

LUNA at LNGS: Status and perspectives

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Over the last few years, several processes relevant to the CNO, MgAl and NeNa cycles have been studied using the LUNA 400 kV machine and I will report about few recent results. By the end of 2022 LNGS is planning to conclude installation and commissioning of the new 3.5 MV accelerator. This investment is allocated in the context of the Progetto Premiale "LUNA-MV". LUNA has been measuring cross sections of nuclear reactions of astrophysical interest with direct approaches, using two accelerators installed underground at Gran Sasso, over the last 30 years. With this MV machine, a long list of experimental possibilities will be opened, and LUNA will presumably keep its leadership in the field. In the scientific program approved by the scientific committee of Gran Sasso Laboratory, the $^{12}\text{C}+^{12}\text{C}$ reaction is one of the key reactions. As a matter of fact, this process is fundamental for the universe evolution since it determines whether a star end its life with the helium burning or proceeds through carbon and successive cycles burning.

Other important reactions will be measured in the first phase of the LUNA-MV scientific program: in particular the (α,n) reactions on ^{13}C and ^{22}Ne , which are crucial for the s-process calculations. Indeed, recently an ERC grant has been obtained to study the $^{22}\text{Ne}(\alpha,n)^{25}\text{Mg}$ reaction (SHADES project). The commissioning phase is planned within 2022 and during 2023 the first scientific experiment will be performed. In this contribution, the LUNA scientific program will be presented and details on the experimental setups (targets, detectors, ...) will be discussed.

Primary author: CACIOLLI, Antonio (Istituto Nazionale di Fisica Nucleare)

Presenter: CACIOLLI, Antonio (Istituto Nazionale di Fisica Nucleare)

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