Title
PHOTO-PRODUCTION OF NEUTRAL MESONS FRCM DEUTERIUM

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The manner in which neutral mesons are coupled to nuclear matter may be determined by an experimental study of the photo-production of neutral mesons from deuterium. This follows from the fact that the radiated meson waves may differ in phase depending on whether they arise from neutron or proton. The relative phase of this radiation is clearly controlled by the algebraic sign of the coupling. Thus, for meson wave lengths comparable to the separation of the particles in the deuteron large interference effects may be expected.

Near threshold meson production may be expected to lead to deuteron formation. For this case interference effects will be large. At higher energies continuum states will be favored and the interference will be less.

We have calculated the cross section for neutral meson production when a deuteron is formed in the final state. The pseudoscalar meson theory with pseudovector coupling has been assumed, and we have treated the process according to perturbation theory. Although there is no straightforward way to do this we have attempted

to incorporate higher order meson processes by using the anomalous moments of the nucleons. Specifically, effects due to exchange currents have been neglected but by using the anomalous moments we have, in a sense, included those virtual mesic effects not due to the presence of a second nucleon. The nucleons have been treated non-relativistically and for simplicity the deuteron wave function has been taken as a Gaussian. In addition to this we have used plane waves in the intermediate states. The results are given in Fig. 1. It is found, as one might expect, that the principal contribution to the cross section is proportional to $(g_p \mu_p + g_n \mu_n)^2$, the square of the interaction energy. If g_n and g_p are of opposite sign this term is larger than when they are the same. For $|g_n| = |g_p|$ the ratio between the two cases is 30. There is a difference in angular distribution but it is slight. We can expect our total cross section to be smaller than the correct value[1,2] if the coupling constant is chosen to be 1/2 (either $g_p^2/\hbar c$ or $g_n^2/\hbar c$). However, the ratio of the cross sections for the two cases should be correctly given.

This experiment would have interesting implications regarding the charge independence of nuclear forces since the symmetrical meson theory, the most elegant designed to yield this result, requires $g_n = -g_p$.

This work was performed under the auspices of the Atomic Energy Commission.

REFERENCES

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2. K. Brueckner and K. Case, Phys. Rev. 83, 1141 (1951).

FIGURE CAPTION

Figure 1. The differential cross section in the laboratory system for photo-production of neutral mesons in deuterium.

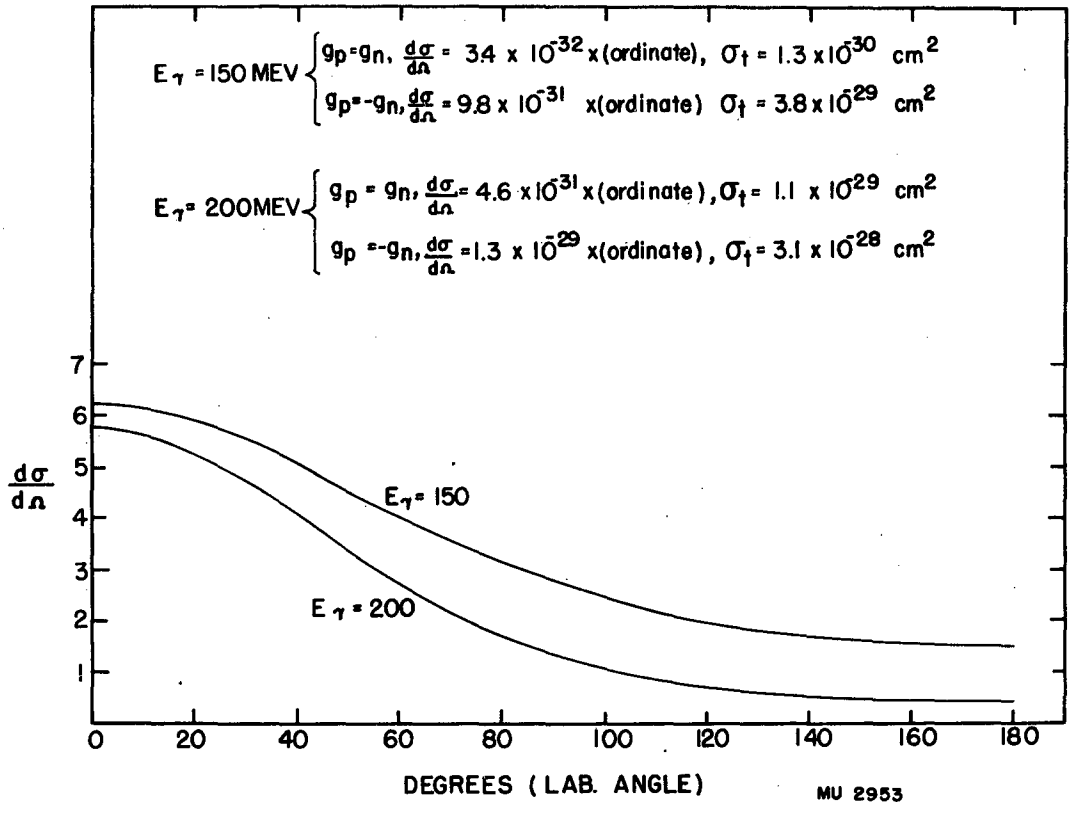
E_γ = 150 MEV
$g_p = g_n$, $\frac{d\sigma}{d\Omega}$ = 3.4 x 10^{-32} x(ordinate), σ_t = 1.3 x 10^{30} cm^2
$g_p = -g_n$, $\frac{d\sigma}{d\Omega}$ = 9.8 x 10^{-31} x(ordinate) σ_t = 3.8 x 10^{29} cm^2
E_γ = 200MEV
$g_p = g_n$, $\frac{d\sigma}{d\Omega}$ = 4.6 x 10^{31} x(ordinate), σ_t = 1.1 x 10^{29} cm^2
$g_p = -g_n$, $\frac{d\sigma}{d\Omega}$ = 1.3 x 10^{29} x(ordinate), σ_t = 3.1 x 10^{28} cm^2
$\frac{d\sigma}{d\Omega}$
E_γ = 150
E_γ = 200
DEGREES (LAB. ANGLE)
MU 2953

Fig. 1