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# Study of the 2H(p,gamma)3He reaction in the Big Bang nucleosynthesis energy range at LUNA

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Study of the 2H(p,γ)3He reaction in the Big Bang nucleosynthesis energy range at LUNA

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The Big Bang Nucleosynthesis (BBN) describes the production of light nuclides in the first minutes of cosmic time. It started with deuterium accumulation when the Universe was cold enough to allow 2H nuclei to be survived to photo-disintegration.
A primordial deuterium abundance evaluation D/H = (2.65 ± 0.07)10^−5 [1] is obtained by merging BBN calculations and CMB analysis obtained by the Planck collaboration. This value is in tension with the astronomical observations on metal-poor damped Lyman alpha systems, according to which D/H = (2.547 ± 0.033)10−5 [2].
The main source of uncertainty on standard BBN prediction of deuterium abundance is actually due to the radiative capture process 2H(p,γ)3He converting deuterium into helium, because of the poor knowledge of its S-factor at BBN energies. A measurement of this reaction cross section is thus desirable with a 3% accuracy in the energy range 10keV < Ecm < 300keV [1]. Furthermore a precise measurement of the 2H(p,γ)3He reaction cross section is crucial for testing ab-initio calculations in theoretical nuclear physics [3].
The measurement of the 2H(p,γ)3He cross section is ongoing at the Laboratory for Under- ground Nuclear Astrophysics (LUNA) taking advantage of the low background of the underground Gran Sasso Laboratories and of the experience accumulated in more than twenty years of scientific activity on precision measurements.
The experiment consists of two main phases characterized by two different setups. The former provides for a windowless gas target filled with deuterium together with a 4π BGO detector. This high efficiency detector has been used for investigating the energy range between 30 keV and 260 keV, finding a continuation of the previous results obtained by the LUNA collaboration in [6], where the 2H(p,γ)3He cross section was studied in the Solar Gamow peak (2.5keV < Ecm < 22keV ).
The latter phase, instead, will cover the medium-high energies (70keV < Ecm < 260keV ) using a High Purity Germanium detector (HPGe). The HPGe high resolution allows the differential cross section of the reaction to be evaluated by using the peak shape analysis.
The cross section preliminary results will be shown.

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