Coherent Photon Beam

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d:\winmcad\glast\coherent_photons.mcd

$$\mathrm{poisson}(n, navrg) := \frac{e^{-navrg} \cdot navrg^{n}}{n!}$$

Compare obtaining photons of a desired energy by 1) Regular brem beam, or 2) Coherent brem beam. In both cases the electron beam is adjusted to give an average of exactly 1 photon/spill (in the range >20 mev that will convert in the tracker) since this maximizes the Poisson probability of having exactly one photon in the pulse.

1) Use a slice of regular brems

$Ebeam := 30.$

$Etrkmin := .020$

$dEgam := .12 \cdot Ebeam$ This is the same energy width as the coherent peak.

$Egam := 10.$

$navrg := 1.00$

$$ngam\_brem := \frac{navrg}{\ln\left(\frac{Ebeam}{Etrkmin}\right)} \cdot \frac{dEgam}{Egam} \cdot \mathrm{poisson}(1, navrg)$$

$ngam\_brem = 0.018$

2) Use coherent brem peak

For 50 um diamond, 30 Gev beam, navrg=1, 10 Gev coherent peak, Peter Bosted calculated fc=.29 = the fraction of coherent peak photons in the peak+brems spectrum.

$fc := .29$

$ngam\_coh := fc \cdot \mathrm{poisson}(1, navrg)$

$ngam\_coh = 0.107$ [single 10 GeV gammas per spill]

Conclude that the coherent brem beam allows us to accumulate single 10 Gev photons, 6 times faster than with the regular brems beam.

We will identify the good 10 Gev single photon spills by selecting 10 Gev energy deposition in the CsI calorimeter. Unfortunately, some fraction = poisson(2,navrg)/poisson(1,navrg) of the spills will have a second gamma in the spill. Sometimes the sum of the energies of the two gammas will be indistinguishable from 10 Gev in the calorimeter and the 2nd (low energy) gamma has a 50:50 chance of being the one to convert. When it does, it will cause tails on the 10 Gev point spread function.

Since both beams have an average of 1 photon per pulse, the coherent beam has ~20% fewer low energy photons than the regular brems beam (since more of the 1 avrg is tied up in the 10 Gev peak). Thus the single 10 Gev gamma pulses from the coherent beam are ~20% less polluted with low energy gammas than the single 10 Gev gamma pulses from the regular brems beam.