CEBAF Experiment 89-044

# Selected Studies of the $^3$He and $^4$He Nuclei through Electrodisintegration at High Momentum Transfer

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Coincidence experiments have proven to be very useful tools to study specific aspects of the nucleus. In particular the *(e,e'p)* reaction has been used not only to study the single nucleon structure of nuclei but also to study the behaviour of nucleons embedded in the nuclear medium. The high energy, high duty cycle beam at CEBAF will allow us to fully develop such studies: (i) to extend the domain of momentum transfers towards higher values where short range effects and possibly the internal structure of the nucleons are manifested, (ii) to explore nuclear structure in its extreme conditions, by focusing on the high momentum part of the wave functions, and (iii) to increase the specificity of the probe by separating the response functions associated with different polarization states of the virtual photon.

We propose to exploit these new possibilities by undertaking a series of *(e,e'p)* measurements on the Helium isotopes. Next to the deuteron, the A=3 and A=4 nuclei are the simplest systems in which all the basic ingredients of a complex nucleus exist. Sophisticated methods to solve the Schrodinger equation almost exactly have been applied to the A=3 nuclei and have been extended recently to $^4$He[1] . Microscopic calculations of FSI and MEC contributions have been developed and applied to reactions on few nucleon systems[2] . For both $^3$He and $^4$He, a substantial body of coincidence data exists, including accurate measurements of the recoil momentum distribution for the 2-body break-up, up to 400 (350) MeV/c in $^3$He ($^4$He). One expects much of the work at $Q^2$ 1 (GeV/c)$^2$ to be performed at the existing laboratories, over the next few years. These studies can only be extended into the most interesting high $Q^2$regime at CEBAF.

We propose to investigate three specific aspects of the electromagnetic response of $^3$He and $^4$He through *(e,e'p)* coincidence measurements at $Q^2$values from 0.4 to 4.1 (GeV/c)$^2$. In Part 1, we propose to study the single nucleon structure of the He isotopes with special emphasis on high momenta (up to q = 0.8 GeV/c) by the separation of the $R_L$ $R_T$ and $R_{LT}$ response functions in constant $(\vec{q},\omega)$ kinematics. The $Q^2$dependence of the reaction will be examined in Part II by performing longitudinal/transverse (L/T) separations for protons emitted along $\vec{q}$, up to $Q^2$= 4.11 (GeV/c)$^2$ at quasifree kinematics ($p_m$ = 0) and for $Q^2$= 0.5 and 1 (GeV/c)$^2$at $p_m$ = ±0.3 GeV/c. In Part III, we focus on the continuum region to study correlated nucleon pairs. Measurements at $Q^2$= 1 (GeV/c)$^2$ and recoil momenta up to 1 GeV/c are proposed, including separations of the in-plane structure functions for $p_m \leq 680$ MeV/c.

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[1] R. Schiavilla *et al.*, Nucl. Phys. **A449**, 219 (1988).
[2] J.M. Laget, Phys,. Lett. **B199**, 493 (1987).