

RESEARCH PROPOSAL TO CEBAF

Search for Free Quarks

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Abstract

A conceptually new search for fractionally charged particles, free quarks, is proposed. Unlike all previous experiments, the experiment will be able to detect quarks if: 1) Their interaction length, λ , with normal matter is as small as $\lambda \approx .05 \text{ g/cm}^2$; and/or 2) Their energy loss per g/cm^2 is much larger than that expected from just electromagnetic interactions.

The experiment is separated into two phases. In the first phase, this proposal, we will search for negatively charged particles whose apparent momenta are above the beam momentum, if they have integer charge. Such particles must be fractionally charged. The experiment will also be sensitive to such particles even if they have very short interaction lengths with matter. A high momentum magnetic spectrometer (the HMS spectrometer in Hall C) will be used. If such particles are observed, we will propose, in a second phase, to measure their mass/charge ratios.

A measure of the sensitivity of the experiment is as follows. Suppose the quark escapes from the nucleon bag (becomes free) with a probability $PE_q \approx 10^{-3}$ per "hard collision." This corresponds to the best limit placed by previous experiments which searched for quarks with very short interaction lengths (P.F. Smith, Ann. Rev. Nucl. and Part. Sci. **39**, 73 (1989) and L. Lyons, et al., Z. Phys. C **36** 363 (1987).) For $PE_q \approx 10^{-3}$ the