Construction of MWPC Prototypes for Pion Polarizability Experiment at JLab

R. Johnston, M. Downing, C. Haughwout, S. McGrath, M. Roberts, R. Miskimen, A. Schick
Department of Physics, University of Massachusetts, Amherst

Pion Polarizability Experiment at JLab

- Pions are particles that mediate the strong nuclear force, which governs the binding of matter like protons and neutrons.
- All particles, including pions, have fundamental properties such as polarizability, which measures rigidity against an external electric field
- Quantum Chromodynamics (QCD) is the leading theory to describe the strong force, and it makes various predictions about physical phenomena, such as the value of the polarizability of the pion.
- Therefore, measuring the polarizablilty gives strong evidence for or against the validity of QCD
- However, there have been many issues in measuring this value, the results are not precise enough to determine if the experiments agree with the theory..

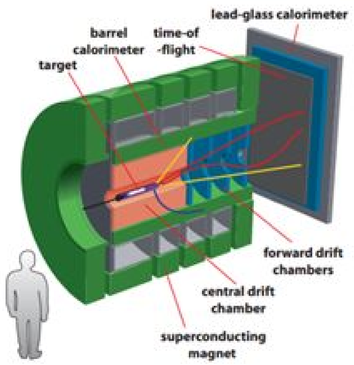


Fig 2: Proposed layout of detector line up for Pion Polarizability experiment.

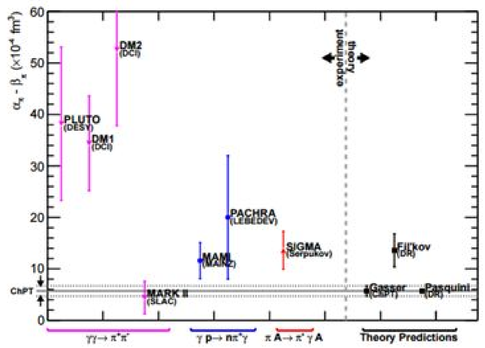
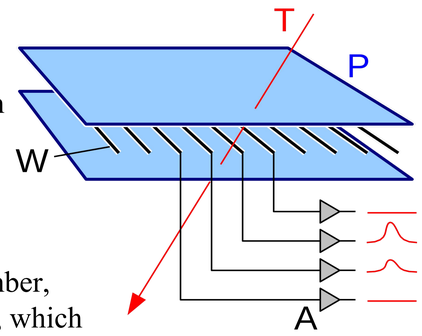


Fig 1: Various measured values for polarizability of pion. Different colors correspond to different ways to measure the polarizability.

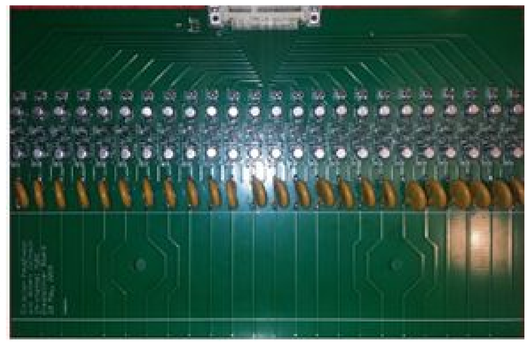
- In order to measure this value more precisely, an experiment has been proposed at JLab in Virginia.
- This experiment will require several detectors in order to determine how the particles are interacting (fig 2)
- UMass MENP will construct one type of the detectors needed, a Multi-Wire Proportional Chamber (MWPC)

What is a MWPC?



- Multi-Wire Proportional Chambers (MWPC) are instruments which detect charged particles. The image to the right illustrates the basics of a MWPC.
- There are many parallel wires enclosed between two metal plates.
- The chamber is filled with gas, such as Argon and Carbon Dioxide
- When particles, such as pions or cosmic rays pass through the chamber, the gasses in the chamber are ionized and cause a current in the wires, which can be detected by electronics attached to the chamber.

Construction and Testing



- A total of 6 to 10 final MWPCs will need to be constructed. Each detector is approximately 60” x 60”, so smaller prototypes have been constructed first to test the design.
- A major component of these detectors is having functioning electronics. The image on right shows the latest form of the circuit boards used for these detectors. The electronics were designed using CAD software, and several prototypes were tested over the past 2 years.
- Small size (8” x 8”) and medium sized (12” x 12”) detectors have been constructed and tested to work though mechanical and electrical complications. The last prototype is to be a full size detector, and is currently plans are being made to assemble it during the coming weeks.
- The electronics are tested individually using test waveforms on a pulser circuit, and looking into the board using a scope probe. The whole detector is tested by filling it with gas and observing cosmic rays as they pass through and ionize the gas.

Fig 3: Circuit diagram of detector electronics

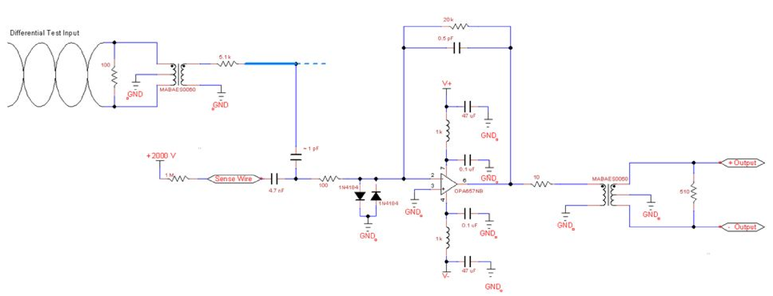


Fig 4: View of Medium MWPC with top plate off