

LOI12-18-004

Title: Physics with Positron Beams at Jefferson Lab 12 GeV

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Motivation: There are three general areas that motivate this proposal. 1) Two-photon contribution to ep scattering. The Q^2 dependence of G_{Ep} has been an important puzzle for over a decade. The advantage of JLab measurements is the access to higher Q^2 than existing measurements. 2) Having positron and electron data will make it possible to separate the different contributions to the cross section of the lepton production of photons, significantly improving the determination of the nucleon Generalized Parton Distributions (GPDs). The proponents foresee an impact, for instance, on the determination of the GPD E, related to quark angular momentum, on the so-called D-term, related to the radial pressure inside the proton. 3) The dark photon (A') search part of the LOI proposes a PADME-like experiment at JLab, looking for a monoenergetic photon from $e^+e^- \rightarrow \gamma A'$. It is certainly a unique process that can be done with a positron beam on a fixed target. In addition, any results will be independent of the A' lifetime. The projected sensitivity to the dark photon mass and its coupling to electrons is beyond current results.

Measurement and Feasibility: The beam time request is 525 days, but there is no accounting for parallel running. The A' search has the largest request of 180 days. While the A' search requires a separate detector, the other measurements use detectors which exist now or are being installed.

Issues: A primary issue is the impact on the laboratory and the already-approved experimental program. The proposers should work out a plan with lab management. The difficulties in developing a technique for fast switching between e^+ and e^- could be large, as would be the impact on the existing program. Specific issues, relevant to the three areas outlined above, include the following: 1) Differences between e^+p and e^-p are expected to be about 10% (see Fig. 20). This puts a significant constraint on the accelerator conversion between e^+ and e^- and back again. 2) Differences between e^+p and e^-p are expected to be up to 0.5 (see Fig. 29). This is likely more feasible than 1). 3) This is a discovery experiment. Most of the potential sensitivity region of the proposed experiment will be covered by NA64 in a few years and will be completely covered by Belle-II in 5-10 years. Therefore, this proposed experiment will have to be scheduled accordingly.

Summary: These measurements all have significant physics interest. The proposers should carefully evaluate feasibility and present the best case possible in a future proposal. The justification must be very strong to enable the significant changes needed in the accelerator, both in equipment and in schedule. Any proposal should have a section on the linkage between a realistic plan for beam and the way the measurement is made.