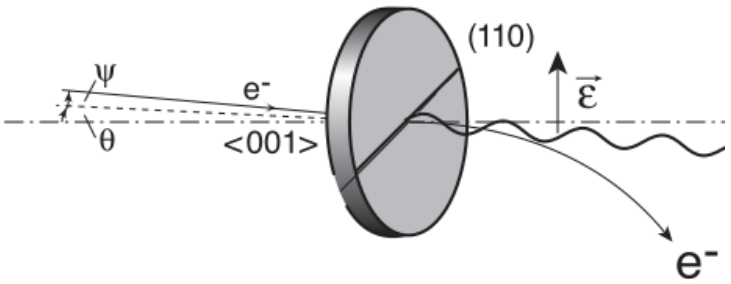
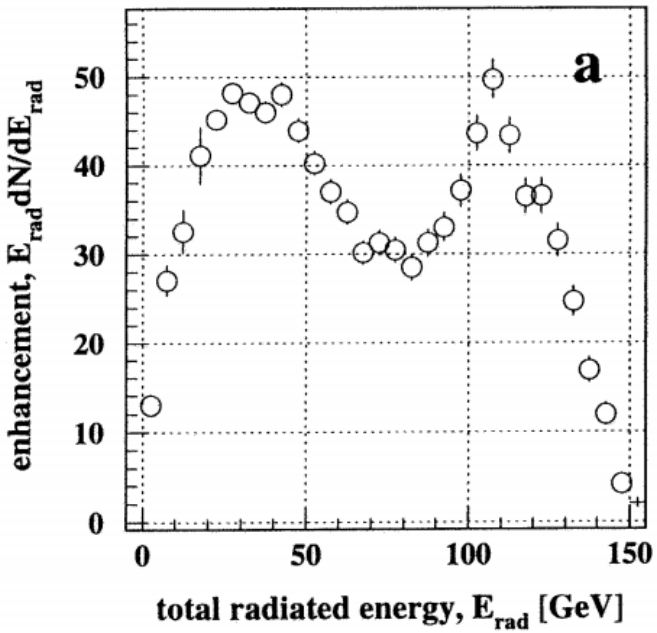
Polarized bremsstrahlung photons

- We plan to use a foil to produce high energy photons
- As well as a foil (amorphous structure), use oriented crystal (Si, Ge, Diamond)
- Energetic, linearly polarised photons produced by unpolarised electrons
- Coherent bremsstrahlung, resonance from lattice planes in phase with photon energy
- Order of magnitude enhancement of photon rate
- Crystal oriented so that electron path is 5 mrad from (001) axis and 70 μrad from (110), 150 GeV e- [CERN-SPSC98-17]
- 10-60% polarisation possible
- OPPP is polarisation dependent
- Schwinger field polarisation dependent?

Polarised bremsstrahlung from oriented crystal



Enhancement of bremsstrahlung

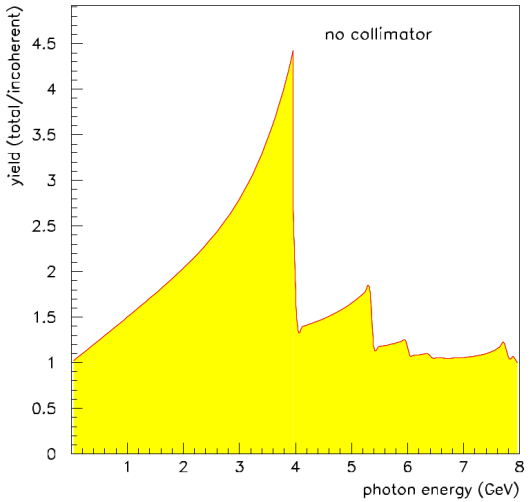


Coherent brem schema with 8 GeV electrons

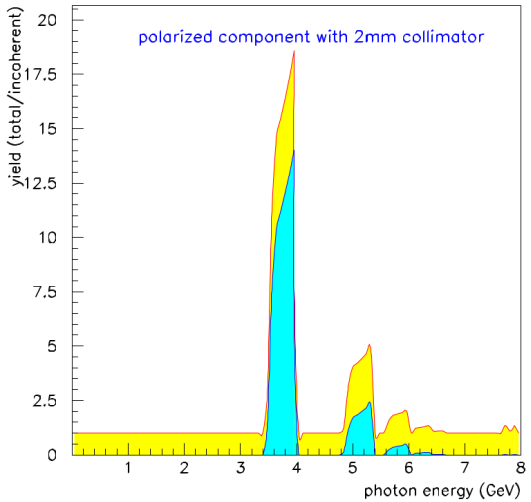
[R.T. Jones, jefferson Lab, 1997]

- Rate described by Bethe-Heitler process with additional form factors for the crystal
- Orient diamond crystal to bias a resonance peak (desired lattice vector perpendicular to beam direction)
- 1mm thick crystal, 8 GeV electrons, linearly polarised photons
- Can change plane of polarisation by azimuthal angle of lattice vector
- Up to 80% enhancement of the rate collimated to 2 mm at 30 m
- Enhancement diminished by multiple scattering if crystal too thick
- **Monoenergetic, polarised photons may help in the Schwinger crit field measurement**

OPPP, laser, gamma same helicity



OPPP, laser, gamma opposite helicity

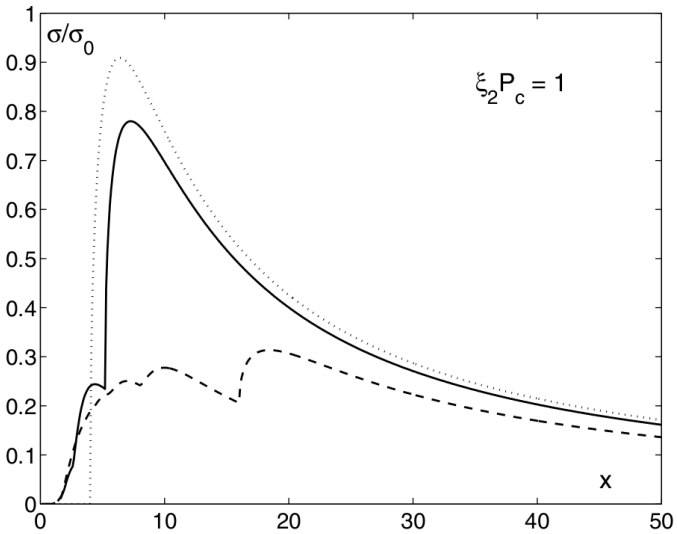


OPPP polarization dependence

[Ivanov, Kotkin, Serbi EPJ C 40,27 (2005)]

- OPPP cross-section calculated with helicity amplitudes
- Stokes parameters for initial photon and laser (ξ_1, ξ_2, ξ_3), $(\widetilde{\xi}_1, \widetilde{\xi}_2, \widetilde{\xi}_3)$
- $x = \frac{4\omega_i \omega_L}{m^2}$ related to χ. $\sigma_0 = \pi r_e^2$
- Cross-sections compared for same and opposite helicity
- Up to 100% enhancement for parameters studied
- This is for circular polarisation, repeat analysis for linear polarisation and for relevant parameter ranges

OPPP, laser, gamma same helicity



OPPP, laser, gamma opposite helicity