A new measurement of the $^2H(p,\gamma)^3He$ cross section in the BBN energy range at LUNA

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The abundances of the primordial elements are sensitive to the physics of the early universe and are therefore a tool to test the Standard Cosmological Model.
The Big Bang Nucleosynthesis (BBN) theory is one of the pillars of standard cosmology: for a given baryon density it provides the abundance of the primordial elements.
Interestingly the abundance of deuterium deduced from observation of pristine gas at high redshift is more accurate with respect to the computed value [1, 2], mainly because the BBN calculation is affected by the paucity of data for the deuterium burning reaction $^2H(p,\gamma)^3He$ cross section at the relevant energies [3]. The concern for the $^2H(p,\gamma)^3He$ cross section error is made worse by the fact that the theoretical and experimental values do not agree at the level of 20% [3, 4, 5].
A new measurement with a 3% accuracy would be very important to push down the BBN uncertainty on deuterium abundance to the same level of observations.
Deep underground in the Gran Sasso laboratory, Italy, the LUNA collaboration is pursuing a dedicated effort to measure the $^2H(p,\gamma)^3He$ cross section directly at BBN energies (30 -300 keV). The campaign, started in 2016, is divided into two phases based on a BGO and a high-purity germanium (HPGe) detector, respectively.
In the present talk the LUNA measurement is described and results from both phases are discussed. The impact of this measurement in cosmology and particle physics is also highlighted: a precision measurement would allow to provide an independent cross-check of the determination of the universal baryon density Ω_b from the cosmic microwave background and to constrain the existence of the so called dark radiation.

References

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