I. Physics Motivation

Electron scattering has already been used for decades to measure the form factors of the proton and the neutron. The proton electric and magnetic form factors as well as the neutron magnetic form factor have been measured to high precision for Q^2 values up to several GeV^2/c^2. However, our knowledge about the electric form factor of the neutron is quite unsatisfactory. This quantity is of fundamental theoretical interest, since it can serve as test for QCD based calculations. It is known from neutron-electron scattering that the slope of G_E^n is positive at $Q^2=0$, which implies an internal charge distribution of the neutron. So far most of the existing data on G_E^n were obtained from elastic and quasielastic scattering off deuterons. Here the model dependence of G_E^n on the deuteron wave functions is a fundamental limit for these kind of measurements. As polarized ^3He targets have become available for nuclear physics experiments, the neutron form factors can be extracted from asymmetry measurements, which are favourable over cross-section measurements, since the systematic uncertainties can be reduced significantly. Recently, a new series of measurements has been launched at different laboratories using polarized ^3He in inclusive and exclusive reactions to extract the electric and magnetic form factors of the neutron ([1]-[4]). There has also been a first attempt to extract G_E^n by measuring the (sideways) polarization transfer to the neutron in the $d(\vec{e}, e'\vec{n})p$ reaction [5]. This experiment allows in principle a direct way of extracting G_E^n in PWIA, when one stays in a kinematical regime where FSI and MEC contributions are kept small. However, one needs a well calibrated neutron analyzer system, to determine the polarization transfer to the neutron. This reduces the efficiency of the neutron detector. Several experiments have been proposed or already been performed to study the neutron spin structure in the deep inelastic regime. For example, the E142 collaboration at SLAC used polarized ^3He to extract the deep inelastic spin structure functions g_1^n and g_2^n of the neutron [6] whereas the SMC collaboration at CERN used deuterons for extracting the same quantities [7]. The HERMES collaboration is going to use both, ^3He and ^2H [8]. Since the knowledge of the structure of the neutron is of fundamental imoprtance for nuclear physics, several nuclear probes should be used to study the form factors. Effects like medium modifications on the form factors are unknown in this kinematical regime and have to be studied in detail. The EMC effect is a good example that the influence of the surrounding medium can be sizeable. Therefore, we propose to measure G_E^n using a polarized ^3He target at three different values of the 4-momentum squared, namely Q^2