The direct SPES target, effusion calculations

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In the framework of the SPES project, a RD study for the realization of a Direct Target is in progress for the construction of a RNB ISOL-type facility at Laboratori Nazionali di Legnaro (IT). Using a proton beam of 40 MeV impinging on a UC_x thick target of 2.5 g/cm^3 density, a production rate of 10^{13} in target fissions per second is expected. The exotic species produced by Uranium fission in the target are collected in the ion source after diffusion and effusion processes. Therefore, in order to optimize the target release efficiency, is very important to minimize the time needed by the radioactive species to reach the ion source. To this purpose, some simulations were performed, using the GEANT4 toolkit [1], in order to estimate the effusion time for some neutron-rich nuclei (^{132}Sn, ^{90}Kr, ^{81}Ga). The same simulations were also performed using the RIBO code (Radioactive Ion Beam Optimiser), a specific Monte Carlo simulation program for the optimization of radioactive ion beam production [2]. The geometry of the full-scale target is described in Fig. 1. The target container is a cylindrical Carbon tube 1 mm thick with radius 4 cm and length 24 cm. The entrance window is a 0.4 mm thick graphite layer of 4 cm radius. The active part of the target is composed by seven UC_2 disks of density 2.5 g/cm^3, leading to a total mass of about 60 g. The disks have a radius of 3 cm and thicknesses varying from 1.3 mm down to 0.9 mm. In order to optimize the power deposition, the thicknesses of the disks have decreasing values as a compensation of the increasing values of the stopping energy per length. The passive dump is made by three graphite discs of density r = 1.75 g/cm^3, 3 cm radius and 0.2 mm thickness. All the disks are 2 cm spaced. The simulated events are generated randomly in the region of the active disks and reach the ion source through a 12 cm long exit cone with a 0.3 cm exit hole. The results obtained with the two codes are in agreement and indicate that for the considered ions the effusion time is significantly lower with respect to their half-life. Comparing to GEANT4, RIBO appears to be more sophisticated, since the diffusion process and the effusion process inside the powder of the disks are implemented.

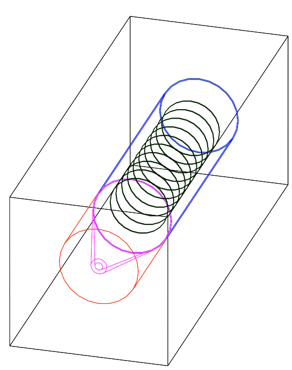

Figure 1: *Thin target geometry.*

[1] S. Agostinelli et al., Nucl. Instr. Meth. A 506 (2003) 250-303;

[2] M. Santana, A Monte Carlo code to optimize the production of radioactive ion beams by the ISOL technique, Ph.D. Thesis, UPC-ETSEIB (2004).