics) Collaboration with both the 50kV and the 400kV accelerators. Presently a rich experimental program is carried on at the LUNA-400 facility with a focus on hot CNO and Neon-Sodium cycles, but this years a new exciting experimental phase is going to start thanks to acquisition of the LUNA-3.5MV facility, already installed and tested at Gran Sasso. The LUNA-3.5MV accelerator is able to provide hydrogen, helium and carbon high current beams and it will allow to explore the helium and carbon burning processes, by studying the key reactions shaping the evolution of massive stars such as $22Ne(\alpha,n)25Mg$, $13C(\alpha,n)16O$ and $12C+12C$. In particular, in 2023, a first data acquisition campaign will be focused on $22Ne(\alpha,n)25Mg$ that for massive AGB stars represents the main source of neutrons, affecting the total abundances of the elements heavier than Fe.

The present contribution is aimed to summarise the most recent results achieved by LUNA Collaboration at the 400kV accelerator, in particular on the NeNa cycle, and to highlight the next steps of the experimental program connected to the new facility.

## Submitted on behalf of a Collaboration?

Yes

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