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Po-production in lead: Calculation and measurement on SINQ-samples (PSI)

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The Paul Scherrer Institut operates a MW-class spallation source, SINQ, using the 590 MeV proton beam delivered by the ring cyclotron, HIPA. The target of the spallation source consists of a bundle of lead filled metal tubes (cannelloni). Five lead samples were extracted from a rod in the target center close to the beam entry window from SINQ target-4, which had been in operation in 2000/2001 and received a total integrated beam charge of about 10 Ah. The lead was radiochemically investigated and the activities of several isotopes could be measured. Special attention was paid to Po as it has α -emitting isotopes with considerable half-lives and the element can show – depending on the experimental conditions - distinct volatility properties. A much larger amount of the Po isotopes ^{208}Po (2.9 y), ^{209}Po (102 y) and ^{210}Po (138 d) was found in the samples compared to the prediction obtained with available cross section models in the particle transport code MCNPX. In particular, the amount of ^{210}Po measured more than 10 years after the target operation is by far too large to be explained by direct production from Bi impurities in the lead. This implies another reaction mechanism not considered in the standard INC (Intranuclear Cascade) and evaporation models. Therefore, a recently improved INC and evaporation model, the Liège intranuclear-cascade model (named INCL) coupled to the de-excitation model ABLA07 was implemented into MCNPX2.7.0. INCL4.6/ABLA07 is one of the most accurate models to describe spallation reactions as an inter-comparison done under the auspices of IAEA demonstrated. In this contribution, preliminary results of the nuclide inventory calculated with MCNPX using INCL4.6/ABLA07 and Bertini-Dresner are presented and compared to the experimental data.

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