

Nuclear astrophysics at LUNA: Status and perspectives

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The talk will be mainly devoted to the measurement of the cross section of the ${}^3\text{He}(\alpha,\gamma){}^7\text{Be}$ reaction which belongs to the p-p chain. Actually, solar neutrino fluxes depend both on astrophysical and on nuclear physics inputs, namely on the cross sections of the reactions responsible for neutrino production inside the Solar core. While the flux of solar ${}^8\text{B}$ neutrinos has been recently measured at Superkamiokande with a 3.5% uncertainty and a precise measurement of ${}^7\text{Be}$ neutrino flux is foreseen in the next future, the predicted fluxes are still affected by larger errors.

The largest nuclear physics uncertainty to determine the fluxes of ${}^8\text{B}$ and ${}^7\text{Be}$ neutrinos comes from the ${}^3\text{He}(\alpha,\gamma){}^7\text{Be}$ reaction. The uncertainty on its S-factor is due to an average discrepancy in results obtained using two different experimental approaches: the detection of the delayed γ rays from ${}^7\text{Be}$ decay and the measurement of the prompt γ emission.

The LUNA Collaboration has performed a new high precision experiment with both techniques at the same time. Thanks to the low background conditions of the Gran Sasso LUNA accelerator facility, the cross section has been measured down to 93 keV, the lowest interaction energy ever reached. The S-factors from the two methods do not show any discrepancy within the experimental errors. An extrapolated $S(0) = 0.560 \pm 0.017$ keV barn is obtained. Moreover, branching ratios between the two prompt γ -transitions have been measured with 3-8% accuracy.

A part of the talk will be also devoted to describe the status of the on-going experiment at LUNA namely the study of the ${}^{25}\text{Mg}(p,\gamma){}^{26}\text{Al}$ reaction.

Recently, the LUNA Collaboration has presented to the Scientific Board of Gran Sasso Laboratory its experimental program for the next five years based on the existing 400 kV accelerator facility. A Letter of Intent addressing the possibility to install a 3 MV machine at Gran Sasso has also been submitted to the Board. The LUNA scientific programs with both the 400 kV and 3 MV accelerator facilities will be illustrated in the final part of the talk.