Photon Flux for η Rare Decays

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Design Goal of Hall D tagger

- Photon energy detection from 70% to 75% of the primary electron beam energy with energy resolution of about 0.5% (r.m.s.) of the primary beam energy. A detector system which allows a counting rate of at least 5×10^6 electrons per second per 0.1% energy bin over this range of photon energies.

- An additional capability for photon energy detection from 25% to 97% of the primary electron beam energy. It will be capable of pre-collimated intensities up to 150MHz/GeV, with 50% sampling of 60 MeV energy bins below 9 GeV and full coverage with 100% sampling of 30 MeV wide energy bins above 9 GeV photon energy.

- Electron beam current for high intensity runs ~2.2μA.

Flux Estimation for η Decays

Assume 10^{-4} R.L. gold radiator, 0.4μA electron beam current

- Equivalent photons rate in tagger is:

$$10^{-4} \times \frac{0.4 \times 10^{-6}}{1.6 \times 10^{-19}} \approx 2.5 \times 10^{8} \ (\gamma / s)$$

- Photon rate in tagger is ~25 MHz/GeV

- For a 5 mm primary collimator, ~30% photons will pass through collimator and reach the target. Equivalent photons rate on target is:

$$2.5 \times 10^{8} \times 0.3 \approx 7.5 \times 10^{7} \ (\gamma / s)$$

- For 9.0-11.7 GeV energy photons on target, the total rate is:

$$7.5 \times 10^{7} \times \ln \frac{11.7}{9.0} \approx 2 \times 10^{7} (\gamma / s)$$