Design of a detector for studies of S=-2 baryon interaction induced by stopped antiproton annihilation

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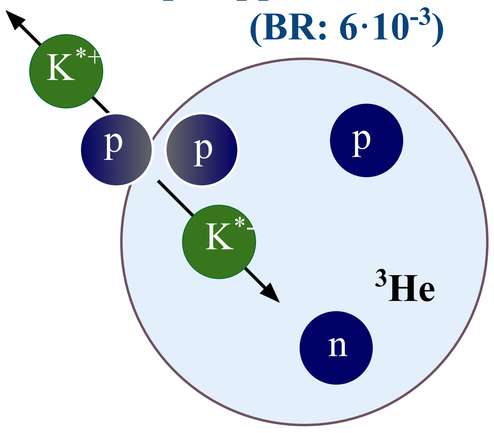
MOTIVATION

- study of Y-N and Y-Y interaction - database limited [1,2], baryon-baryon interaction of S = −2 system important for better understanding of SU(3) flavor symmetry and H-Dibaryon search (H : [uu dd ss]) [3,4]
- availability of low energy, phase space cooled antiproton beam with ELENA and FLAIR

RECOIL FREE PRODUCTION OF S=−2 SYSTEMS

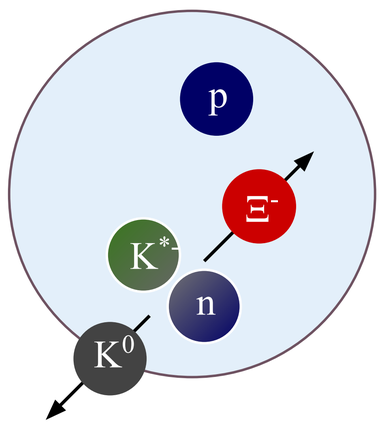
- optimum condition for investigation of Ξ-N interations [5,6]

step 1: $\bar{p}p \rightarrow \bar{K}^{*-} K^{*+}$ (BR: $6 \cdot 10^{-3}$)



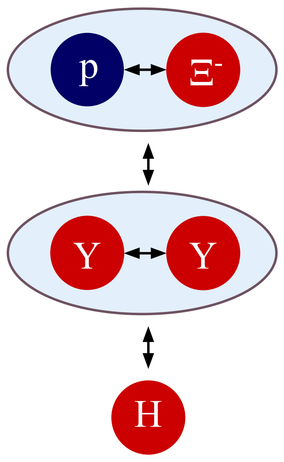
large $\bar{p}$ stop rate on a ^{3}He target

step 2: $K^{*-} n \rightarrow \Xi^- K^0$



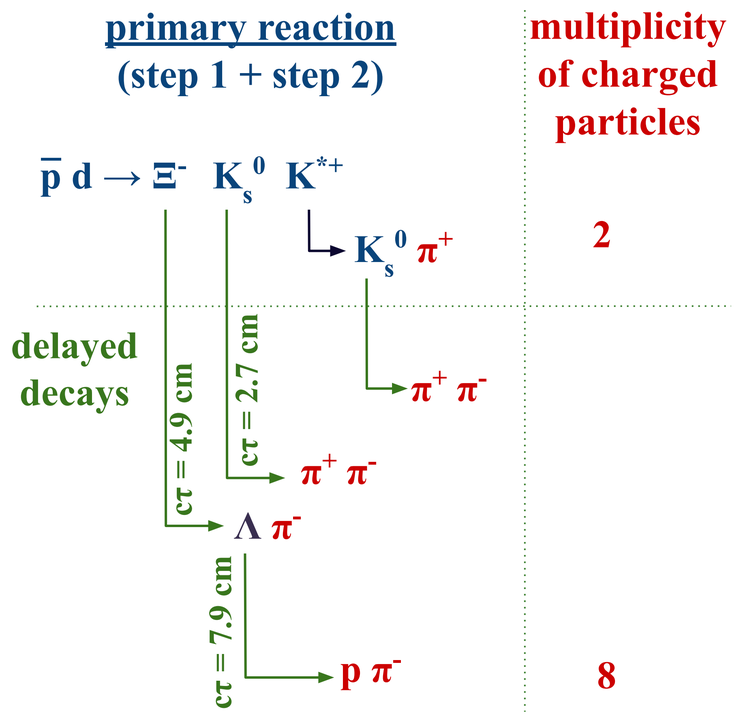
very low recoil on Ξ⁻ (recoil free kinematics)

S = −2 states

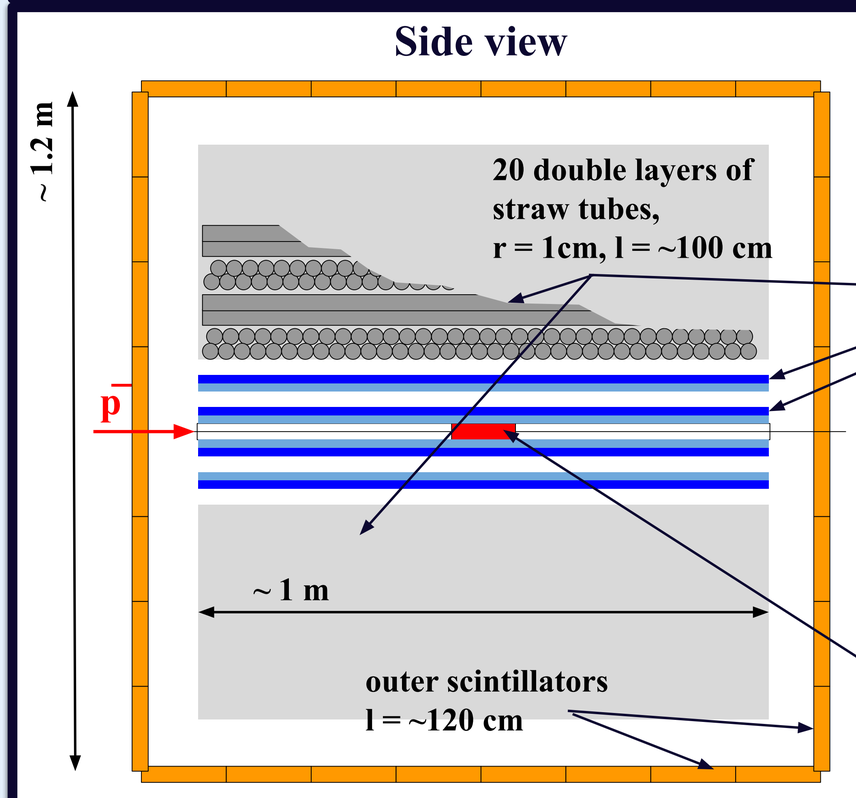


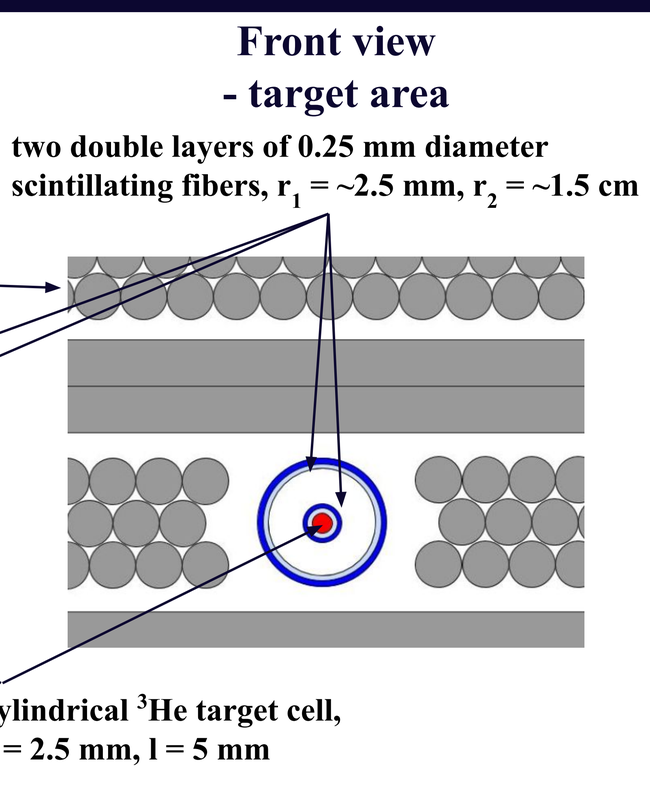
low relative energy

TRIGGERING



DETECTOR DESIGN

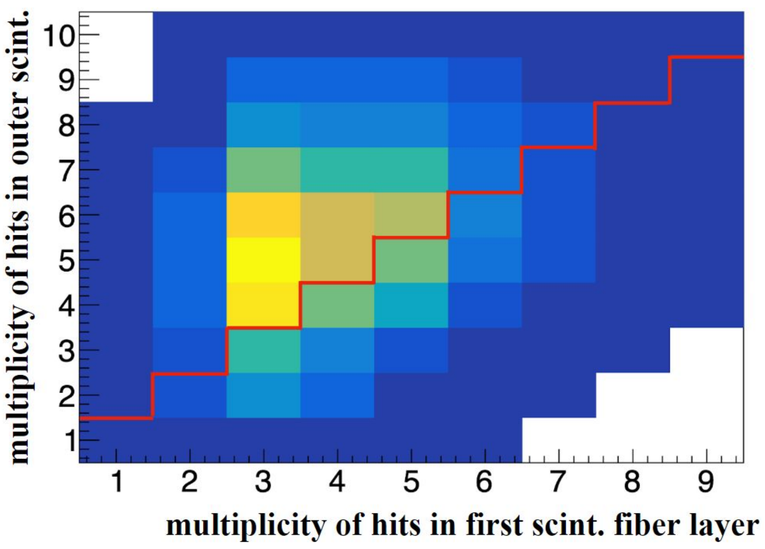




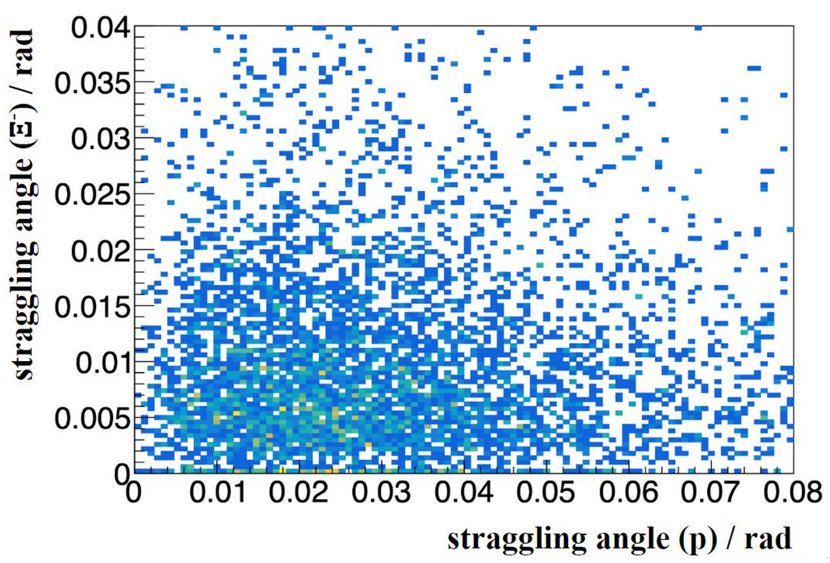
- low energy, low emittance antiproton beam needed
- antiprotons should be stopped within a small target volume
- geometry close to 4π necessary for a high efficiency, balance between tracking precision and straggling is of a key importance
- tracking close to the target performed by two double layers of thin scintillating fibers
- volume between scintillating fiber tracker and outer scintillators is filled with straw tubes

RESULTS OF THE MONTE CARLO SIMULATIONS

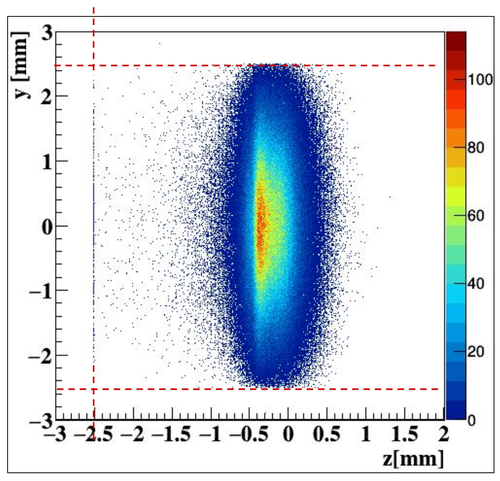
Generation of the reaction $\bar{p}^3He \longrightarrow K^* K^0 \Xi^- p$ in the target cell



Multiplicity correlation of outer scintillator hits (m_s) vs. scintillating fiber hits (m_f) online trigger efficiency $m_s > m_f$: 70%



Straggling angles of Ξ and p, relevant for the precision of the Ξ-p interaction analysis



Antiproton stopping distribution in a ^{3}He target cell generated by Geant4

1. J.A.Kadyk st al.,0
2. Eisele Phys. Lett. 37B, 205 (1971)
3. R.L. Jaffe, PRL 38, 195-198 (1977)
4. T. Sakai et al., Prog.Theor.Phys.Suppl., 137, 121 (2000)
5. K. Kilian, Proc. 4th LEAR Workshop (1988)
6. D. Grzonka et al., AIP Conf. Proc. 793 (2005) 190