Exit window in Geant

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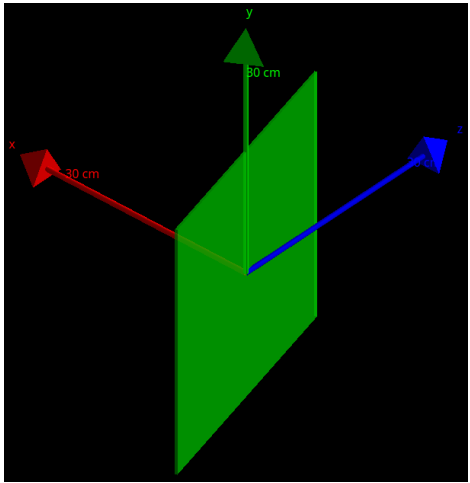
Far-Backward meeting

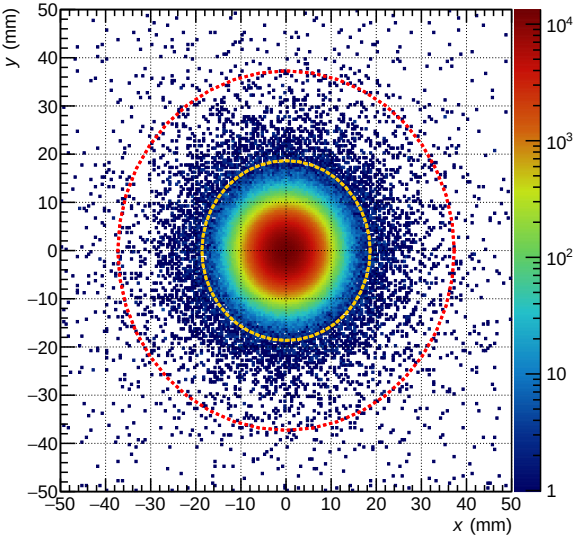
Geant model for exit window

- Aluminum square of 400 mm side
- Thickness of 2.6 mm
- Tilt along *y* axis by 250 mrad
- Origin of local coordinates (center of the window) is at *z* = -18.644 m
- Input is a sample of 5M bremsstrahlung photons with angular divergence and vertex spread by CDR Table 3.3



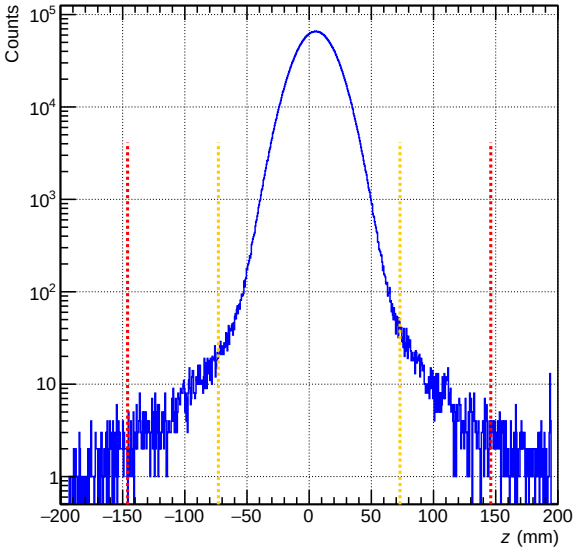
Hits by primary photons in x and y at 18x275 GeV

- Impact points on the exit window as projected onto the x-y plane
- Red circle: 2 mrad cone at the position of the exit window
  - 99.98% of events pass the limit
- Orange circle: 1 mrad cone at the position of the exit window
  - 99.87% of events pass the limit
- Not much events are lost in either case, but the 1 mrad is getting close
- Caveat: crabbing will make the distribution more broad in x



Hits by primary photons in z at 18x275 GeV

- Impact points on the exit window as projected along the z axis
- Red lines: 2 mrad cone projected in z
- Orange lines: 1 mrad cone projected in z



Hits by primary photons in x and y at lower energies

Figure: 10x100 GeV

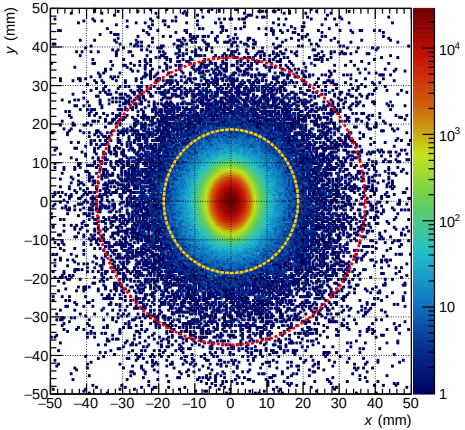
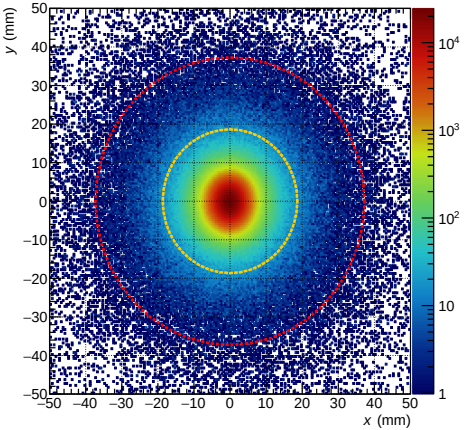


Figure: 5x41 GeV



- Fraction of events lost by aperture is also $\sim$1%, crabbing will make the x distribution wider

Hits by primary photons in z at lower energies

Figure: 10x100 GeV

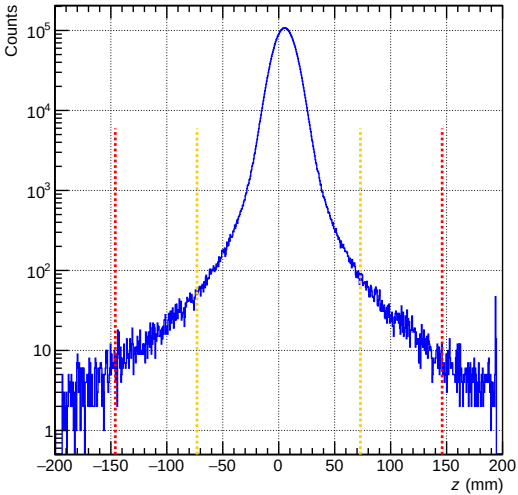
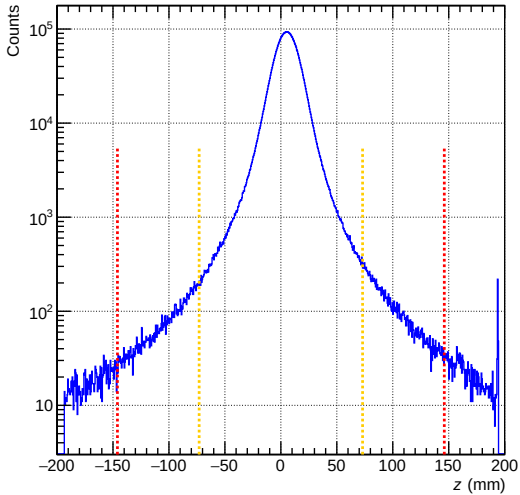
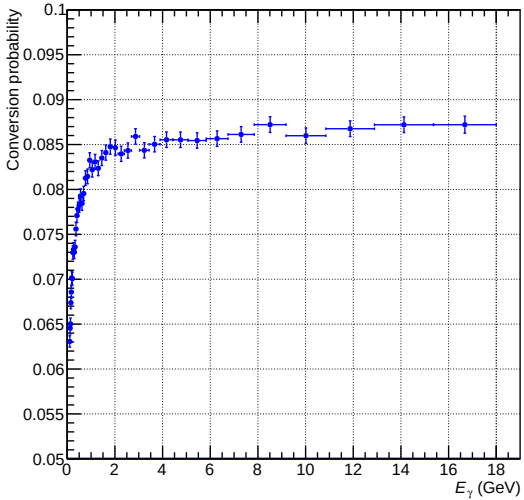


Figure: 5x41 GeV



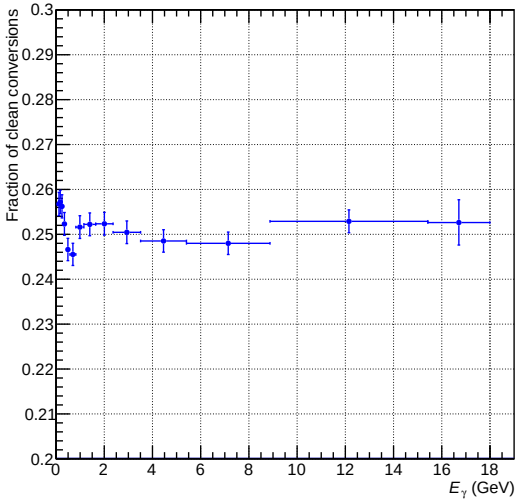
Conversion probability as a function of photon energy

- Fraction of events where the photon converts to a e^+e^- pair in the exit window
- Given as a function of generated bremsstrahlung photon energy E_γ
- Simulation starts at 0.1 GeV
- Almost flat beyond 2 GeV



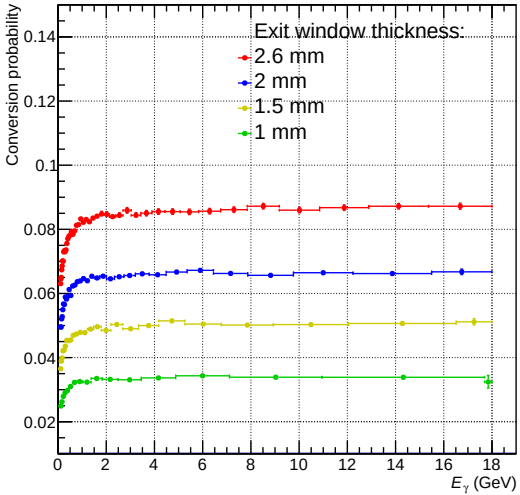
Fraction of clean conversions in conversion events

- The conversion is marked as clean when only the e^+e^- pair is created in the event and no additional photons or electrons are present
- The fraction of clean conversions is a ratio of such conversions to all events where a conversion took place
- The e^+e^- pair carries all original photon kinematics in the case of clean conversion (up to some deposited energy in the exit window)



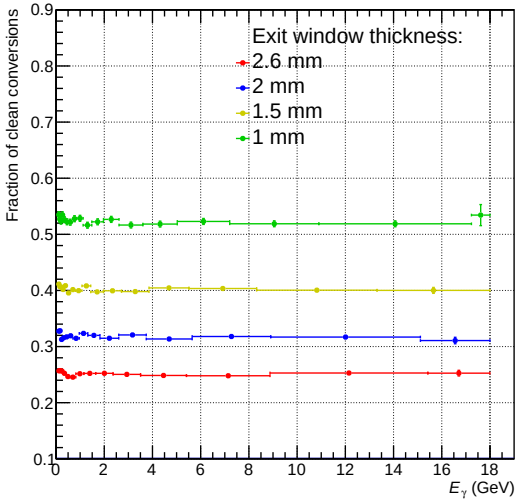
Conversion probability for reduced exit window thickness

- The conversion probability is shown as a function of generated bremsstrahlung photon energy E_γ for 18x275 GeV beams
- Thickness of the exit window is gradually reduced from the original 2.6 mm to 1 mm
- All other conditions, including the 250 mrad tilt remain the same
- In all cases the probability is about constant beyond 2 GeV
- Still above 3% for 1 mm thickness



Fraction of clean conversions for reduced exit window thickness

- Fraction of clean conversions is shown as a function of generated bremsstrahlung photon energy E_γ for 18x275 GeV beams
- Thickness of the exit window is gradually reduced from the original 2.6 mm to 1 mm
- All other conditions, including the 250 mrad tilt remain the same
- The fraction increases with decreasing thickness
- For 1 mm thickness more than half of the conversions have only the e^+e^- pair and no additional particles



Vertex position with crabbing

- Model of beam effects including crab cavities was shown by Brian Page indico.bnl.gov/event/12022/, github.com/bspage912/eicSimuBeamEffects
- Crabbing makes spread in vertex positions wider in x (horizontal) than in y
- The model was used to generate samples of vertex positions for 18x275 GeV, CDR Table 3.3:

- The width is 0.6 mm in x and 8 µm in y
- Overall effect is a specific Gaussian in x and y (and also in z)
- Bremsstrahlung photons need to be reproduced with vertex generated according to the Brian's model
- It will add some mm to positions in x

Figure: Vertex position in x

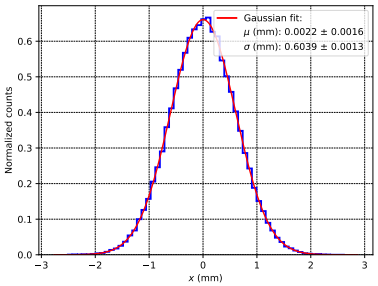


Figure: Vertex position in y