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Ambient Neutron Background in the Shallow-Underground Laboratory Felsenkeller

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One important component of the ambient background in underground laboratories are neutrons, which may cover a wide energy range from thermal up to 100 MeV and may affect γ-ray spectra for example by capture and inelastic scattering processes. Underground with more than a few meters rock overburden, cosmic-ray neutrons are removed, and the remaining flux is due to neutron production by cosmic-ray muons and by (α,n) reactions caused by natural radioactivity in the rock.

There are only a few measurements of the spectral neutron flux underground available in the literature, a fact which hampers comparisons between laboratories and negatively affects the planning of future experiments. In an effort to overcome this problem, a setup consisting of moderated and one unmoderated 3 He neutron counters that has already been used at a depth of 850 m in the Canfranc underground laboratory, Spain [1], was utilized to study the neutron flux in the 47 m deep Felsenkeller underground laboratory, Germany. At Felsenkeller, one more counter with a lead liner was added in order to address also the high-energy flux up to several hundreds of MeV.

The contribution will describe the Monte Carlo modeling of the neutron detectors, its validation with calibrated neutron sources, the spectral deconvolution of the neutron flux, and the final neutron flux data. Potential normalization issues in previous measurements will be discussed.

The experimental neutron flux data at Felsenkeller are matched by a Monte Carlo simulation starting from the measured muon flux (for the muon-induced neutrons) and the known ambient radioactivity of the rock and construction materials (for the (α,n) neutrons).

The present data have influenced the planning of the new laboratory hosting the 5 MV Pelletron ion accelerator in Felsenkeller.

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