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PION-OXYGEN SCATTERING IN THE FOUR-α-PARTICLE MODEL

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Many theoretical studies have been devoted to pion-nucleus scattering in the past decade. Most of these studies used first-order π-nucleus optical potentials defined in the multiple scattering theory of KMT. Others also included second-order effects, which unfortunately could only be achieved either phenomenologically or approximately. On the other hand, for nuclei such as ^{12}C and ^{16}O which can be regarded as being made up of α-clusters, one could regard the α-particles as the scatterers and utilize the π-α amplitude (directly from fitting data) as basic input to construct a theoretical π-nucleus optical potential. In this way, various higher-order effects (in particular true π-absorptions) would be "automatically" included to a certain extent.

In this model, the first-order π-nucleus optical potential is given by

$$\langle \vec{k}' | U_{opt} | \vec{k} \rangle = -(N-1) \frac{1}{4\pi^2 \mu} f_{\pi\alpha}(q) \eta_\alpha(q) \qquad (1)$$

where $f_{\pi\alpha}$ is the π-α amplitude, and η_α the form factor representing the α-particle distribution in the nucleus.

Here, we present some preliminary results for $\pi^{-16}O$ scattering. $f_{\pi\alpha}(q)$ is taken from reference (1), and $\eta_\alpha(q)$ from a model of α-particle structure of the nucleus.[2] Differential and total cross sections have been calculated from low energy to the (3,3) resonance region. Some of these results are shown in Fig. 1 and 2. In view of the fact that this is a parameter-free calculation, the results are rather satisfactory. (As is well known, first-order optical potentials using π-N amplitude as input fail badly in the low energy region.)

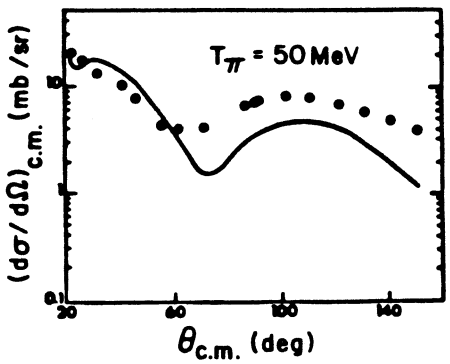

Fig. 1

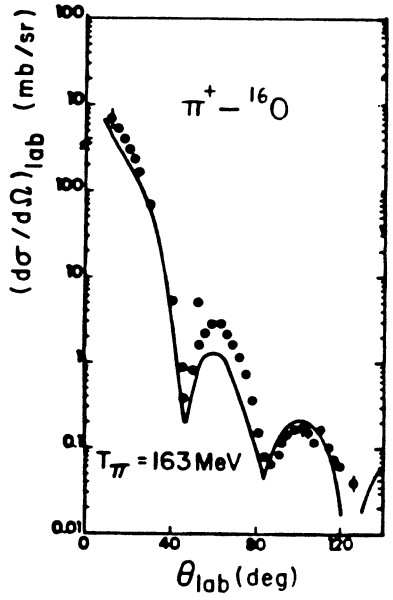

Fig. 2

References

1. F. Binon et al., Nucl. Phys. A298 (1978) 499.

2. Li Qing-run et al., Physica Energiae Fortis et Physica Nuclearis 5 (1981) 531.