The π^0 Lifetime: Experimental Probe of the QCD Chiral Anomaly

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Abstract

The $\pi^0 \to \gamma\gamma$ decay rate is a fundamental prediction of QCD which gives insight into one of its most profound symmetry issues—namely, the Chiral Anomaly. It is this anomalous symmetry-breaking mechanism by which the $\pi^0 \to \gamma\gamma$ decay channel primarily proceeds, and thus a measure of its rate or partial width, $\Gamma_{\gamma\gamma}$, represents a direct probe of the anomaly plus chiral corrections. The PrimEx Collaboration at Jefferson Lab has extracted $\Gamma_{\gamma\gamma}$ from precision measurements of π^0 photo-production cross sections using their Primakoff components. Measurements were made using 5% X_o nuclear targets of ^{12}C and ^{208}Pb with incident photons between 4.9 and 5.5GeV tagged by the Hall B tagger facility. The π^0 decay photons were detected at very forward angles by a specially constructed high resolution hybrid calorimeter (HYCAL). In this presentation, the final result from the PrimEx measurement will be given along with a general overview of the physics, experimental design and setup, detector construction and performance, and data analysis strategies and techniques.