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Helicity Dependence in Photodisintegration of the Deuteron

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Abstract. The weak proton neutron interaction can be studied through parity violation in deuteron photodisintegration. The experiment's feasibility is presently under study. The intensity and polarization of the electron beam at CEBAF allow to produce a record intensity of circularly polarized beam of a few MeV photons ($\sim 10^{15}$ per second). The status and the program of development will be presented.

Weak nucleon-nucleon forces were parameterized with weak meson-nucleon coupling constants about 20 years ago [1]. The links between a large body of experimental observables such as polarized pp scattering, nuclear decays, neutron capture, hyperon decays and many others are based on these six (or seven) coupling constants. The accurate determination of coupling constants is very essential for the test of present theoretical framework which is based on QCD and further understanding of the hadronic interaction.

The deuteron provides a very effective laboratory for the study of parity violating effects because it has a well established structure at the relevant energy/momentum range.

The PNC asymmetry in the total cross section of $D(\vec{\gamma},n)p$ reaction is [2]:
$A_{circ}(\omega) = \alpha \cdot g_\rho h^0_\rho + \alpha' \cdot g_\omega h^0_\omega + \beta \cdot g_\rho h^2_\rho + \gamma \cdot (g_\rho h^1_\rho - g_\omega h^1_\omega) + \gamma' \cdot g_\rho h'^1_\rho + \delta \cdot g_\pi f'_\pi$.
The value of δ is growing fast with photon energy and is making the pion contribution to dominate from 1 MeV above the disintegration threshold. For the DDH "best guess" weak meson-nucleon coupling constants $A_{circ} \sim 2.5 \cdot 10^{-8}$ at $E_\gamma = 10\,MeV$. The proposed experiment can be done at JLab by using the polarized electron beam from the CEBAF injector.

Below we outline the major parameters of the proposed apparatus:

- the beam polarization P_e is $\sim$ 80%.

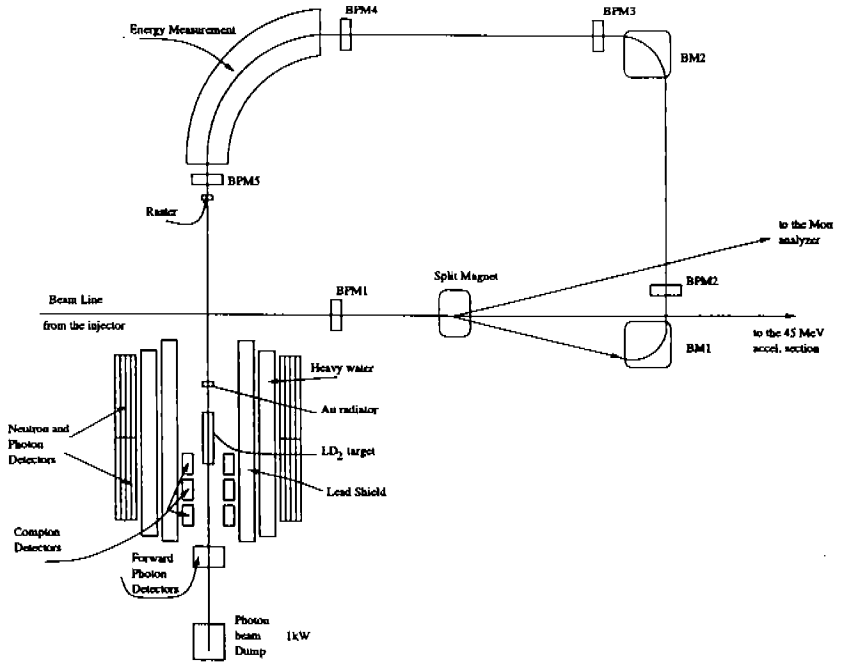

FIGURE 1. Schematic view of the $D(\vec{\gamma}, n)p$ experiment at JLab.

- the beam current is $\sim$ 1 mA.
- the beam energy is 8.1 MeV.
- the beam spot size is 2-3 mm, achieved by the use of a rastering scheme.
- the photon production target is made of a 0.75 mm Au plate.
- the liquid deuterium target is 25 cm long.
- photon detectors at large angle will detect Compton scattering, which allow to control systematics errors of the experiment.
- the photon detectors located in the forward direction will be used to measure the intensity and angular distribution of the photon beam.

The expected high counting rate of the neutron detectors ($\sim 10^{12}$ Hz) will aid in the study of tiny systematic effects.

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1. B. Desplanques, J. Donoghue, and B. Holstein, Ann.Phys. **124**,449(1980).
2. Takamitsu Oka, Phys. Rev. D **27**, 523 (1983).