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Design and Fabrication of Calibration Device for Scintillating Fibers of Tagger Microscope: For use in GlueX's QCD Experiment[1]

EMILY BRIERE, Duke University — For decades, scientists have struggled to understand the chromo-electromagnetic field which confines quarks and gluons within the hadron. GlueX is a QCD experiment centered at Jefferson Lab, Virginia, seeking to better understand this gluonic field by exciting it and mapping the spectrum of exotic hybrid mesons that it generates. The experiment uses coherent bremsstrahlung radiation to produce a beam of photons, which due to their polarity act as virtual vector mesons. When incident on a liquid hydrogen target, these mesons are expected to form exotic hybrid mesons. Such particles quickly decay into new particles which are captured in a solenoid detector. The decays can then be reconstructed to examine the properties of the original exotic hybrid meson, although the initial energy of the photon is required to draw meaningful conclusions. The post-bremsstrahlung degraded electrons are bent from the main beam into the tagger microscope where they strike an array of scintillating optical fibers. Given the correlation between momentum and radial bend, the Silicon Photmultiplier sensors attached to the optical fibers are able to "tag" the electrons', and thus the photons', initial energies based on which fibers were hit. Providing central data for GlueX, the tagger microscope must be accurate. This paper details the design and fabrication of a scintillating fiber calibration device that moves horizontally above fiber bundles, using a green laser diode to direct light pulses into the fibers. This calibration method has been tested mechanically and via a Monte Carlo Matlab simulation, and has proven to be effective.

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