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Production of Xi hyperons in the storage ring HESR in PANDA

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The most recent developments in the field of the Strong Interaction Physics led the High Energy Community to investigate very rare reactions (production of strange baryons, formation of heavy quark systems?) using quite rare projectiles like antiprotons or kaons (1,2). Since these reactions have in general very low cross section, they require very intense beams to produce high statistics and it is mandatory to avoid as much as possible to waste the projectiles. In order to obtain high quality beams, projectiles are sometimes stored in rings and targets are located inside the ring pipe. As an example the FAIR project (3) foresees to accumulate the antiprotons inside the High Energy Storage Ring (HESR) and to put some targets inside the beam pipe to produce reactions at each passage of the antiproton bunch. The transmitted beam is re-cooled and re-focused after each target crossing. This technique, which recovers the transmitted beam, puts some severe constraints on the target design.

In the frame of the production of hypernuclear reactions, the PANDA Collaboration planned to produce Xi hyperons and Doubly Strange systems using antiprotons at 3GeV/c inside HESR. The 2-target set-up includes a solid diamond target to be located within the beam pipe. Sizes and densities of the target, together with the antiproton beam profile, will play a crucial role in the hyperon production rate, beam losses and background on the detector. To maximize the former effect and minimize the latter ones the width and thickness has been evaluated to be of the order of some micron. Some prototypes of the target have been constructed and their mechanical and thermal properties are under test.

After a short review of the physics items that will be investigated in the hypernuclear section of the experiment (production and spectroscopy of doubly strange hypernuclei, double hypernuclei, doubly strange exotic atoms...), the characteristics of the antiprotons facility will be presented. The results of the feasibility study concerning the effects of the antiproton interactions with the solid target and the optimization of material and sizes will be also reported together with the expected rates of the production of stopped hyperons per day.

(1) K.Szymanska et al., Acta Phys. Pol. B 41, 285 (2010)

(2) K. Tanida et al. Hyperfine Interact. 193, 81 (2009)

(3) F. Iazzi, Few-Body Systems, vol. 43, no.1, pp. 97 (2008)

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