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Determination of the alpha-activity from samples with an extremely strong background of beta-emitting radionuclides by liquid scintillation counting

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One of the biggest challenges regarding the exploitation of nuclear energy concerns the proper management of its high-level radioactive waste. Accelerator Driven Systems (ADS) offer a new pathway to address this issue by transmuting the produced nuclear waste. Lead-Bismuth-Eutectic (LBE) represents an attractive choice of coolant for an ADS, since it can serve simultaneously as a spallation source. In such a case, significant amounts of polonium are generated in the coolant, alongside many additional radionuclides. For the safe operation of such systems, the release behaviour of various radionuclides from the coolant needs to be thoroughly investigated. Earlier studies on this subject have been carried out by means of the transpiration technique, using LBE samples containing only one single radionuclide. However, in a running ADS many different impurities will be present in the coolant simultaneously. It is thus important to study the influence of possible chemical interactions between impurities on the evaporation behaviour of hazardous volatile radionuclides. For such studies, we intend to make use of LBE samples from the prototype high power liquid LBE spallation target MEGAPIE. This material is worldwide unique, because exhibits a similar radionuclide inventory as the coolant of an ADS, since it has been irradiated with a high proton current for several months at PSI in 2006. In particular, we are interested in studying whether the evaporation behaviour of polonium is influenced by the presence of other impurities. In order to conduct such experiments, the initial amount of alpha-emitting Po needs to be carefully analysed in the presence of a large quantity of beta-emitters. In this talk, we will present a fast and straightforward pathway to accurately quantify the activity of an alpha-emitting radionuclide in the presence of an extremely high beta background using the technique of liquid scintillation counting. The presented approach is based on the pulse shape discrimination feature of modern TRI-CARB liquid scintillation counters.

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