

ISOSPIN BOUNDS ON  $\pi$ N AND NN ELASTIC POLARIZATIONS  
AT HIGH ENERGIES

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Recent experimental results have been obtained on  $\pi$ N and NN elastic polarizations both at FNAL and CERN. As it is well known, isospin invariance implies some restrictions on these polarizations and we feel that these old results should be reconsidered quantitatively, in particular, at the highest available energies.

For  $\pi$ N scattering a classical result<sup>1</sup> is

$$|P_+ - P_-| < 2 \sin \omega \quad (1)$$

where  $P_+$  and  $P_-$  denote respectively the  $\pi^+p$  and  $\pi^-p$  elastic polarizations. The three unpolarized differential cross sections  $\sigma_+$ ,  $\sigma_-$ ,  $\sigma_0$  which correspond to  $\pi^+p$ ,  $\pi^-p$  and the charge exchange reaction  $\pi^-p \rightarrow \pi^0n$  must be such that  $\sqrt{\sigma_+}$ ,  $\sqrt{\sigma_-}$  and  $\sqrt{2\sigma_0}$  are the three sides of a triangle and  $\omega$  is the angle between the two sides  $\sqrt{\sigma_+}$  and  $\sqrt{\sigma_-}$ , i.e.  $\cos \omega = (\sigma_+ + \sigma_- - 2\sigma_0) / 2\sqrt{\sigma_+\sigma_-}$ . Using the experimental fact that  $\sigma_+$  and  $\sigma_-$  are much larger than  $\sigma_0$  it is obvious that

$$\sin \omega < \sin \omega_{\max} = \sqrt{\frac{2\sigma_0}{\sigma_s}} \quad (2)$$

where  $\sigma_s = \sup(\sigma_+, \sigma_-)$ . Then the bounds in (1) become

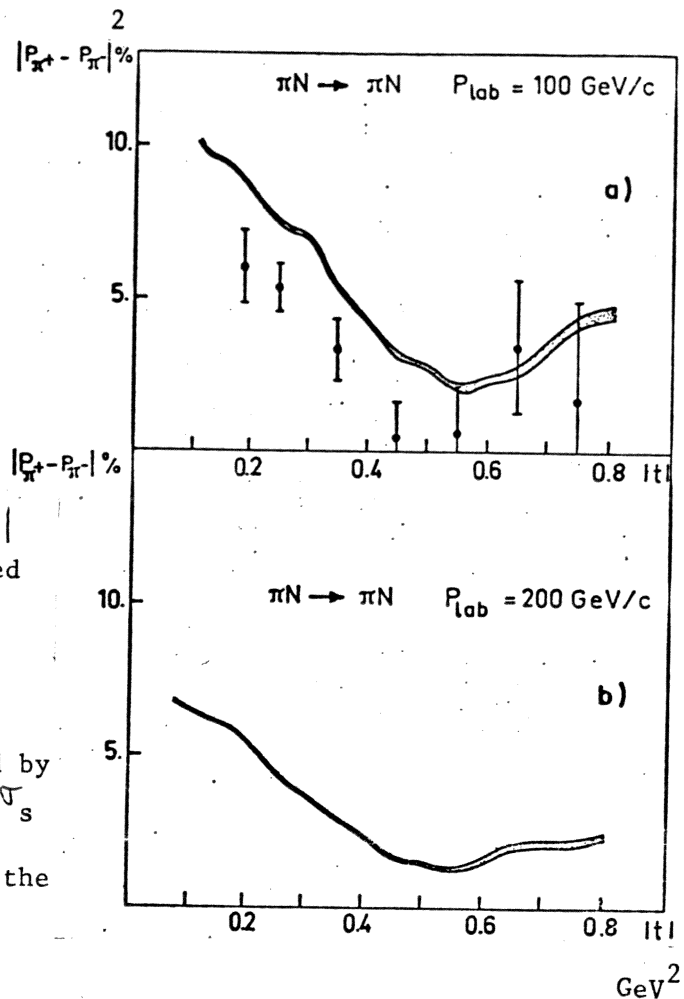
$$|P_+ - P_-| < 2 \sqrt{2} \sqrt{\frac{\sigma_0}{\sigma_s}} \quad (3)$$

valid at all energies and scattering angles.

Fig. 1

Fig.1a Bounds on  $|P_{\pi^+} - P_{\pi^-}|$  at  $p_{lab} = 100$  GeV/c compared with data from ref.2.

Fig.1b Same as before at  $p_{lab} = 200$  GeV/c. These bounds were obtained by using  $\sigma_0$  from ref.5 and  $\sigma_s$  from ref.6 and the shaded area shows an estimate of the errors.



The difference of the two elastic polarizations can be bounded knowing only the unpolarized cross sections. Moreover the size of the bound is controlled by the rapid decrease with energy of  $\sigma_0$  and is minimum at the position of the dip of  $\sigma_0$  ( $|t| \sim 0.6$  GeV<sup>2</sup>). The results are shown in fig. 1 at  $p_{lab} = 100$  GeV/c and 200 GeV/c. In fig.1a, we have compared the bound with recent data<sup>2</sup> which satisfy the constraint except at  $|t| = 0.65$  GeV<sup>2</sup>. This simple check should be made for future high energy experiments and any violation in a sizeable  $t$  range of these bounds would clearly indicate the presence of a Coulomb-nuclear interference polarization<sup>3</sup>.

For NN scattering the analogous of (3) is

$$|P_{pp} - P_{pn}| < 2 \sqrt{\frac{\sigma_0}{\sigma_s}} \quad (4)$$

where  $P_{pp}$  and  $P_{pn}$  denote respectively the pp and pn elastic polarizations,  $\sigma_0$  is the charge exchange differential cross section

and  $\sigma_s = \sup(\sigma_{pp}, \sigma_{pn})$ . Knowing  $P_{pp}$  and the differential cross section this result gives the allowed domain for  $P_{pn}$ . This is shown at  $p_{lab} = 24$  GeV/c in fig. 2, together with some  $P_{pn}$  preliminary data <sup>4</sup>. We have also calculated the bounds for the difference  $|P_{pp} - P_{pn}|$  at  $p_{lab} = 100$  GeV/c and 280 GeV/c, and the results are shown in fig. 3. A bound for  $P_{pn}$  will be obtained from these results when  $P_{pp}$  will be measured at these high energies.

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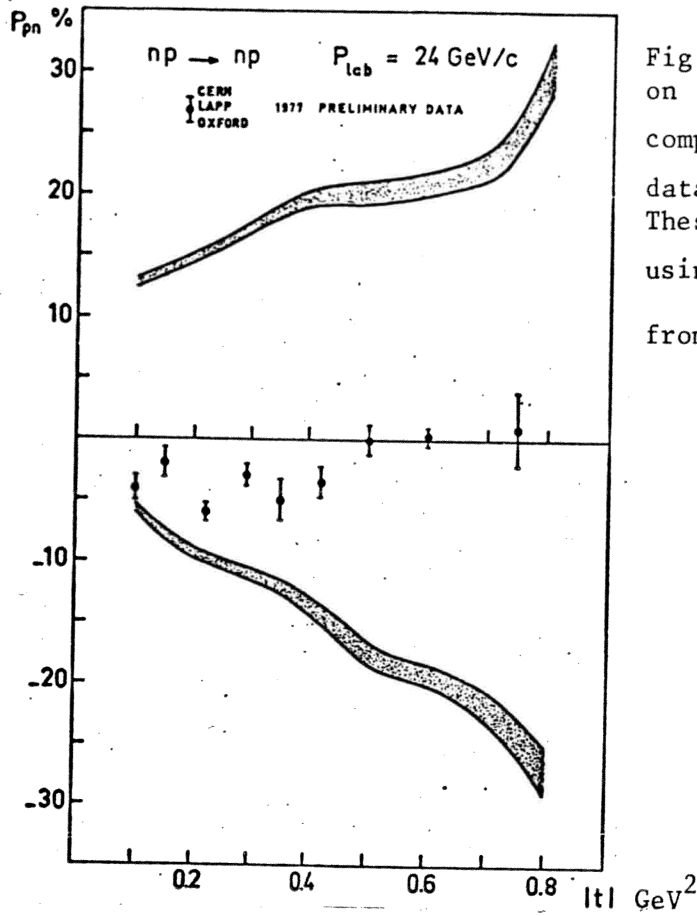


Fig.2. Upper and lower bounds on  $P_{pn}$  at  $p_{lab} = 24 \text{ GeV/c}$  compared with preliminary data from ref.4. These bounds were obtained by using  $\sigma_0$  from ref.7 and  $\sigma_s$  from ref.8.

Fig. 3. Bounds on  $|P_{pp} - P_{pn}|$  at  $p_{lab} = 100 \text{ GeV/c}$  and  $280 \text{ GeV/c}$ . These bounds were obtained by using  $\sigma_0$  from ref.9 and  $\sigma_s$  from ref.10.

