

Nuclei in the Cosmos (NIC XVII)



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Nuclear Astrophysics in underground laboratories: the LUNA experiment

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In nuclear astrophysics, a crucial aspect is understanding the thermonuclear reactions that power the stars and lead to the synthesis of chemical elements. At astrophysical energies, the cross section of nuclear processes is significantly reduced by the Coulomb barrier, making direct measurements challenging. In addition, the low value of cross sections often hinders their measurement on Earth's surface, necessitating extrapolations. To overcome this problem, the Laboratory for Underground Nuclear Astrophysics (LUNA) is located under the Gran Sasso mountain. This position reduces the effects of cosmic-ray background and allows cross sections investigations at energies close to the Gamow peak in stellar scenarios. The LUNA-50kV and LUNA-400kV accelerators have been used to directly measure many crucial reactions involved in hydrogen burning at astrophysical energies, and work continues with the installation of a 3.5MV machine that will explore helium and carbon burnings. Due to this progress, there are currently running projects in several countries using underground accelerators. This presentation will describe the typical techniques used in underground nuclear astrophysics and review the most significant results achieved. The talk will also highlight the exciting science that can be probed with the new facilities.

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