



Large-scale boron-lined neutron detectors for Cosmic-Ray Neutron Sensing

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Cosmic-Ray neutron sensors are widely used to determine soil moisture on the hectare scale, reaching maximum soil penetration depths of 83 cm. Precise measurements, especially in the case of mobile application, demand for neutron detectors with high counting rates and high signal-to-noise ratios. For a long time CRNS instruments have relied on helium-3 as an efficient neutron converter. Its ongoing scarcity demands for technological solutions with other converters. We present our developments of a modular neutron detector consisting of several boron-10-lined proportional tubes, which features high counting rates via its large surface area. The modularity allows for different shielding of the individual segments within the detector giving the possibility of measuring also spectral information. This can be especially applied to mobile measurements, where the constantly changing vicinity of the sensor has a significant influence on the overall signal (also called 'road effect'). Furthermore we increase the signal-to-noise ratio by combining pulse-height and pulse-length spectra to discriminate between neutrons and other environmental radiation. This novel detector therefore combines high-sensitivity counting electronics with large-scale instrumentation technology bringing CRNS to the next level.