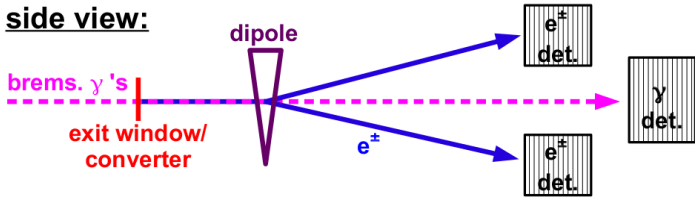
Backgrounds in far-backward area

Jaroslav Adam

Czech Technical University in Prague

August 22, 2022

Background in luminosity monitor



- Synchrotron radiation produced mainly at B2eR beam magnets is the only relevant source
- The main issue is its heat load on the exit window (passive conversion material)
- Filters are used in front of direct γ detector to block it (graphite was used at HERA)
- Acceptance for the $e^{\pm}$ spectrometer starts at photon energies well above the maximum for synchrotron photons
- The synchrotron radiation can be generated by Synrad, there is a converter to HepMC3 in github.com/adamjaro/convert_sr_hepmc

Background sources in low-Q^2 taggers

Synchrotron radiation by beam electrons

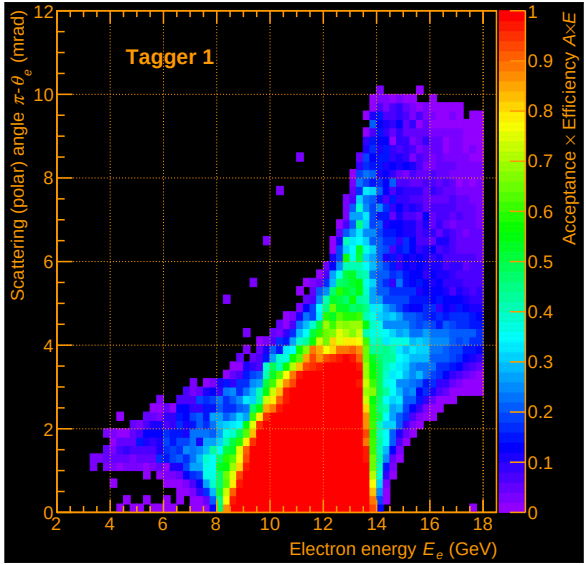
- Produced in upstream beam magnets, could reach taggers by scattering off the opposite beam pipe wall
- Mitigation is proposed by the machine group by a peculiar arrangement of the opposite wall
- Cavity-like structures, called ante chambers will absorb the synchrotron photons
- We have to observe the development and potentially simulate events of residual scattered synchrotron radiation

Elastic bremsstrahlung in *ep* (and *e*N) interactions

- Scattered electrons and photons are produced at the interaction point by electron and proton (nuclear) beams
- Large production cross section, kinematics of the electrons fits into tagger acceptance
- Mitigation is possible only with proper track reconstruction at every bunch crossing
- More details on this topic will be given in following slides

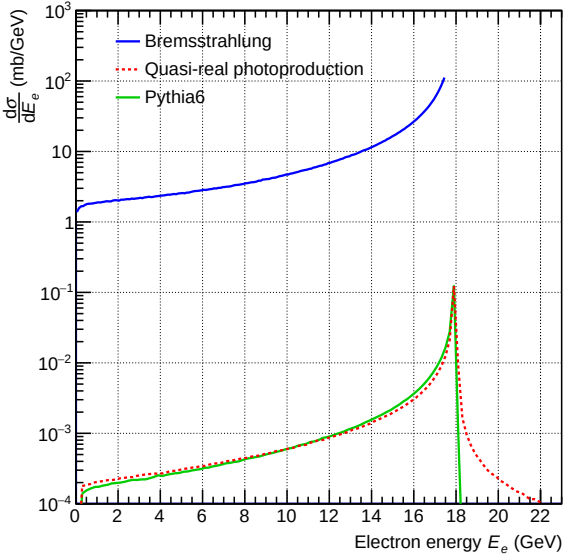
Tagger acceptance

- The acceptance is shown for photoproduction electrons – the signal we want to measure
- General $Q^2 < 0.1$ GeV^2 and scattering angles $\pi - \theta_e < 10$ mrad
- Example is shown for tagger 1, larger energies E_e are covered by tagger 2 while angles and Q^2 are similar



Production cross sections

- Background by bremsstrahlung is compared to signal of photoproduction (full Pythia6 and quasi-real approximation)
- Most of bremsstrahlung electrons come at small angles $\pi - \theta_e < 10$ mrad over tagger acceptance
- Mitigation is possible provided all electron tracks are reconstructed and separated from each other, all at each bunch crossing
- Bremsstrahlung electrons reconstruct to the lowest $Q^2 < 10^{-3}$ GeV^2, leaving a window for clean photoproduction signal



Generator implementation

- Done as extension for event generator in Comput.Phys.Commun. 272 (2022) 108251
- Output is a HepMC3 containing bremsstrahlung electrons (and photons)
- Production cross section and luminosity per bunch crossing give mean number of interactions per bunch crossing
- At the top energy *ep* it is ≈19 interactions
- Actual number of interactions follows Poisson distribution (right plot)
- The generator directly simulates the bunch crossings using the Poisson distribution
- The HepMC3 will be possible to merge with signal data (Pythia6 or quasi-real), or run as a separate production (done so far)