Transport concept for highly activated antiproton production targets

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The antiprotons of the FAIR facility will be produced by a 29 GeV proton beam hitting a nickel target. Then they are focused by a circular magnetic field (magnetic horn) and transferred to the collector ring (CR) [1]. The target and the magnetic horn will become highly activated (up to 10^{11} Bq) during the antiproton production. Dedicated shielding calculations have been performed so far [2].

The target and the magnetic horn have to be exchanged regularly. Their activation leads to several technical challenges: To dismount the target or the magnetic horn these components have to be transported into a hot cell in the building of the Super Fragment Separator (SFRS). It is absolutely mandatory, that during handling and transport target and magnetic horn are surrounded by a sufficient shielding at all times [3]. Additionally, due to the radiation level the access to the target hall is limited (controlled area) and remote handling components have to be used. A target handling concept has been developed that fulfills all of these conditions (see [4]). A study together with Kraftanlagen Heidelberg has been carried out concerning legal aspects of this concept and to develop functional specifications of the necessary handling components in order to obtain the operation permit.

The handling in the pbar building is schematically shown in figure 1: In the first step the target and the magnetic horn are pulled out of the target station by a half-automated transport container via a dedicated rail system (pos. 1). To fix the components a fast coupling system is used. (The target and the magnetic horn are transported separately.) After the transport container is closed it is positioned under a shaft (pos. 2). A shielding flask above the shaft is equipped with a carrying frame that pulls the component through the shaft (pos. 3). Finally the shielding flask is closed (pos. 4) from below and lifted up by a transport trolley to bring it to the SFRS building.

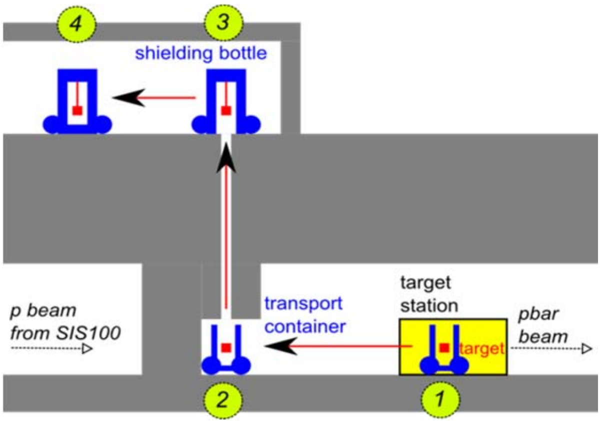

Figure 1: Schematic drawing of the target handling in the pbar building.

Inside of the shielding flask the target or the magnetic horn is fixed vertically, the highest radiation level is at the bottom, the lowest at the top. Figure 2 shows a cut of the flask with the magnetic horn fixed inside at the carrying frame. The wall thickness of the flask is designed in a way that the maximum dose rate at the outer surface is below 100µSv/h. The total weight of the flask is about 24 t.

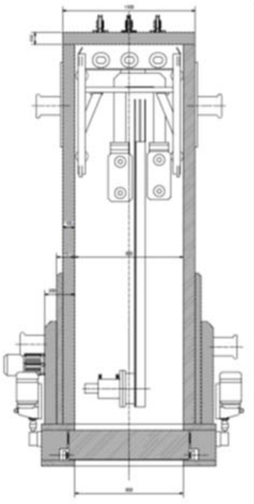

Figure 2: Cut of the shielding flask with magnetic horn and its stripline fixed inside.

Finally inside of the SFRS building the content of the shielding flask is transferred into the hot cell: First a traverse is fixed at the shielding flask that it can be moved by the crane of the building. This crane meets high safety standards, which are already predefined. With this traverse the flask is lowered about 6 m down next to the roof of the hot cell. Then for the final connection with the hot cell an adapter is placed also providing an interlock signal for the shutters of the hot cell and the shielding flask. When both shutters are open the carrying frame of the flask lowers down the component into the hot cell where it is dismounted by a technician of the SFRS group. Then the flask is closed again and is brought back to a parking position in the pbar building. The new target is then brought inside by using the same carrying frame of the shielding flask.

References

[1] Dolinski et al., Nuc. Instr. Meth. A 629 (2011) 16-24.
[2] GSI Scientific report (2011) PNI-ACC-14 483.
[3] 7. Teilerrichtungsgenehmigung, Hessisches Ministerium für Umwelt, Energie, Landwirtschaft und Verbraucherschutz, Wiesbaden (2013).
[4] Technical Design Report on the Antiproton Target and Separator, pbar working group, GSI, Darmstadt (2014).

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