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THEORY OF PROTON COMPTON SCATTERING

MASTER

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We wish to report the preliminary results of a quantitative calculation of the differential cross-section for proton Compton scattering using a fixed angle dispersion relation formalism previously reported.⁽¹⁾ This process has the advantage over most of the well known strong scattering processes in that the imaginary part of the scattering amplitude in a two particle approximation involves the amplitude for Compton scattering only in order e^4 , which may be neglected, and, furthermore, all necessary subtraction

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constants in fixed angle dispersion relations appear to be derivable from the low energy limit. In principle, then, a no parameter fit is possible at low energies provided detailed information is known about the two particle intermediate state processes involved. Unfortunately, not all of this is available from experiment.

The most important contribution comes from the photoproduction amplitudes. These have been included by using a model for neutral and positive pion photoproduction recently proposed by Gourdin and Salin,⁽²⁾ which gives a very accurate fit up to nearly 1 BeV by including the following terms+

- (i) The full relativistic photoproduction Born terms,
- (ii) Relativistic Breit-Wigner resonance formulas to fit the two pion-nucleon resonances in this region,
- (iii) A constant s-wave contribution up to 600 MeV and a slowly varying p-wave contribution from 500 MeV upwards, which are sufficient to account for non-resonant effects and peripheral vector meson exchanges.

Salin emphasizes that all terms are necessary to obtain a correct fit to photoproduction experiments, and we have accordingly plotted in the figure the effect on Compton scattering of varying amounts of this model at 90° barycentric scattering angle. Note that the graph does not include the peripheral exchange contributions to Compton scattering of the π^0 and η , or the two pion contribution for which our numbers are not yet reliable. Curve A includes both the resonances and the s-wave projection of the photoproduction Born terms, which is roughly equivalent to the model used in previous calculations of this

process, although Mueller⁽³⁾ estimated the effect of the single pion exchange in photoproduction in his calculations. Curve B shows the effect of including the full Born terms and resonances, and Curve C the full model.

The effect of π^0 exchange can also be estimated, and has been discussed before. Its effect is not able to explain the systematic discrepancy between theory and experiment in the medium energy region. An estimate of η exchange indicates that this too is a small effect in this region.

Thus if theory and experiment are to agree, a relatively large two-pion exchange contribution is to be expected. Preliminary results indicate that this may indeed be true. (It should be remembered that neither the ρ nor the ω can contribute to the process.)

The calculations have also been taken up to 800 MeV, the limit of available photoproduction information. It is interesting to note that the results at 90° fit qualitatively up to the peak of the second resonance shown in the recent experiments by Deutsch, Loh, and Steining.⁽⁴⁾

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FIGURE CAPTION

Differential Cross-section for Proton Compton Scattering at 90° Barycentric Angle, showing the effect of including varying amounts of the Gourdin-Salin model for photoproduction. Peripheral exchanges are not included.

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