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Model Comparison of GEANT4 Simulations

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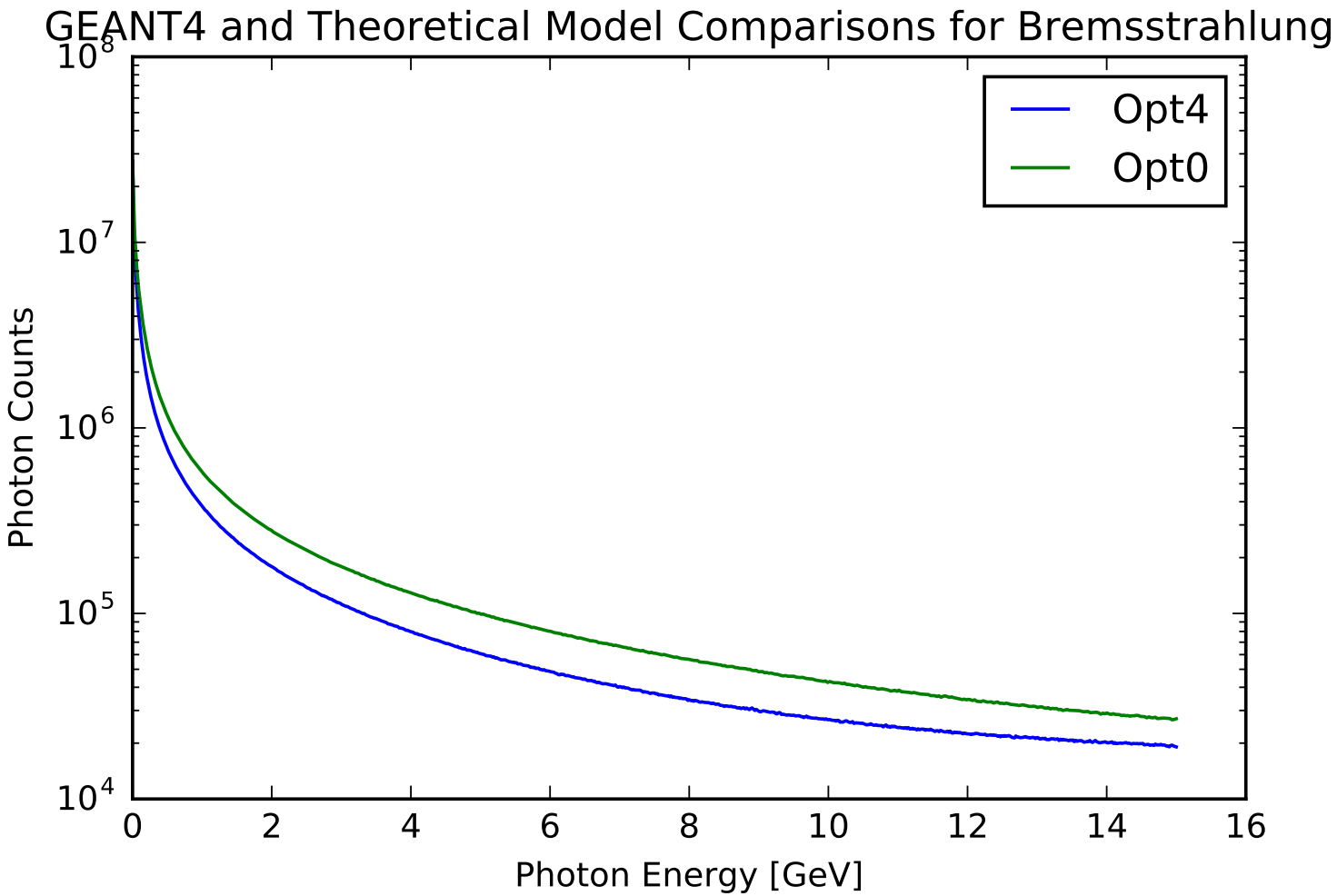
Motivation

- Independently generate accurate experimental models to inform radiation related designs and measurements (detectors, optics, shielding)
- Provide realistic information for dependent models
- Enable the explanation of decisions, measurements, and calculations for outside parties

Bremsstrahlung Spectra

- "Opt0" in GEANT4 uses standard physics for LHC particles, ie. $E_{e^-} \sim$ TeV
- "Opt4" applies standard physics plus supplements for low energies
- Bremsstrahlung is usually measured experimentally and a formalism has been developed spanning from MeV to hundreds of GeV
- Lower energy portion of the curve is important for shielding considerations and background measurements
- High energy portion of the curve is crucial to pair production rate measurement

Bremsstrahlung Spectra



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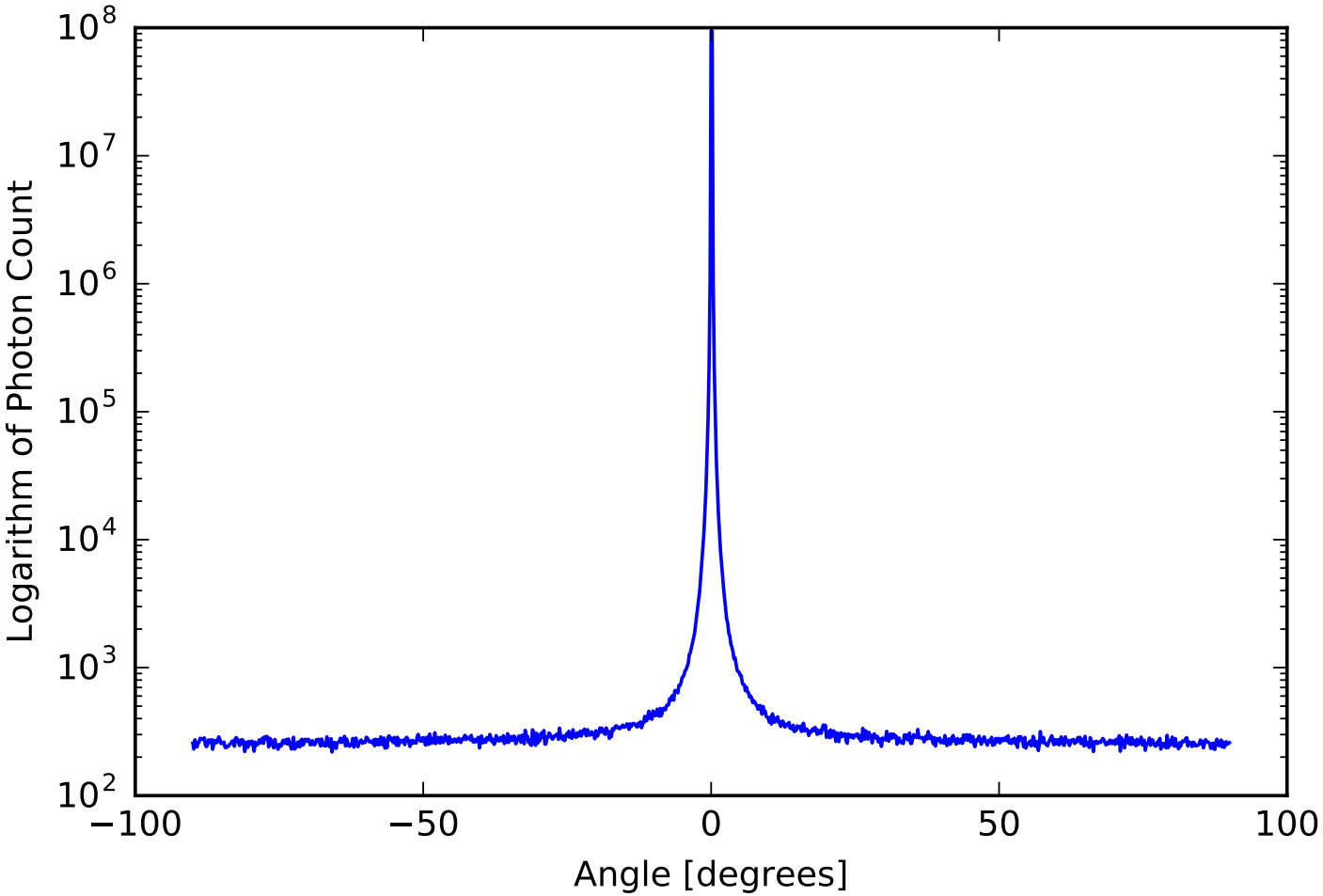
Bremsstrahlung Spectra



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Bremsstrahlung Spectra

Theoretical comparison comes from *"Pair Production and Bremsstrahlung of Charged Leptons"* (Tsai, 1974):

$$I_\gamma(E_0, k, t) \approx \int_k^{E_0} e^{-\mu t} \left(\frac{T^{BT}}{B} + \left(\frac{1}{B^2} - \frac{2\gamma}{B^3} \right) (1 - e^{BT}) + \cdots \right.$$

$$\left. \cdots + \gamma e^{BT} \left(\frac{T^2}{B} - \frac{2T}{B^2} \right) \rho(E, k) dE / E_0 (1) \right.$$

- Calculated in atomic units
- Based on Bethe-Heitler bremsstrahlung and pair production rates with experimental improvements and approximations
- Valid for the upper 2% of the spectrum for a thin foil

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Conclusion

- Working toward γ in focus and expected background counts
- Collaboration on a standard for scripts will ease analysis
- Experimental opportunity to contribute to bremsstrahlung data

Thank you