Radiative corrections for the reaction $\bar{p}p \rightarrow e^{+}e^{-}$ using PHOTOS

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PHOTOS

- Is an universal Monte Carlo algorithm to generate photon radiative corrections.
- Adds final state QED radiation corrections (FSR).
- No photon emission from initial state (hadrons).
- In average, photons are emmitted collinear to the direction of parent particle.
- Real photons are generated above a certain energy defined by a cut-off parameter.

PHOTOS: version 2.02

- This version is implemented in Pandaroot .

- XPHCUT=0.01 (cut-off parameter).

$$XPHCUT = E_{\gamma\,\min}^{CM} / (\sqrt{s}/2)$$

For p=1.7 GeV/c , minimal energy of photons(CM)= 11.5 MeV.

- ISEC=true (double photon emission).

- INTERF=true (interference weight switch on, for 2-body symmetric channels only).

Simulation

- Monte Carlo simulation : 4pi acceptance, no detector geometrie.
- Antiproton beam momentum p= 1.7 GeV/c.
- 10^6 events.
- Ratio of proton form factor equal to unity (GE=GM).

Photos effect on the energies of electrons and positrons

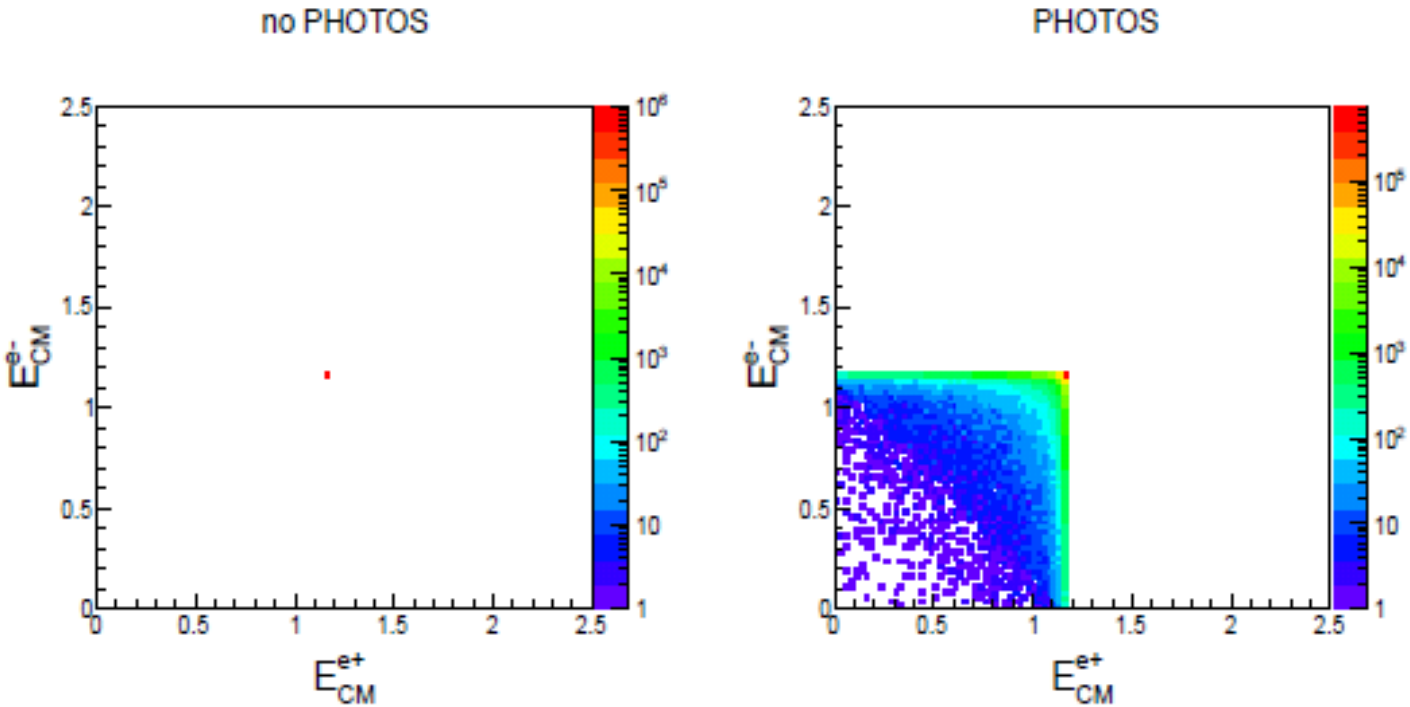


Fig. 1. Dalitz plot of the emitted electron and positron energies in the CM for $p_p = 1.7$ GeV.The maximum energy of the emitted leptons is 1.1614 GeV ($\sqrt{s}/2$).

Photos effect on the masse invariant

Maximal number of
emitted photons =2 (version 2.02)

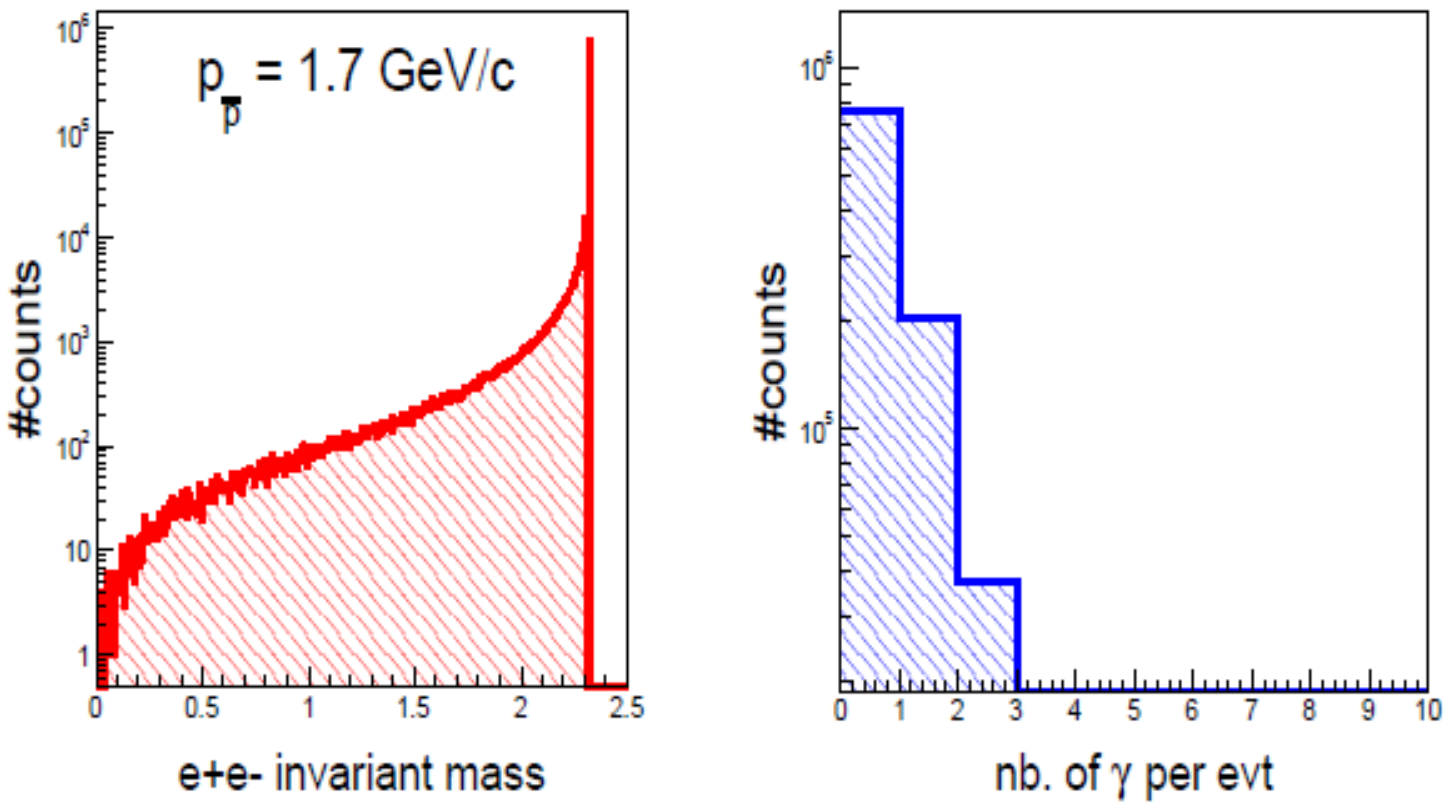
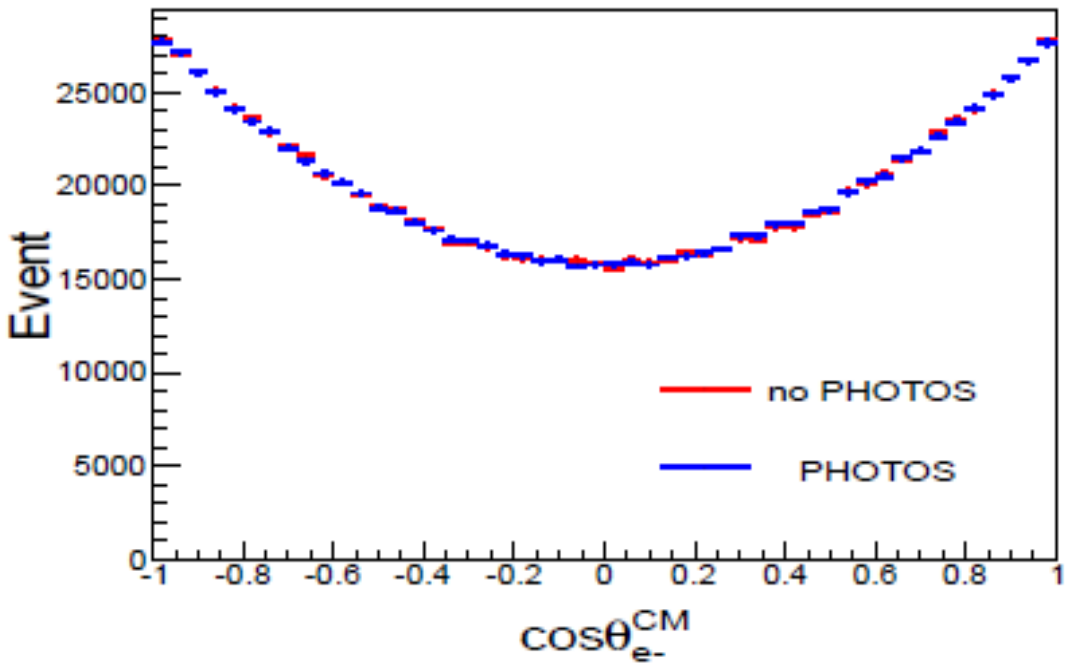


Fig. 2. Electron-positron invariant mass and Number of emitted γ's per event for $p_{\bar{p}}$ = 1.7 GeV.

Angular distribution of electron



Full phase space integration

Fig. 3. Angular distribution of the emitted electron, with and without Photos for $p_p = 1.7$ GeV.

Same angular distribution : The photons are emitted in photos collinear (in average) to the parent direction.

Opening angle positron-photon

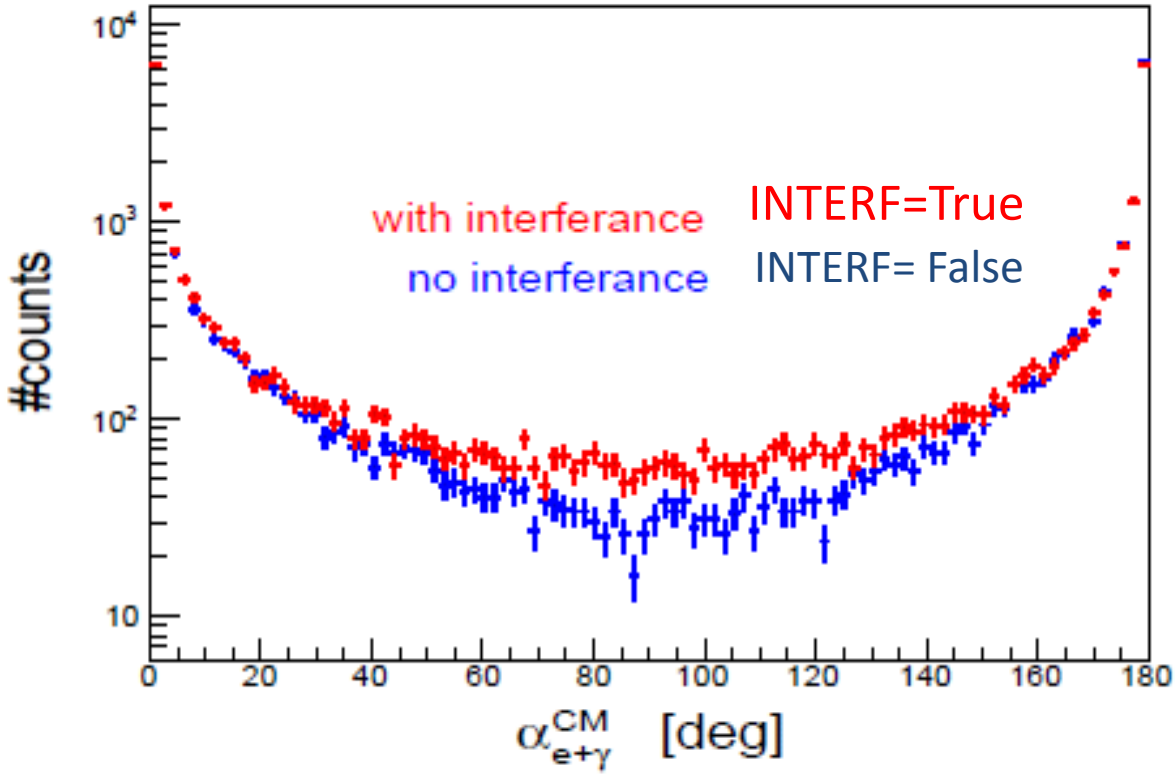
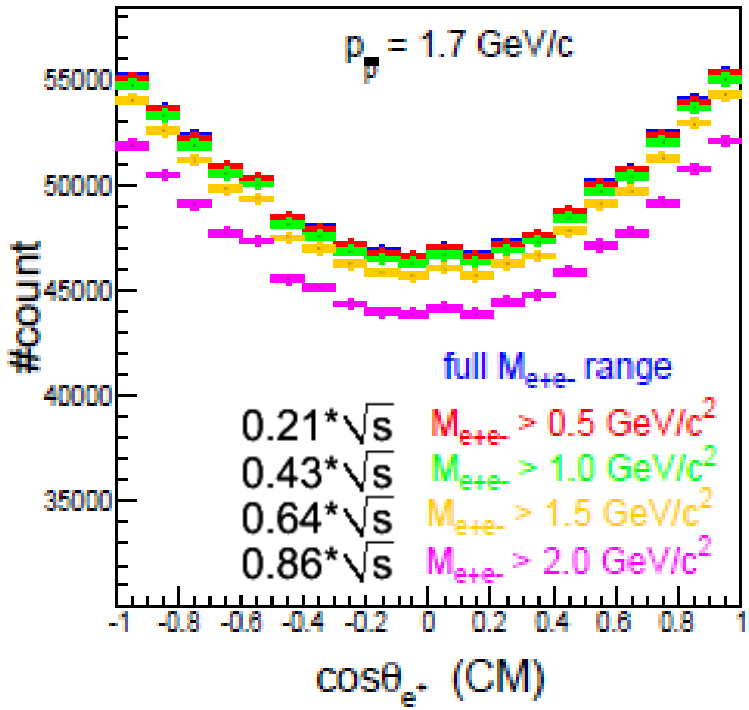
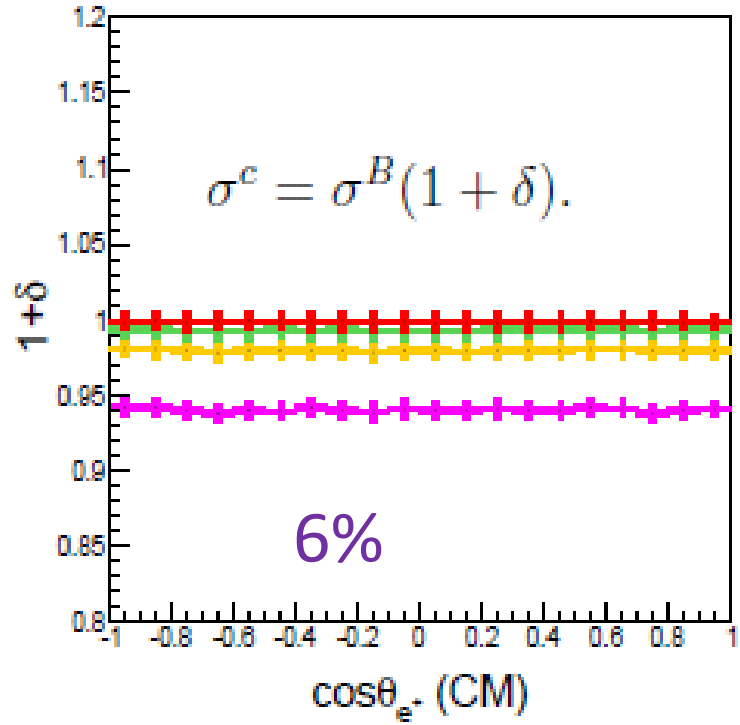


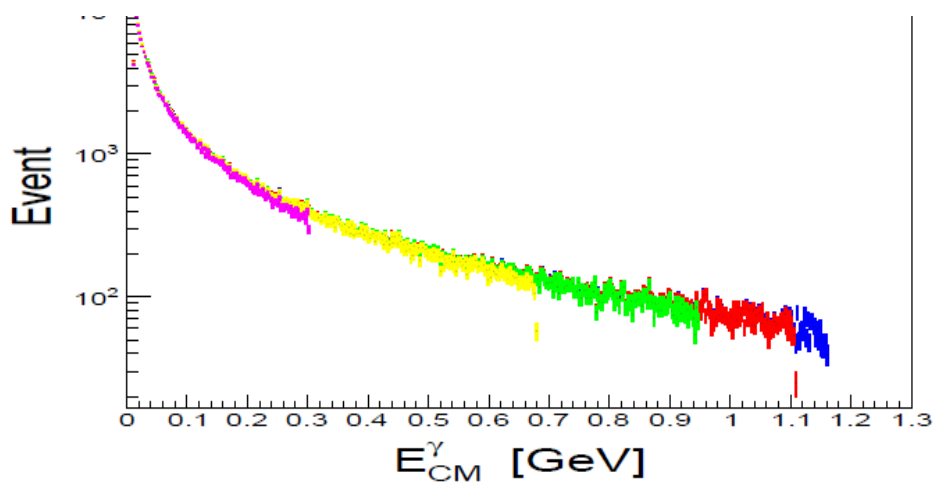
Fig. 4. Opening angle between positron and emitted photon in the CM, for $\bar{p}$ momentum of 1.7 GeV.

The photon can be emmitted from the electron or positron:

Angular distribution of positron with hard photon cut-off







References:

- **P. Golonka and Z. Was, Eur. Phys. J. C 45, 97 (2006).**

- **E. Barberio and Was, Comput. Phys. Commun. 79, 291 (1994).**