

ELECTROMAGNETIC PROCESSES

ANALYSIS OF DATA FOR DEUTERON TENSOR POLARIZATION IN ELECTRON-DEUTERON SCATTERING

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A high efficiency deuteron polarimeter developed at the University of Alberta and calibrated at the Laboratoire National Saturne was used to measure the tensor polarization of recoil deuterons in electron-deuteron scattering at the MIT-Bates Lab in 1987-88.¹ Data were taken at incident electron energies of 650, 750, and 850 MeV and constitute by far the highest Q^2 measurements to date. Several on-line modifications necessitated by the hostile radiation environment have made analysis of this data much more complicated than originally anticipated. Additional shielding added at the higher two energies required a relocation of some of the polarimeter detectors. In addition the deuteron energies incident on the polarimeter at Bates were midway between calibration points. A Monte Carlo simulation program was developed and calibrated using the LNS data. This was then used to make the adjustments necessary to predict the polarimeter response. Analysis of the data are now essentially complete. Work continues to determine the systematic errors due to Monte Carlo modeling and to various software cuts on the Bates data. These systematic errors are tentatively estimated to be between 0.1 and 0.15. The preliminary results at the three energies are shown in Fig. 1. The data clearly indicate that the tensor analyzing power is not at its perturbative QCD expectation value of $-\sqrt{2}$ and that the prediction of the full Bonn potential² including meson exchange corrections and relativistic effects give a good account of the deuteron structure.

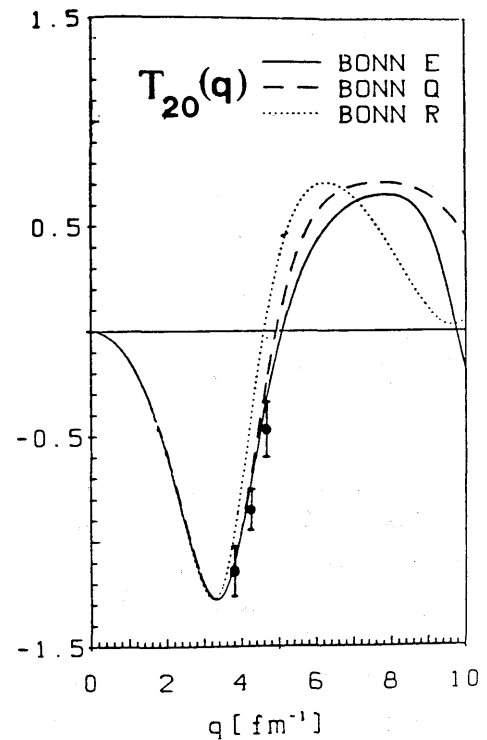


Figure 1. Deuteron tensor polarization data. The results of the present experiment are shown as solid dots. The error bars include only statistical uncertainties. The calculations are for three versions of the Bonn Potential and include both meson exchange current and relativistic effects.²

1. M. Garcon *et al.* in *Spin Observables of Nuclear Probes, 1988* edited by C.J. Horowitz, C.D. Goodman, and G.E. Walker (Plenum Press, 1988) p.357.
2. J. Pauschenwein, L. Mathelitsch and W. Plessas, Nucl. Phys. **A508** (1990) 253c.

DIELECTRONIC RECOMBINATION IN He^+ IONS*

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Dielectronic recombination (DR) is an atomic collision process which involves electron capture accompanied by simultaneous ionic excitation, i.e., an inverse Auger transition. We have investigated DR for $1s \rightarrow nln'l'$ transitions in $\text{He}^+ + e^-$ collisions¹ at IUCF using the ion storage ring and the electron Cooler in a "single pass" mode, i.e., the ions circled the magnet, and then are collected in a Faraday cup. A beam of 44 MeV $^3\text{He}^+$ ions (current ~ 300 nA) was merged with the electron cooling beam (current ~ 0.2 A) over an interaction length of ~ 2.8 m. Events resulting in DR were detected by observing neutral He atoms produced in the electron Cooler. These atoms, which exited through a 0° port following the cooler region, were observed with solid-state detectors in a dE/dx arrangement thereby allowing particle identification to separate the He atoms from background events.

For $\text{He}^+ (1s)$ ions DR is expected to occur for relative energies of 33–39 eV between the ion and electron. By ramping the relative electron energy from $-50 \text{ eV} \leq E_{\text{rel}} \leq +50 \text{ eV}$, DR maxima were observed for electron velocities less and greater than the ion beam velocity, respectively. Between these DR maxima, a peak due to radiative recombination (inverse phototelectric effect) was observed for $E_{\text{rel}} = 0$. A typical spectrum is shown in Fig. 1. Maximum counting rates at the DR maxima were about 10 Hz and the signal to noise ratio was about 18:1. Due to a hardware problem, the electron beam energy resolution (about 20 eV in the projectile frame) was insufficient to resolve individual transitions due to DR. New measurements are planned with this problem corrected, and it is anticipated that the resolution will be sufficient to observe these individual transitions.