The σ meson in a nuclear medium through two pion photoproduction

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On the basis of a previously well tested model for double π photoproduction on nucleons [1], we have studied the $(\gamma, \pi^0\pi^0)$ production on nucleons and nuclei in the kinematical region where the scalar isoscalar $\pi\pi$ amplitude is influenced by the σ pole. The dropping of the σ mass as the nuclear density increases has been commonly accepted The study of the invariant mass distribution of the two final pions in a double pion production experiment could, in principle, manifest this effect. In the work [2], we implement the renormalization of the scalar-isoscalar part of the amplitude through a Bethe-Salpeter like equation using the results of [3] for the $\pi\pi \to \pi\pi$ scattering amplitude in the nuclear medium in I=0. On the other hand, the treatment of the final pions distortion in their way out through the nucleus is of crucial importance since it has much influence in the effective density seen by the reaction. For this reason it has been carefully studied. In the figure we can see the results for the 2π invariant mass distribution for ^{12}C and ^{208}Pb. The difference between the solid and dashed curves is the use of the in medium $\pi\pi$ amplitudes instead of the free ones. We can appreciate a shift of the strength to low invariant mass region due to the in medium $\pi\pi$ interaction. The results obtained in this work, prior to any experiment, have been recently corroborated, both in shape and in strength in a recent experiment [4] at Mainz. This is a clear manifestation of the droping of the σ pole to smaller mases as the density increases.

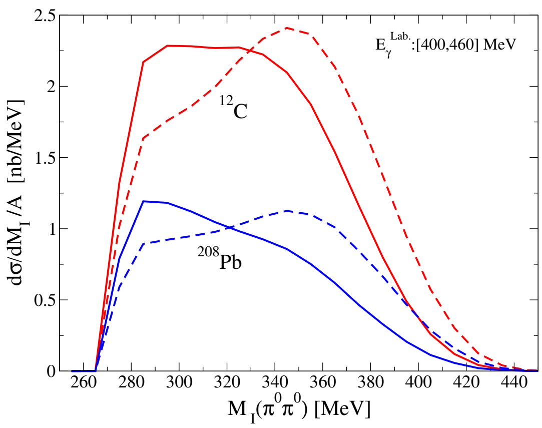

Figure 1: Two pion invariant mass distribution for $2\pi^0$ photoproduction in ^{12}C and ^{208}Pb. Continuous lines: Using the in medium final $\pi\pi$ interaction. Dashed lines: using the final $\pi\pi$ interaction in free space.

References

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