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Measurement of the neutron flux at the Canfranc Underground Laboratory with HENSA

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Neutrons constitute a main limitation for experiments dealing with rare event searches underground. Even if neutrons produced by cosmic-ray muons are largely suppressed in underground laboratories, radiogenic neutrons are still produced in the rocks by (alpha,n) reactions and spontaneous fission. They have a large penetrability and can induce background signals in the detectors [1,2] affecting nuclear astrophysics, neutrino and dark matter experiments.

Therefore it is of paramount importance to measure and fully characterize the neutron flux at the experimental location. Since the neutron background in underground laboratories is low, measurements have a low rate and last for months, demanding detectors with high efficiency for neutrons, high background discrimination capability and long-term stability. These requirements are fulfilled by 3He proportional counters [2-6]. The new High Efficiency Neutron-Spectrometry Array (HENSA), based on the Bonner spheres principle [3], is composed of ten long proportional counters filled with 3He gas embedded in high-density polyethylene moderators with different thickness, achieving sensitivity to neutron energies ranging from thermal to 10 GeV.

In October 2019 we started a long-term measurement of the neutron flux with HENSA in the Hall A of the Canfranc Underground Laboratory (LSC). The aim is to measure the neutron flux and characterize the energy spectrum precisely as well as to study the long-term evolution of the neutron rate looking for possible seasonal variations. These goals are of relevance for a number of experiments at LSC investigating fundamental questions of modern physics [7,8]. The Hall A measurement campaign extended up to March 2021, demonstrating an excellent stability of the HENSA setup. Results from the campaign in Hall A will be presented for the first time at the TAUP conference.

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Reference to paper (DOI or arXiv)

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