Pion pairs in nuclear matter

E. Fragiacomo[a] [1]

[a] *Istituto Nazionale di Fisica Nucleare, 34127 Trieste, Italy*

Abstract

The pion-production reaction $\pi^+ A \to \pi^+\pi^\pm A'$ as a function of A and T has been studied with the CHAOS spectrometer at the TRIUMF meson facility. Charged pion pairs have been detected in coincidence to ensure a unique identification of $\pi^+\pi^\pm$ events.

The $\pi^+\pi^-$ invariant mass $M^A_{\pi^+\pi^-}$ has been found to peak increasingly toward the $2m_\pi$ threshold as the nucleus mass number increases, while the $M^A_{\pi^+\pi^+}$ yield shows a negligible A-dependence near threshold. The $\pi^+\pi^-$ pairs have been found to predominantly couple to $S-$wave, i.e. $J = 0$. Theoretical works on the $(\pi\pi)_{I=J=0}$ interaction in nuclear matter, have shown that such enhancement is the combined effect of standard many-body correlations and the restoration of chiral symmetry in nuclear matter, i.e. the appearance of the σ-meson.

New data for the pion-production reaction on ^{45}Sc at five energies (240, 260, 280, 300 and 320 MeV) are being analysed. Preliminary results will hopefully be ready at the time of the conference. The results for ^{45}Sc at 280 MeV will directly be compared with the ^{40}Ca results, previously being published by the $CHAOS$ collaboration. The ^{45}Sc results at different energies will highlight the $T-$dependence of the $\pi\pi$ interaction in nuclear matter. Finally, the composite ratio $\mathcal{C}^A_{\pi\pi}$ between the $\pi^+\pi^\pm$ invariant masses on nuclei and on the nucleon as a function of T will also be presented.

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[1] Corresponding author, enrico.fragiacomo@trieste.infn.it