ANTIPROTON YIELDS FOR STOCHASTIC ACCUMULATION

Carlos Hojvat and A. Van Ginneken

July 15, 1981

(Revised)

Two sets of parameters have been developed to study stochastic accumulation (See Notes on Stochastic Cooling Meeting of 10 July 1981). The question arises of the size of the transverse emittance required to achieve an antiproton yield of $1.2 \times 10^8 \bar{p}$'s/MR cycle for 4.5 GeV and 8 GeV $\bar{p}$ kinetic energies, given a full momentum acceptance of 4%.

The results quoted below are obtained with a Monte Carlo program which uses a fit to the $\bar{p}$ production invariant cross section that has been presented previously. An article describing the program is in preparation.

If the 1.2×10^8 antiprotons arise from 2×10^{12} protons on target then the required yields are:

1) 4.5 GeV (5.4 GeV/c):

$$y = \frac{1.2 \times 10^8}{2 \times 10^{12} \times 5.4 \times 0.04} = 2.78 \times 10^{-4} \left(\frac{\text{antiprotons}}{\text{protons} \cdot \text{GeV}/c} \right)$$

2) 8.0 GeV (8.9 GeV/c):

$$y = \frac{1.2 \times 10^8}{2 \times 10^{12} \times 8.9 \times 0.04} = 1.69 \times 10^{-4} \left(\frac{\text{antiprotons}}{\text{protons} \cdot \text{GeV}/c} \right)$$

To collect the antiprotons a lithium lens of 1 cm radius and a gradient of 1000 T/M is assumed. For practical considerations we

will maintain the distance between the target center and the upstream end of the lens to be 14.5 cm for both antiproton energies. This requirement results in a 10 cm long lens for the 4.5 GeV case and a 15 cm long one for the 8.0 GeV case.

Consistent with previous calculations of energy deposited on the target we utilize a proton beam spot of $\sigma_x = \sigma_y = 0.022$ cm. The target length is chosen to be 5 cm long Tungsten.

8.0 GeV Antiprotons

For 100 GeV incident protons the required transverse emittance is $21\pi \times 10^{-6}$ m, with 17% of the antiprotons due to production by secondaries.

For 200 GeV incident protons the required transverse emittance is $12\pi \times 10^{-6}$ m, with 25% of the antiprotons arising from secondary production.

4.5 GeV Antiprotons

The required yield is difficult to obtain with 100 GeV protons. For example, for an acceptance of $40\pi \times 10^{-6}$ we obtain a yield of 2.36×10^{-4} , or 1.18 times below the desired value. Secondaries contribute 28% of the total antiproton yield.

For 200 GeV incident protons a transverse emittance of the order of $27\pi \times 10^{-6}$ m is required, with 38% of the antiprotons due to secondary production.

Conclusions

The transverse emittances assumed for the Stochastic Accumulator design are approximately correct, depending on what proton energy is chosen.

It should be remembered that the minimum achievable cycle times are expected to be 1.68 seconds at 100 GeV and 2.61 seconds at 200 GeV.