Title

K-p and pp CHARGE EXCHANGE CROSS SECTIONS BELOW 1.1 GeV/c

Author

Alston-Garnjost, M.

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M. Alston-Garnjost, R. Kenney, D. Pollard, R. Ross,
R. Tripp, H. Nicholson, and M. Ferro-Luzzi

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K^-p and $\bar{p}p$ CHARGE EXCHANGE CROSS SECTIONS BELOW 1.1 GeV/c*

M. Alston-Garnjost, R. Kenney, D. Pollard, R. Ross, R. Tripp,

LAWRENCE BERKELEY LABORATORY
University of California
Berkeley, California 94720

H. Nicholson

MT. HOLYOKE COLLEGE
South Hadley, Massachusetts

M. Ferro-Luzzi

CERN
Geneva, Switzerland
(presented by R. Kelly, LBL)

We have measured the cross sections for $K^-p \rightarrow \bar{K}^on$ at 48 momenta from 520 to 1060 MeV/c and the cross sections for $\bar{p}p \rightarrow \bar{n}n$ at 22 momenta from 270 to 960 MeV/c with a typical point-to-point precision of about 1%. The experiment was performed at the Brookhaven AGS in the low-energy separated beam and employed the apparatus shown in Fig. 1 for the $\bar{p}p \rightarrow \bar{n}n$ reaction. The incident beam was defined by scintillation counters M and S_2. For $\bar{p}p$, background mesons in the beam were rejected by time of flight between M and a counter S_1 placed at the mass slit 5 meters in front of M, by a threshold Čerenkov counter C, and by a pulse height in M. A veto box consisting of counters $A_1 \ldots A_5$ detected all reactions except those yielding neutral final states, while counters $G_1 \ldots G_5$ detected gamma rays converted by approximately one radiation length of lead placed between the A and G counters. The signature for a charge exchange reaction was an incident antiproton, $\phi = S_1 \cdot M \cdot S_2 \cdot \bar{C}$, with no signal in either the A or G counters, $\phi \cdot \bar{A} \cdot \bar{G}$. Empty target rates, typically 5% of full rates, were measured at each momentum and subtracted.

*Work done under the auspices of the U.S. Energy Research and Development Administration.

For K^- the Čerenkov counter alone was used to reject background particles. Here the kaons were identified in the differential Cerenkov mode while pions were rejected in the threshold mode. The K^-p veto box was thicker than shown in Fig. 1 and consisted of two identical layers of lead and scintillator to increase the rejection of neutral final states with gamma rays present. The reaction $K^-p \rightarrow K_L n$ was identified by the signature $\phi \cdot \bar{A} \cdot \bar{G}$.

Monte Carlo calculations were made to correct the cross sections. The major corrections were: 1) attenuation and decay (for K^-) of the beam in passing through the 16-inch hydrogen target, and 2) interactions of n, K_L, or $\bar{n}$ in the hydrogen target or the AG veto box surrounding the target.

The corrected cross sections are shown in preliminary form for K^-p in Fig. 2 and $\bar{p}p$ in Fig. 3. The K^-p exchange data agree well with bubble chamber data of much lower statistical accuracy. We note the following points: 1) There is a sharp dip in the cross section between 700 and 800 MeV/c due to interference between $\Lambda(1670)$ and the I = 1 S-wave amplitude, with evidence for a cusp-like behavior at $\Lambda\eta$ threshold (725 MeV/c). 2) Some small structure may be present near $\Sigma\eta$ threshold (889 MeV/c), while the plateau from 800 to 900 MeV/c is poorly reproduced by previous partial wave analyses.(1) 3) The large enhancement at 1050 MeV/c is due mainly to the highly elastic $\Lambda(1815)$. 4) No evidence is found for $\Sigma(1590)$ at 560 MeV/c, suggesting that its spin is at least 3/2.

The $\bar{p}p$ charge exchange cross section displayed in Fig. 3 appears to have no narrow structure but instead falls monotonically, behaving approximately as p^{-1} above 500 MeV/c. In particular there is no evidence for a bump at 475 MeV/c, where an 18-mb narrow enhancement has been reported(2) in the $\bar{p}p$ total cross section. If this enhancement is interpreted as a resonance in pure isospin state, then by unitarity our result implies that the spin of the resonance must be at least 4.

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(1) R. Armenteros et al., Nucl. Phys. B8, 195 (1968) and B14, 91 (1969); A. Lea et al., Nucl. Phys. B56, 77 (1973).

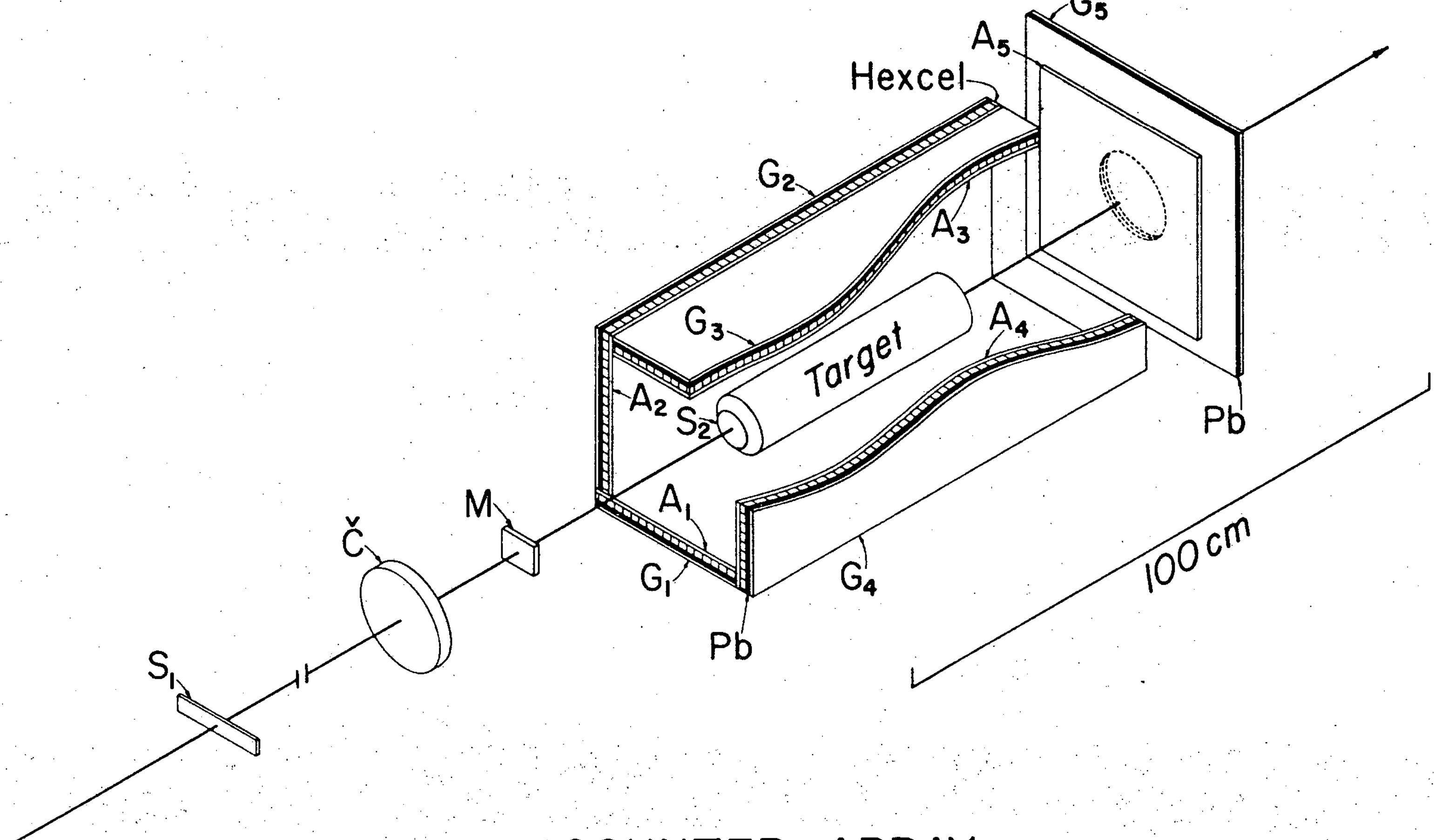
(2) A. Carroll et al., Phys. Rev. Lett. 32, 247 (1974).

Figure Captions

Fig. 1 Isometric projection of the apparatus. G_5 and its lead converter have 5-inch-diam holes through which the beam passes.

Fig. 2 Cross section for the reaction $K^- p \to \bar{K}^0 n$ vs lab momentum.

Fig. 3 Cross section for the reaction $\bar{p}p \to \bar{n}n$ vs lab momentum. The full points are from this experiment. The open circles are bubble chamber points and crosses are from a counter experiment. The dashed curve is a theoretical calculation of Bryan and Phillips. The resonance curve at 475 MeV/c is calculated from the total-cross-section results of Ref. 2 assuming J = 4, and is shown with and without our resolution folded in.



COUNTER ARRAY

XBL 755-1432

Fig. 1

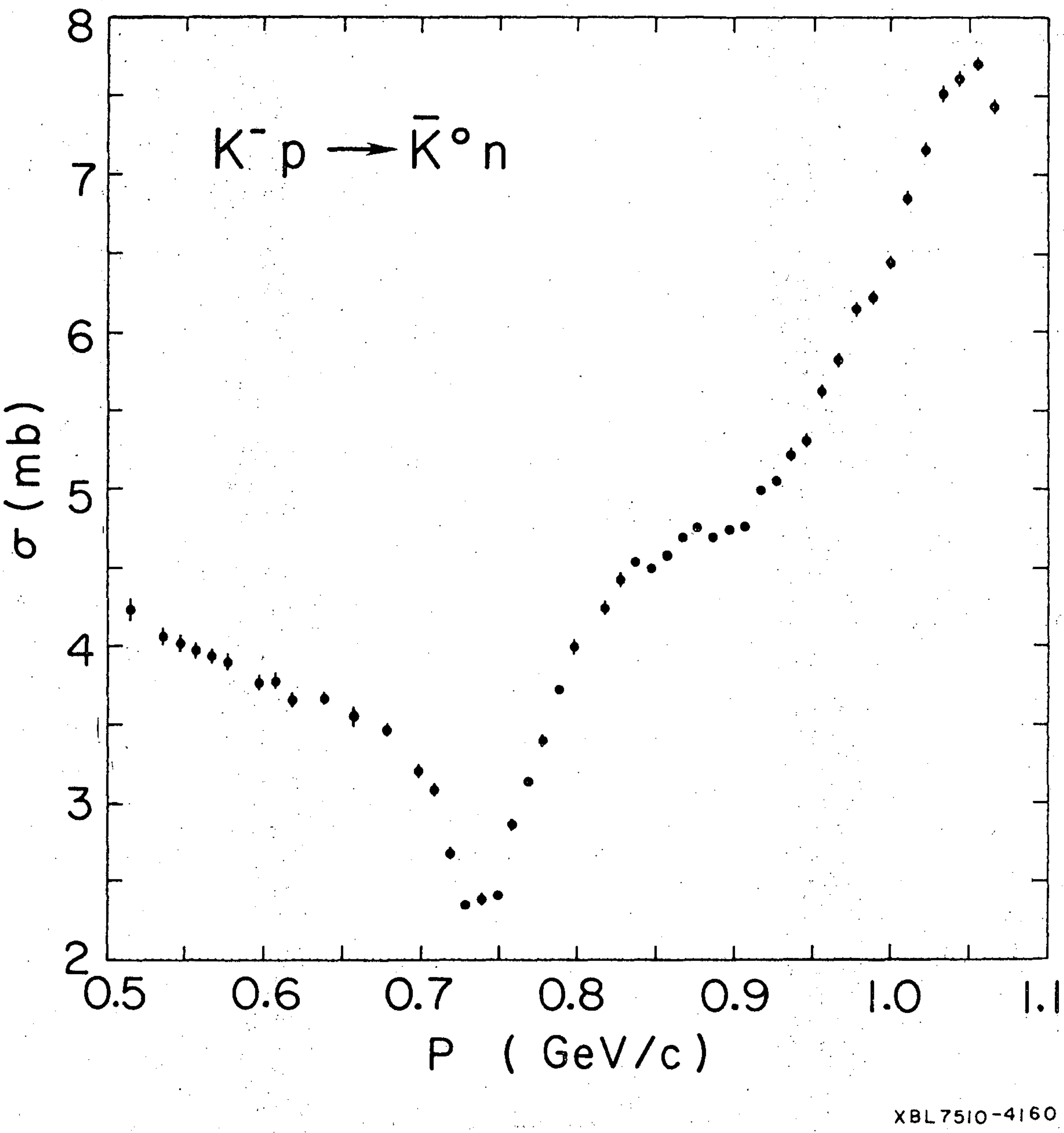
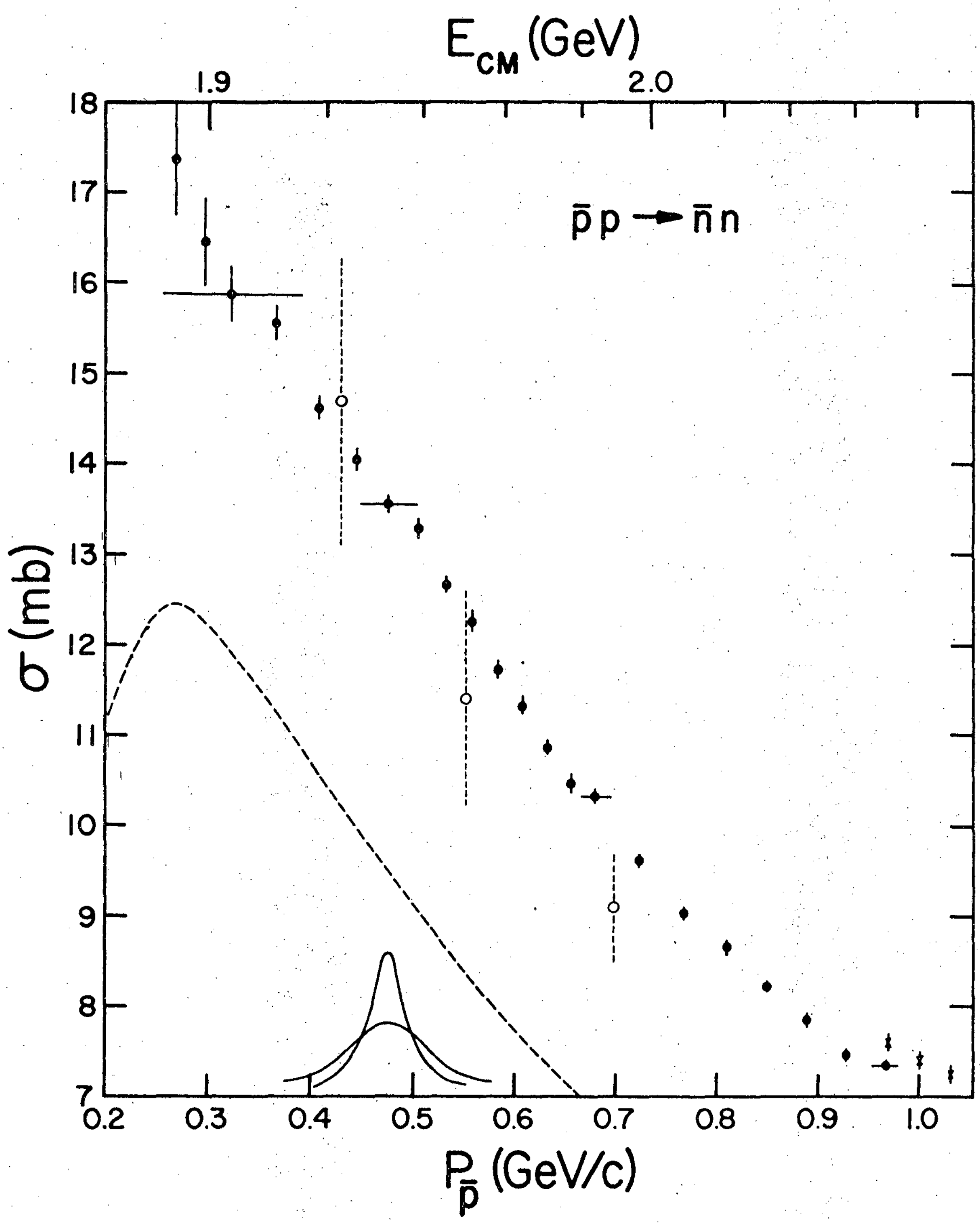


Fig. 2



XBL 756-3306

Fig. 3

TECHNICAL INFORMATION DIVISION
LAWRENCE BERKELEY LABORATORY
UNIVERSITY OF CALIFORNIA
BERKELEY, CALIFORNIA 94720