

E12-13-008A: *Measuring the Neutral Pion Polarizability*

A. Szczepaniak, R. Briceño

The proposal is to measure the neutral di-pion spectrum in $\gamma - \gamma$ fusion from threshold to center of mass energy, W of approximately 0.8 GeV. Pion pairs are produced from the Primakoff reaction on the lead target and detected with the GlueX apparatus. Primakoff production dominates at the very low momentum transfer, $t \sim 0.01 \text{ GeV}^2$, when the nucleus remains intact. At low energies the process is calculable in ChPT and matching ChPT with the low-energy expansion gives a prediction for pion polarizability. The amplitude can be further constrained by dispersion relations which account for the behavior of the amplitude at masses farther above threshold. This measurement is expected to improve on the overall determination of the di-pion spectrum in photon fusion by measuring it to within 5% accuracy, and to determine the polarizability difference, $\alpha_0 - \beta_0$ to within 40%.

The experiment is expected to run concurrently with the measurement of the charge di-pion production. Since the submission of the letter of intent in 2019 the authors have performed extensive studies of i) the detector efficiency and signal resolution, ii) the influence of physics backgrounds. The backgrounds are dominated by incoherent di-pion production and can reach up to 35% of the signal. Therefore extraction of the signal will require data analysis at the amplitude level, which is something that the collaboration is prepared to do. In the proposal the authors have shown some preliminary amplitude parameterizations. The non-Primakoff di-pion production can be constrained by a slightly higher t data where it dominates the cross section. It will be very interesting to explore this region to further constrain reaction models. It appears the authors are well aware of the need for theory input and are collaborating with experts in this field.

This is an important measurement with impact on hadron structure (polarizability) and spectroscopy (d-pion spectrum) investigations.