Particle Identification Using a Ring Imaging Cherenkov Counter

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I. Motivation

The theory of quantum chromodynamics (QCD) predicts that nucleons are composed of three valence quarks along with a sea of virtual pairs of quarks and gluons. However, experiments indicate that the spin of the quarks does not add up to the known spin ½ of the nucleon. Thus, scientists are examining the sea of virtual pairs to explain this discrepancy. In particular, our group aims to study the contribution of the strange quark-antiquark pair. Using semi-inclusive deep inelastic scattering experiments, we will be able to probe the strange sea through the detection of kaons.

\[ P = uud + u\bar{u} + d\bar{d} + s\bar{s} + g + \ldots \]

II. Theory of the RICH Detector

As a charged particle travels through the aerogel at velocities greater than the speed of light in the radiator, Cherenkov photons are emitted with an angle dependent on the particle velocity.

\[ \cos(\theta_c) = \frac{1}{\beta n} \]

Due to the complexity of the electronic systems, a slow control system is needed to monitor certain process variables (PVs) inside the RICH detector. These PVs can be monitored or changed on the client side through CS-Studio GUIs using channel access protocol 2.

III. RICH Detector Design at JLab

- Momentum range: 3-8 GeV/c
- Precise detection of kaon particles

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IV. Slow Control System

The slow control system was successfully built and tested using a simulated input/output controller. Once the construction of the RICH is complete, these operator interfaces will be tested with real hardware.

V. Results

- High Voltage
- Temperature

VI. Conclusions

I would like to thank my mentors—Dr. Fatiha Benmokhtar, Dr. Valery Kubarovsky, and Dr. Nathan Baltzell—for allowing me to participate in their research endeavors. This work was partially funded by the National Science Foundation.

VII. Acknowledgements