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Portable cosmic particle detectors for subsurface density mapping

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Muography deduces the density length in the interior of the investigated geological object, such as a mountain or volcano by the measurement of the cosmic muon absorption along different paths through the object. If path lengths (average densities) are measured, the average density (path length) can be deduced along the muon paths.
A portable, low power consumption cosmic particle tracking detector based on Close Cathode multi-wire proportional chambers [1,2] has been developed for muography based on our earlier developments and experiences at the Wigner RCP of the HAS in Budapest [3,4,5]. The newly developed tracking system consists of six layers with the sensitive area of 0.25 m2 [6]. The spatial resolution of 2 mm provides an angular resolution of 15 mrad. This instrument has been optimized for underground and outdoor measurements: it has a Raspberry pi controlled data acquisition system which includes a custom designed board with a coincidence unit and allows high level remote control, data management and analysis. The individual trigger signals, number of missed triggers, analogue signals from chambers and the temperature are recorded. The duration of data readout (dead time) is 100 microsec. The DAQ software runs on the Raspberry Pi. For standard operation, a graphical user interface has been developed, running on any remote computer with Internet connection (both of wired and wireless) to the Raspberry Pi. A temperature-controlled high-voltage power supply provides a stable and reasonable (> 95 %) tracking performance for the measurements.
With total power consumption of 5W, a portable tracking detector can operate for 5 days with a standard 50 Ah battery and with gas (non flammable Ar-CO_2 mixture) consumption of 0.5 liter per hour, a 10 l bottle at pressure of 150 bar is enough for four month. The portability (total weight of less than 30 kg) allowed that our tracking detectors have been applied in underground caverns for subsurface density mapping. The developed detectors were reliably operated in natural environmental conditions proving operational stability. For each measurement, the experiences and the muon flux will be presented.

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