4c. Comparison of Positron-Proton and Electron-Proton Elastic Scattering

Summary

The data from Experiment 4a. will separate the electric and magnetic form factors of the proton through an analysis assuming the validity of the first order Born approximation (one-photon exchange). Two-photon exchange processes can be directly investigated in electron-proton elastic scattering by measuring the ratio of positron-proton to electron-proton scattering. Such results will not only be interesting in themselves but will provide useful information to assist the analysis of the data from Experiment 4a.

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Approved: 13 February 1966, 100 hrs

Approved: 12 August 1967, 100 hr extension

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Supplement No. 1 to
SLAC Proposal No. 4 - C.

DATE: 12 July 1966

TO : M. Sands

FROM : R. Taylor R.E.T.

SUBJECT: Comments on Proposal 4c - Comparison of Positron and Electron Scattering from Hydrogen.

Since the last meeting of the PAC, an experiment at CEA (Hand and Engels), similar to that proposed by our group but at lower q^2(20 and 36 F^{-2}) has shown a 2-standard deviation's excess of σ_+ compared with σ_-.

We feel that the higher q^2 measurements now may be crucial in detecting a two photon contribution to the scattering, since as long as the ratio is close to unity there is always the possibility of errors in the absolute values of the corrections. A measurement of the q^2 dependence of deviations of the ratio from unity will give confidence that the effect truly arises from 2 photon contributions.

In the last meeting of the PAC 100 hours of time was allotted for data gathering in this experiment. We hope that some of the additional time originally requested can be allotted at a later date. We feel that some time will be required for experimental tests beyond that required for the positron beam, which will presumably be accomplished during the time scheduled for "accelerator" check-out and tune-up. Some time may be available for check-out during the positron beam tests, but we feel that 25 hours of check-out at 60 cycles will be necessary. We realize that this may require a reduction in the data time of 100 hours already allotted for the first scheduling period.

RT:as

MS 7/13/66

Supplement No. 2 to SLAC Proposal 4c.

DATE: 1 November 1966

TO : M. Sands

FROM : H. DeStaebler

SUBJECT: Comments of SLAC Proposal 4c.

In the original proposal we asked for 50 hours of shake-down time and 200 hours of data taking time; we were allotted 100 hours. Our original program consisted of roughly 10 measurements of σ_+/σ_- with errors $\lesssim \pm 4\%$ at various angles with $q^2 \lesssim 4(\text{BeV/c})^2$ followed by measurements up to higher $q^2 \lesssim 12\ (\text{BeV/c})^2$ with decreasing accuracy. A reasonable way to truncate this program is to reduce the maximum value of q^2 to perhaps $8\ (\text{BeV/c})^2$ since the predicted counting rates drop rapidly as q^2 increases, and to decrease somewhat the amount of data at low q^2.

The present experimental situation on σ_+/σ_- continues to be ambiguous. The recent Cornell experiment is quite consistent with $\sigma_+ = \sigma_-$ (4 points up to $q^2 = 0.8\ (\text{BeV/c})^2$). The preliminary Harvard points have not changed; σ_+ exceeds σ_- by about two standard deviations at q^2 of 0.7 and 1.4 $(\text{BeV/c})^2$. The remaining world data tend to favor a slope through the Harvard points rather than $\sigma_+ = \sigma_-$.

The q^2 variation of σ_+/σ_- is interesting for its own sake and because it bears on the single photon exchange interpretation of electron scattering. We feel that our experiment will contribute significantly toward clarifying the situation and that the high q^2 points may be important in this respect.

What we will want to do in the next period depends almost entirely on what we find in the first 100 hours. For example, if we complete our truncated program satisfactorily and find no hint of an interesting deviation, we might

M. Sands
Comments of SLAC Proposal 4c.

1 November 1966.

feel that the experiment was too uninteresting to pursue. However, it feels very unlikely that 100 hours with brand new equipment will be enough to satisfy scientific interest in σ_+/σ_-, and we request 150 hours in the next scheduling period to continue the experiment.

HDeS:as

RET