Ways to make polarised antiproton beams

K. Kilian[(a)], D. Grzonka[(a)], D. Möhl[(b)], W. Oelert[(a)]

[(a)] Forschungszentrum Jülich, IKP, 52425 Jülich, Germany
[(b)] CERN, CH-1211 Geneva 23, Switzerland

For making polarised antiproton beams the so called filter method is normally discussed. From a cooled stack of antiprotons preferentially one spin component is depleted by spin dependent interaction. With an internal polarised target the polarisation builds up on the expense of intensity. The method has been proven by the FILTEX collaboration on protons [1].

So far the first and only experiment with polarised antiprotons was done at Fermilab with strongly polarised antiprotons from antilambda decays [2]. Antilambdas from a high energy production target at 200 GeV were used. Better suited for the FAIR energy range will be the reaction $\bar{p} + p \rightarrow \bar{\Lambda} + \Lambda$ as source of polarised antiprotons. The flux will be low but all relevant numbers are known from the PS185 experiment done at LEAR [3]. This method is feasible.

Another possibility for the generation of polarised antiprotons may be the production process itself. All antiprotons which we use are produced in high energy quasi-free proton - nucleon collisions. Out of the high energy density antibaryon baryon pairs appear. The reaction can be assumed to be: $p + N \rightarrow \bar{p} + (3N)_{0<\epsilon<E_{max}}$. The shape of the antiproton production spectrum on heavy targets around zero degree supports this assumption. In such hadronic interactions the antiprotons may have substantial polarisation. Dilution of polarisation has to be avoided by a) cutting out pure s wave production, namely antiprotons at small angles with transverse momenta below 150 MeV/c b) cutting out up and down components and one side of the antiproton production distribution. Most attractive in this method would be that it can use the normal antiproton factory. Only proper absorbers in the beam line to the cooler/collector have to be installed. Depolarisation in the cooler synchrotron has to be avoided.

Are there polarised antiprotons in the production at all? No theoretical predictions exist. Experimentally the reaction has never been studied. Coulomb-nuclear interference offers a polarimeter reaction for antiprotons. One should do a test experiment and search for the degree of polarisation in the produced antiproton continuum at the CERN PS accelerator.

[1] F. Rathmann et al. Phys. Rev. Lett. 71, 1379 (1993).

[2] A. Bravar et al. Phys. Rev. Lett. 77, 2626 (1996).

[3] P.D. Barnes et al. Phys. Rev. C54, 1877 (1996).

E-mail: d.grzonka@fz-juelich.de