CEBAF EXPERIMENT 94-015

Study of the Axial Anomaly using the $\gamma\pi^+ \to \pi^+\pi^0$ Reaction Near Threshold

The study of the chiral anomaly is important because it provides a test of fundamental principles of chiral quantum field theory and the Standard Model. The anomaly was first discovered in theoretical investigations of π^0 decay through the partially conserved axial current (PCAC). The amplitude for the $\gamma \to \pi^+\pi^-\pi^0$ reaction, $F^{3\pi}$, can be exactly calculated from the Wess, Zumino, and Witten effective chiral Langrangian in the limit of zero momentum. The amplitude, given by $F^{3\pi} = eN_c / (12\pi^2 F_\pi^3)$, depends only on N_c the number of QCD colors, and the pion decay constant, F_π. By using N_c = 3 and F_π = 92.4 $\pm$0.1 MeV, the chiral anomaly predicts $F^{3\pi} = 9.72 \pm 0.06$ GeV^{-3}. However, this theoretical prediction is quite different from the experimental result of Antipov *et al.* in which $F^{3\pi}$ = 12.9$\pm$0.9 (*stat*) $\pm$0.5 (*sys*)GeV^{-3}, and is consistent with N_c = 4.

Experiment 94-015 will measure $F^{3\pi}$ in the physical region by measuring $\gamma p \to \pi^+\pi^0 n$ cross sections at low momentum transfer $t \approx -m_\pi^2$. The experiment will use the CLAS detector and tagged photons with energies between 1 and 2 GeV. The advantage of using incident photons, as compared to radiative production with hadrons, is that the signal-to-background ratio is optimized, since both signal and backgrounds are electromagnetic in origin. We will use the Chew-Low method to extrapolate data to the pion pole. The experiment is planned for 58 days of CLAS operations with 2.4 GeV incident electron energy and tagging rate of 10^7 photons/s.