Brief GlueX Note
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Photon Coverage

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As we prepare for the calorimeter review, this is a reminder about the photon coverage, especially in the BCAL to FCAL transition region. Please see the detector drawing below. Note the lines at angles of 10.8°, 14.7°, 118.1° and 126.4°. These are defined by the length of BCAL, the inner and outer radius and placement with respect to the target center.

As one of the signature reactions several of us have studied $\gamma p \to \eta\pi^0 p \to 4\gamma p$ at $E_\gamma = 9$ GeV. For events with uniform $\eta\pi^0$ masses between 1.0 and 2.0 GeV/c^2, uniform in decay angles, with a $e^{=5|t|}$ distribution, here is how photons populate the calorimeters:

Element	Percent of all photons
Hole in FCAL	0.97%
FCAL	53.15%
BCAL	45.68%
Upstream of BCAL	0.20%

There are four photons per event. The definition of BCAL angular coverage in the table is from 10.8° to 126.4°. As we know, and as is being addressed, photons trajectories exiting the end of BCAL are challenging.

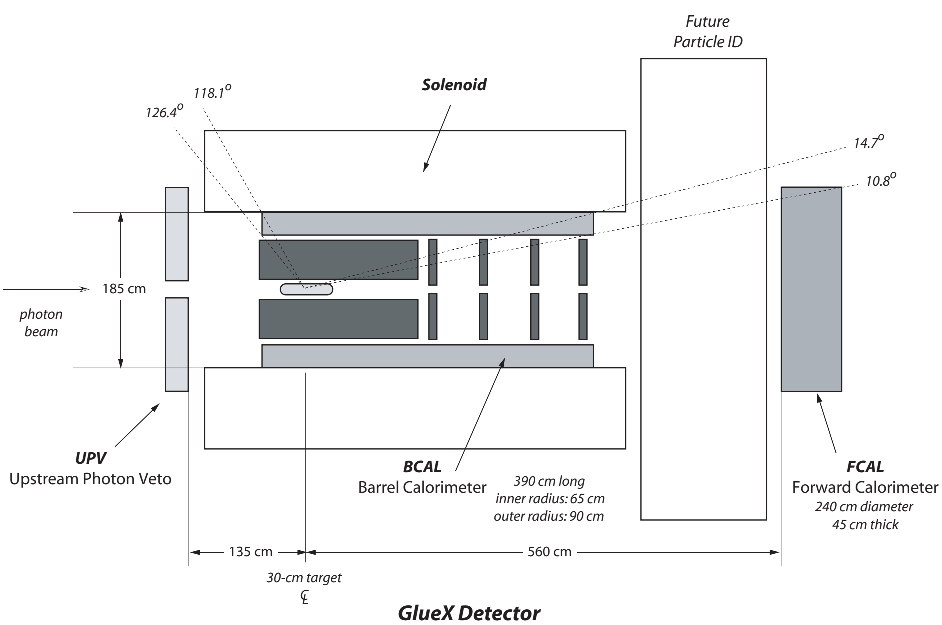

Figure 1: Note the lines at angles of 10.8°, 14.7°, 118.1° and 126.4°. These are defined by the length of BCAL, the inner and outer radius and placement with respect to the target center.

Figure 2 has information about the photons hitting BCAL. The variable z is distance along the inner surface of BCAL starting from the upstream end at $z = 17$ cm and ending at the downstream end at $z = 407$ cm. The 30-cm target center is at $z = 65$ cm. The histogram is the distribution of the photons along z (use the left vertical scale) while the dashed curve (use the right vertical scale) is the integral fraction of photons in percent. For example, 80% of the photons hit between $z = 17$ cm and $z = 345$ cm. The other curves also use the right vertical scale. The green curve is the number of BCAL radiation lengths intercepted by the photon trajectory assuming a 1.45 cm radiation length for the Pb/SciFi matrix. The cusp at $z = 312$ cm corresponds to a photon angle of 14.7° where the number of radiation lengths is 68. The cusp at $z = 30$ cm corresponds to a photon angle of 118.1°. The minimum of the green curve is at $z = 65$ cm or at 90° corresponding to 17 radiation lengths (the module is 25 cm thick). The blue curve shows the photon angle as a function of z and the red curve is the photon reconstruction efficiency as estimated by M. Kornicer[1].

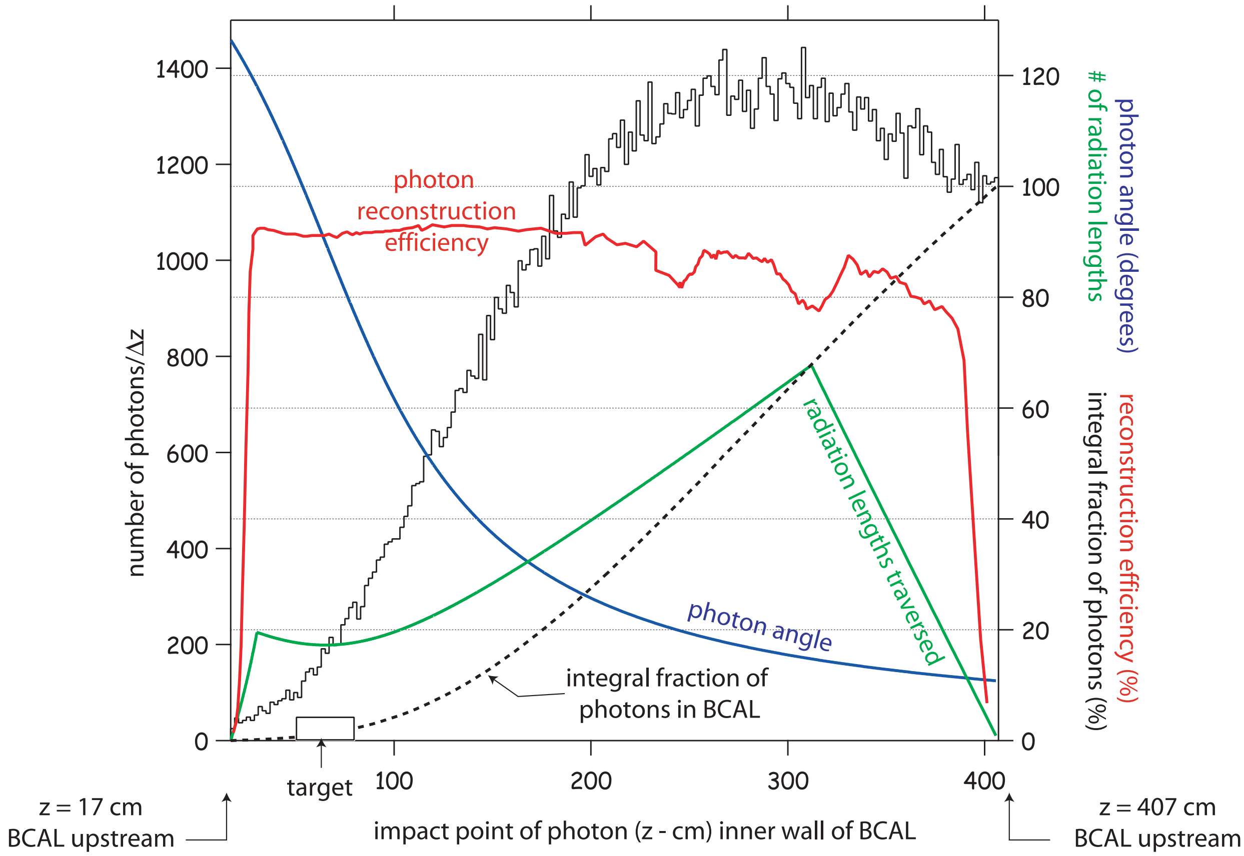

Figure 2: Histogram: Distribution of photons from the $\gamma p \to \eta\pi^0 p$ reaction along the inner wall of BCAL. The upstream end of BCAL is at $z = 17$ cm and the downstream end at $z = 407$ cm. Use the left vertical scale for the histogram. The four curves (all as a function of z) use the right vertical scale. The black dashed curve is the integral fraction of photons in BCAL in percent. The blue curve is the photon angle in degrees measured with respect to the beam (or with respect to the inner surface of BCAL). The green curve is the number of radiation lengths traversed by a photon. The red curve is M. Kornicer's estimate of the photon reconstruction efficiency. See the text for more discussion.

[1] M. Kornicer, *Neutrals Reconstruction in BCAL/FCAL*, Talk at the GlueX PID Workshop (July 2007) GlueX-doc-852-v2.