

Luminosity measurement at the EIC

Jaroslav Adam

BNL

BROOKHAVEN
NATIONAL LABORATORY



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Luminosity measurement by bremsstrahlung photons

- Large cross section driven by QED, photons in a narrow angular cone along electron beam

$$\frac{d\sigma}{dE_\gamma} = 4\alpha r_e^2 \frac{E'_e}{E_\gamma E_e} \left(\frac{E_e}{E'_e} + \frac{E'_e}{E_e} - \frac{2}{3} \right) \left(\ln \frac{4E_p E_e E'_e}{m_p m_e E_\gamma} - \frac{1}{2} \right); \quad \frac{d\sigma}{d\theta_\gamma} \sim \frac{\theta_\gamma}{((m_e/E_e)^2 + \theta_\gamma^2)^2}$$

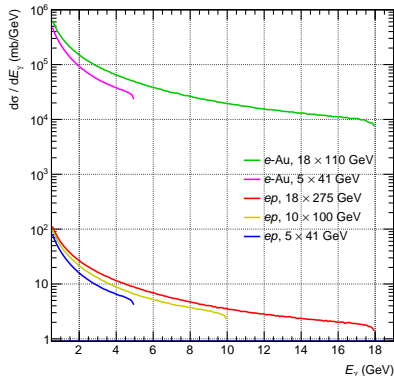


Figure: Bethe-Heitler cross section for several electron and proton/ion beam energies

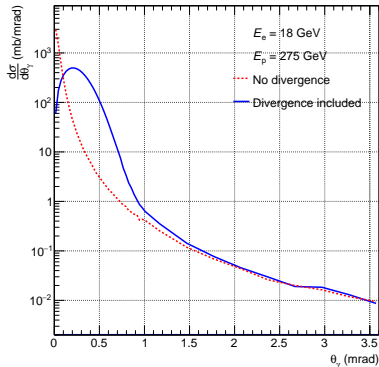
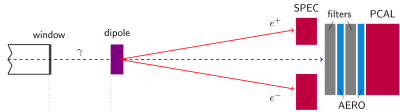


Figure: Photons angular cross section, effect of beam angular divergence is illustrated

- Luminosity will be measured by counting the bremsstrahlung photons
- Desired precision is 1%
- Very large cross section in e-Au case
- Angular distribution is modified by beam angular divergence

Mechanism for luminosity measurement



- Two methods to detect the bremsstrahlung photons
- Non-converted photons are detected at PCAL
- Spectrometer SPEC detects converted $e^+ e^-$ pairs
- Geant4 provides basic characteristics like spectrometer acceptance

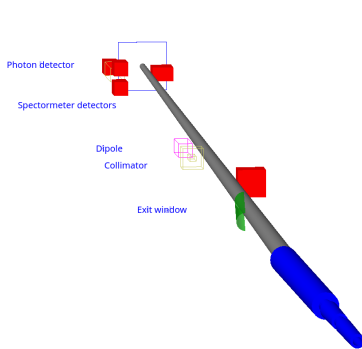


Figure: Geant4 model for luminosity monitor

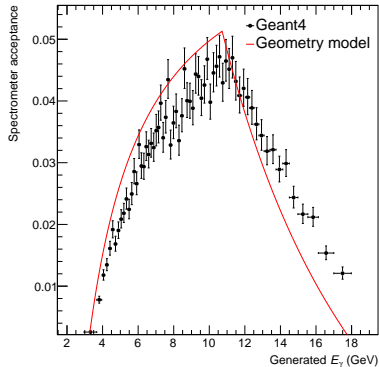


Figure: Spectrometer acceptance as a function of photon energy

Challenging goal of 1% precision will require to cope with high event rates and beam effects