

3.19 TENSOR POLARIZATION MEASUREMENT OF THE RECOIL DEUTERON IN ELASTIC ELECTRON DEUTERON SCATTERING

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We intend to measure the tensor polarization moments of the recoil deuteron in the range between $q^2 = 14$ and 26 fm^{-2} . With these measurements, important new constraints will be placed on the deuteron form factors. A high-efficiency deuteron polarimeter, based upon d-p elastic scattering, will be constructed for this experiment, in addition to a high-power liquid deuterium target and a deuteron transport channel.

A complete understanding of the deuteron would include information on its charge (G_C), quadrupole (G_Q) and magnetic (G_M) form factors as a function of momentum transfer, q . Elastic e-d cross section measurements yield information for G_M but cannot separate G_C from G_Q ; to do so requires a measurement of an observable involving a different combination of the form factors. Two such observables are t_{20} and $t_{21}^{(1)}$, tensor polarization components of the recoil deuteron following elastic e-d scattering. The only extant experiment involving the measurement of tensor polarization is one carried out at $q^2 = 3.02$ and 4.12 fm^{-2} ²⁾. The lack of a suitable polarimeter limits the extension of such measurements to higher q where one expects to learn about such non-nucleonic degrees of freedom as meson exchange currents, N^* and $\Delta\Delta$ components and six quark components in the deuteron, etc.

An extensive survey of the deuteron tensor-analyzing powers of exclusive and inclusive reactions with several targets has been carried out at LNS/Saclay ³⁾ ($T_d = 191, 395 \text{ MeV}$) and at Indiana ⁴⁾ ($T_d = 80 \text{ MeV}$). As a result and for the first time, a high efficiency T_{20} polarimeter ($\geq 10^{-3}$ efficiency with $|\bar{T}_{20}| \approx .4$) is possible and is being constructed at Alberta. The polarimeter is based on d-p elastic scattering with an operating range of $T_d = 100 - 280 \text{ MeV}$. It will be calibrated for the analyzing powers $iT_{11}, T_{20}, T_{21}, T_{22}$ at LNS/Saclay in mid-1986.

The polarimeter shall be used for a $d(e, e' \bar{d})$ experiment at Bates ⁵⁾ where the tensor polarization components of the recoil deuteron shall be measured at $T_e = 650, 750, 850, 950 \text{ MeV}$ ($q^2 = 14 - 26 \text{ fm}^{-2}$). The construction of a 7 cm long LD_2 target capable of withstanding $50 \mu\text{A}$ average electron current is being planned at Bates. A deuteron transport channel, capable of collimating all elastically scattered deuterons that are in coincidence with electrons detected in the OHIPS spectrometer, will be assembled as well. The channel, in conjunction with a carbon energy-wedge degrader, will reduce contaminant protons entering the polarimeter to low, acceptable levels.

We plan to acquire 1000 events per energy requiring a total of 724 hours (including overhead) which yields an estimated statistical precision for t_{20} of .08 to .12. The first measurements at Bates are anticipated in late 1986 following the energy upgrade of the accelerator.

References

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