LABORATORI NAZIONALI DEL GRAN SASSO

SEMINAR ANNOUNCEMENT

Alberto Lemut

Lawrence Berkeley National Laboratory

DIANA: The US Project for Underground Nuclear Astrophysics

Current stellar model simulations are at a level of precision such that nuclear-reaction rates represent a major source of uncertainty for theoretical predictions and for the analysis of observational signatures. To address several open questions in cosmology, astrophysics, and non-Standard-Model neutrino physics, new high precision measurements of direct-capture nuclear fusion cross sections will be essential. Experimental studies of nuclear reactions of astrophysical interest are hampered by the exponential drop of the involved cross-sections often preventing measurements in laboratories at the earth surface: Because of the cosmic ray interactions with detectors and surrounding materials the signal to noise ratio would be too small, even with the highest beam intensities presently available from industrial accelerators. An excellent solution is to install an accelerator facility deep underground where the cosmic rays background into detectors is reduced by several orders of magnitude, allowing the measurements to be pushed to far lower energies than presently possible. This has been clearly demonstrated at the Laboratory for Underground Nuclear Astrophysics (LUNA) by successful studies of important reactions in the pp-chains and the CNO cycles. The DIANA project (Dakota Ion Accelerators for Nuclear Astrophysics) is a collaboration between the University of Notre Dame, University of North Carolina, Western Michigan University, and Lawrence Berkeley National Laboratory to build a nuclear astrophysics accelerator facility 1.4 km below ground. DIANA will support experiments that address long-standing questions in the field providing potentially transformational results about the inner structure and working of stars. DIANA is designed to achieve large laboratory reaction rates by delivering high ion beam currents (up to 100 mA) to a high density (up to 10^{18} atoms/cm^{2}), super-sonic jet-gas target as well as to a solid target. DIANA will consist of two accelerators, 50-400 kV and 0.4-3 MV, that will cover a wide range of ion beam intensities, with sufficient energy overlap to consistently connect the results to measurements above-ground. Three fundamental scientific issues in stellar nucleosynthesis will be addressed by DIANA: (i) solar neutrino sources and the metallicity of the sun; (ii) carbon-based nucleosynthesis; (iii) neutron sources for the production of trans-Fe elements in stars. The design of the DIANA accelerator facility and the physics goals will be presented in this seminar.

JULY 11, 2012 – 2:30 PM
LNGS - “B. PONTECORVO” ROOM