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Feasibility study of detection of high-Z material in nuclear waste storage facilities with atmosperic muons

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Muon radiography is a well-estabilished technique which is widely used in investigating the internal density structure of targets of different size and composition. Some examples of successful applications are the search for hidden chambers in archaeological sites and the monitoring of geological structures like volcanoes. The two main approaches to muon radiography are based on the effects of multiple Coulomb scattering and on absorption inside the target of atmospheric muons.
The results of a Monte Carlo feasibility study of using muon radiography to investigate the presence of high-Z material (e.g. uranium) inside nuclear waste storage facilities using both the above mentioned techniques are presented. Albeit muon radiography has already been successfully applied to this kind of investigation in the past, this is the first time that it is benchmarked against the detection of cm-sized, high-Z samples inside building-sized storage facilities. For both multiple scattering and absorption approaches, preliminary results show that uranium samples of typical size greater than 5 cm can be detected inside a storage silo with a size of some meter filled with concrete, with a data taking period of several weeks. Smaller samples with size 2 cm are not detectable due to multiple scattering within the concrete matrix. The dependence of these results on the positon of the samples and on the duration of data acquisition have been investigated and are reported as well, together with an estimate of the detection probability for fake signals.

Collaboration

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