Measurement of the Parity Violating Gamma Asymmetry in the Capture of Polarized Cold Neutrons by Para-Hydrogen

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The hadronic weak interaction manifests itself in parity-violating phenomena in two-nucleon systems and in nuclei. Its small contribution to the nucleon-nucleon force can be represented by meson exchange potentials. In particular, the parity-violating nucleon-nucleon observables can be described in terms of the weak meson-nucleon-nucleon coupling constants corresponding to the various exchange mesons π,ρ,ω. An important, directly related parity violating observable is the γ-asymmetry (A_γ) with respect to the neutron spin in the capture of cold polarized neutrons on para-hydrogen: $\vec{n} + p \rightarrow d + \gamma$. The measurement of A_γ is essentially a measurement of the weak coupling constant H^1_π.

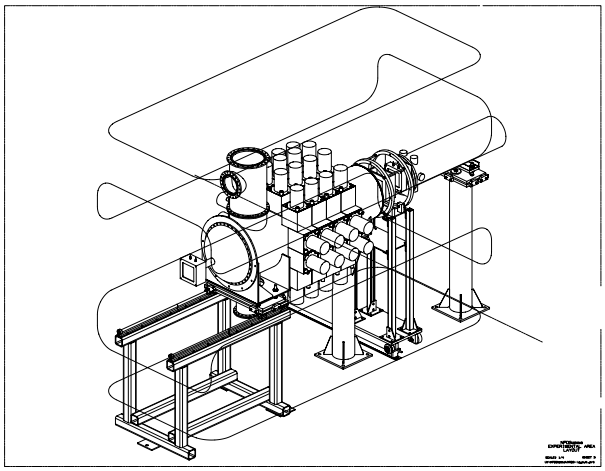

Figure 1: Engineering drawing of all experimental components of the NPDGamma-experiment. The four encircling lines represent one position of the guide field coils.

An A_γ measurement aiming at a precision of 0.5×10^{-8} or better is planned at LANSCE (Los Alamos Neutron Science Center). Fig.1 shows a drawing of the setup of the NPDGamma experiment.

The apparatus consists of a high pressure polarized ^{3}He neutron spin filter, a RF neutron spin flipper, a liquid para-hydrogen target, and a CsI detector array for the 2.2 MeV γ's following neutron capture.

This year the flight path guides, chopper and cave designs were completed and are now in the installation phase. The construction of the final detectors and stands was initiated. All crucial components and, in particular, various alignment procedures between the CsI detector symmetry axis (γ's) and the magnetic field (neutron spin), were successfully tested in the fall 2001 run.

We are presently designing the guide field coils to achieve the best homogeneity in the most sensitive part of the experiment.

Production data taking of the NPDGamma experiment is scheduled to start in late 2003.

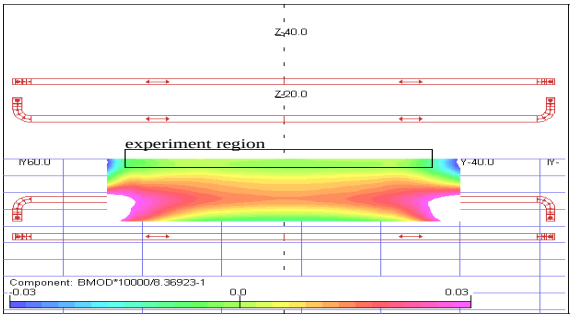

Figure 2: A calculation of the field value over the experimental region for a particular choice of 4 coils. The cave iron is included.

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