Study of S = -2 baryonic states at FLAIR

Dieter Grzonka

Forschungszentrum Jülich, Institut für Kernphysik,
52425 Jülich, Germany

At the future FAIR project of the GSI low energy antiprotons will be available at FLAIR, the Facility for Low energy Antiproton and Ion Research. Within the FLAIR LOI [1] it is proposed to study the production of strangeness S = -2 baryonic states based on ideas proposed for LEAR [2].

The study of the baryon-baryon interaction is a basic tool to investigate the strong interaction. Especially in the strangeness S = -2 sector the available data are strongly limited. Most studies in this field were devoted to the search for the H-particle, a $(B = 2, S = -2)$ system with the quark configuration $(uuddss)$ first proposed by Jaffe [1]. The entrance into the S=-2 baryonic systems is mostly the cascade hyperon Ξ produced via K^- or p induced reactions. Slow Ξ particles can go into interacting ΞN systems which can couple to YY or might also directly connect to the H particle.

With stopped antiprotons a very efficient reaction chain for the production of slow Ξ hyperons can be initiated. In a first step a $\bar{K^*}$ "beam" is produced in the annihilation of a stopped antiproton on a nucleon. The production of $S = -2$ systems proceeds then in a second step via the double strangeness and charge exchange reaction $(\bar{K^*}, K)$. Due to the short decay length of a few fm both, $\bar{K^*}$ production and the double strangeness and charge exchange reaction have to take place in the same nucleus. The special feature of this reaction channel is the low momentum of the produced Ξ hyperon. The 'magic' $\bar{K^*}$ momentum at which the Ξ can be produced at rest is at around 200 MeV/c which is very close to the momentum of the produced $\bar{K^*}$ in the first reaction step.

The studies will start with the pure Ξ production via e.g. $\bar{p}d \rightarrow \Xi^- K^0_s K^{*+}$. To investigate the ΞN , $\Lambda\Lambda$ or H systems a ^3He target has to be used. The slow Ξ hyperons with recoil momenta down to even zero MeV/c have a high probability of producing a (B = 2, S = -2) system. A further extension of the programme may be the production of double hypernuclei. With the technique of recoil-free kinematics the Ξ can also be produced and deposited in more extended nuclei. A highly efficient production of double hypernuclei is expected with this method.

From the experimental point of view the delayed decays of the strange exit particles allows a highly selective trigger on these reaction channels and the event reconstruction is relatively simple. A non magnetic detection system with track reconstruction ability is sufficient for the complete kinematical reconstruction.

References:

[1] FLAIR LOI, http://www-linux.gsi.de/ flair.

[2] K. Kilian, Proc. 4th LEAR Workshop (1988) 529; K. Kilian et al., Memorandum PSCC CERN (1990).

[3] R.L. Jaffe, Phys. Rev. Lett. 38 (1977) 195.