The LUNA phase beyond the Sun

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Nuclear reactions that generate energy and synthesize elements take place inside the stars in a relatively narrow energy window: the Gamow peak. The extremely low value of the cross-section inside the Gamow peak has always prevented its measurement in a laboratory at the Earth's surface, where the signal to background ratio is too small because of cosmic ray interactions. In order to explore this new domain of nuclear astrophysics LUNA (Laboratory for Underground Nuclear Astrophysics) started in 1991 its activity by installing a 50 kV electrostatic accelerator underground at the Gran Sasso Laboratory in central Italy, followed in the year 2000 by a second 400 kV one. The qualifying features of both accelerators are a very small beam energy spread and a very high beam current even at low energy. After 16 years LUNA still remains the only underground accelerator facility existing in the world.

In the talk I will briefly summarize the main contribution given by LUNA to the study of the pp-chain and the CNO cycle in the Sun, in particular to the precise determination of the solar neutrino spectrum. Then I will describe the measurements we are planning to perform during the next 5 years with the existing accelerator. They are no longer focalized on the Sun, but they concern Big-Bang nucleosynthesis and Hydrogen burning at temperatures higher than the solar one. Finally, I will illustrate the experimental program we submitted to the Gran Sasso laboratory for a new higher voltage (3 MV) underground accelerator.