Polarization of particles in electromagnetic showers developing in media

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Processes important for shower formation

1. Pair production and Compton scattering
2. Bremsstrahlung, elastic scattering and ionization energy losses (iel)

Formulas describing all these processes (except iel) with account for polarizations of all particles involved have been rederived and computer programs are created

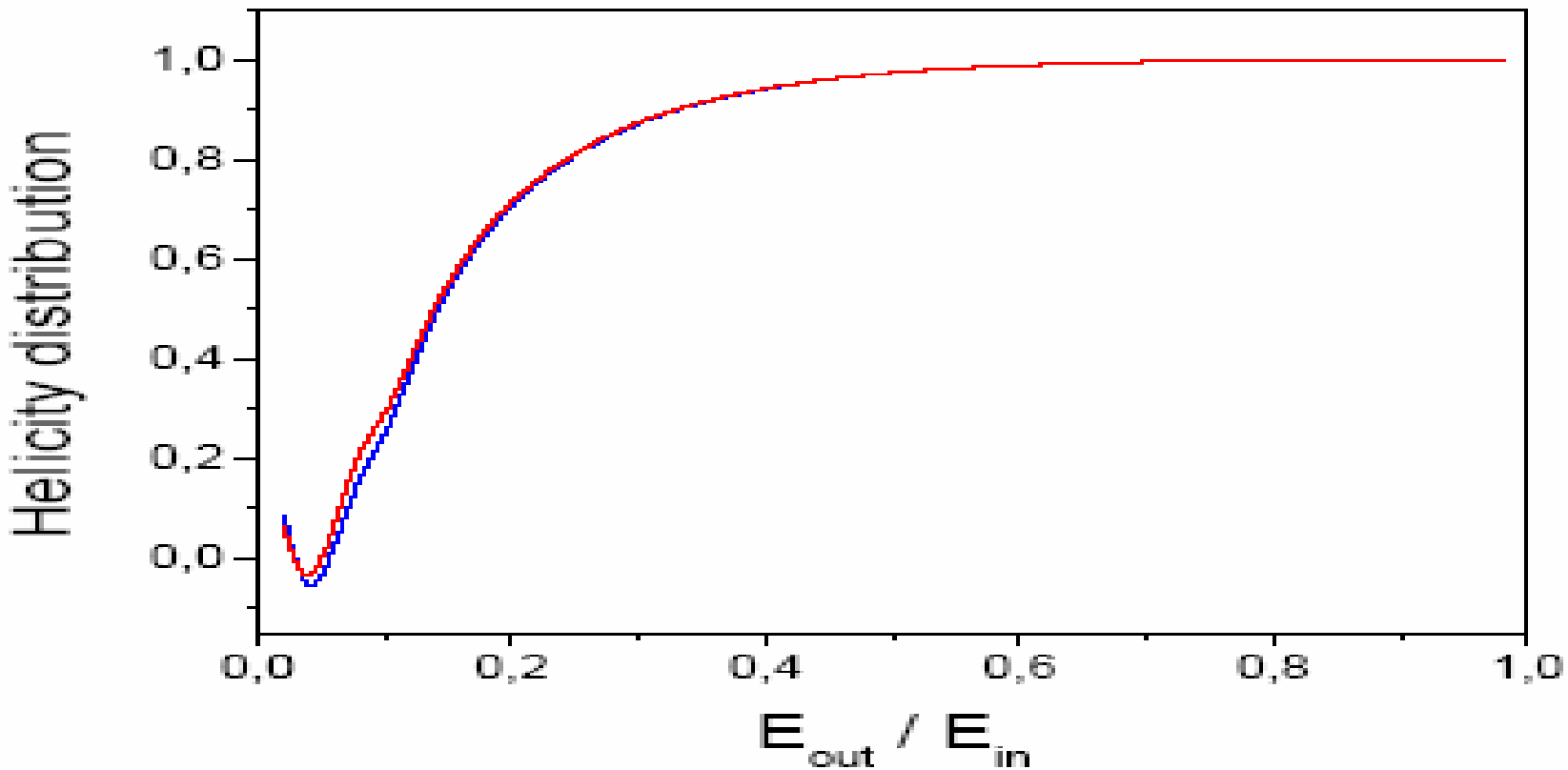
The following scheme is used in event generation:

1. Energies of particles are generated from the cross section summed up over all spins and integrated over angles (from spectra)

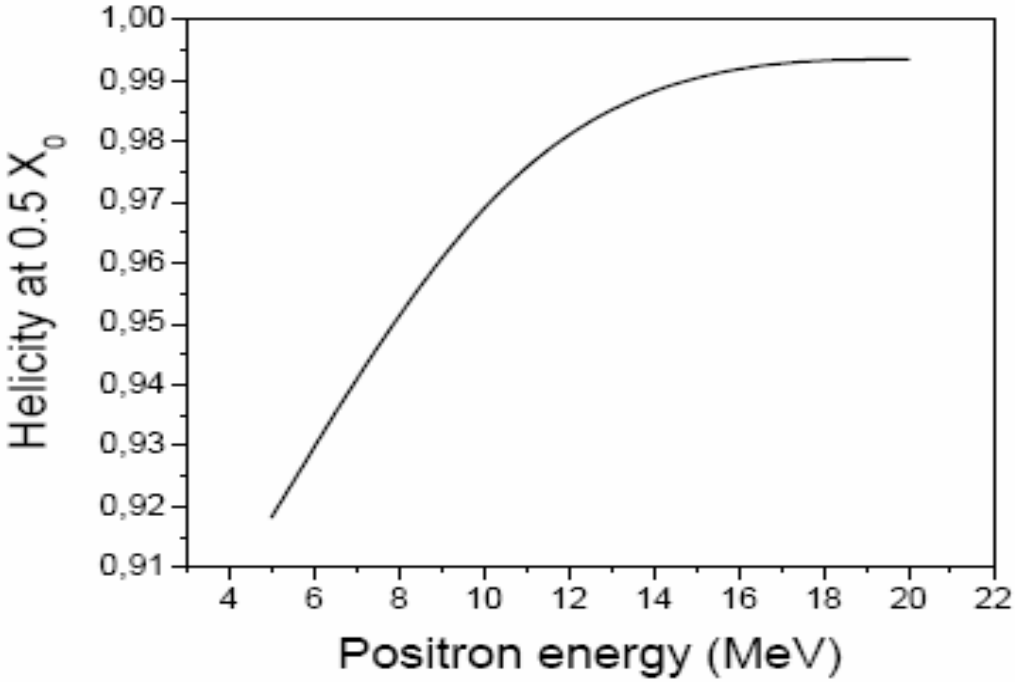
2. With energies obtained, momenta are generated from unpolarized cross section

3. With kinematics established the spin (or Stokes) vectors are obtained from the cross section with polarization

Depolarization of initial photons in Compton scattering at 5 MeV



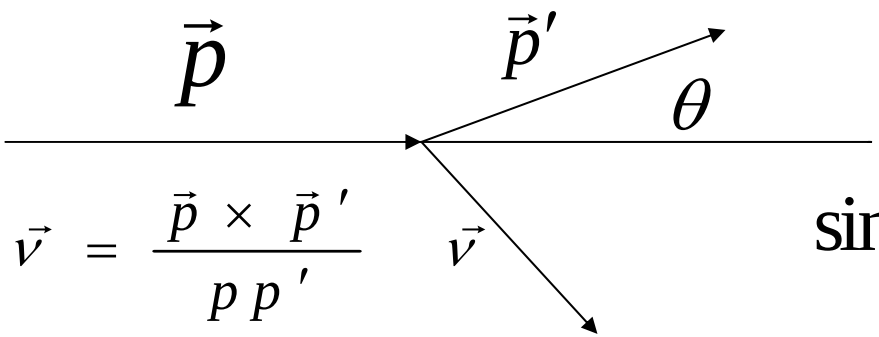
At x = 2 mm, 0.935 photons go through the target without scattering, keeping thereby the initial helicity = 1. At x = 4 mm, this number is 0.884



Positron depolarization

in elastic scattering

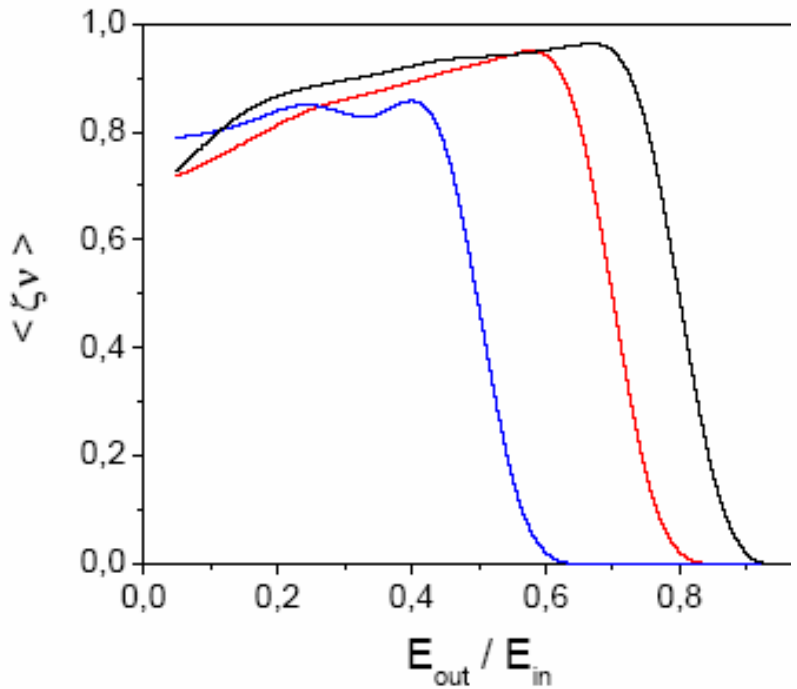
X = 1.75 mm

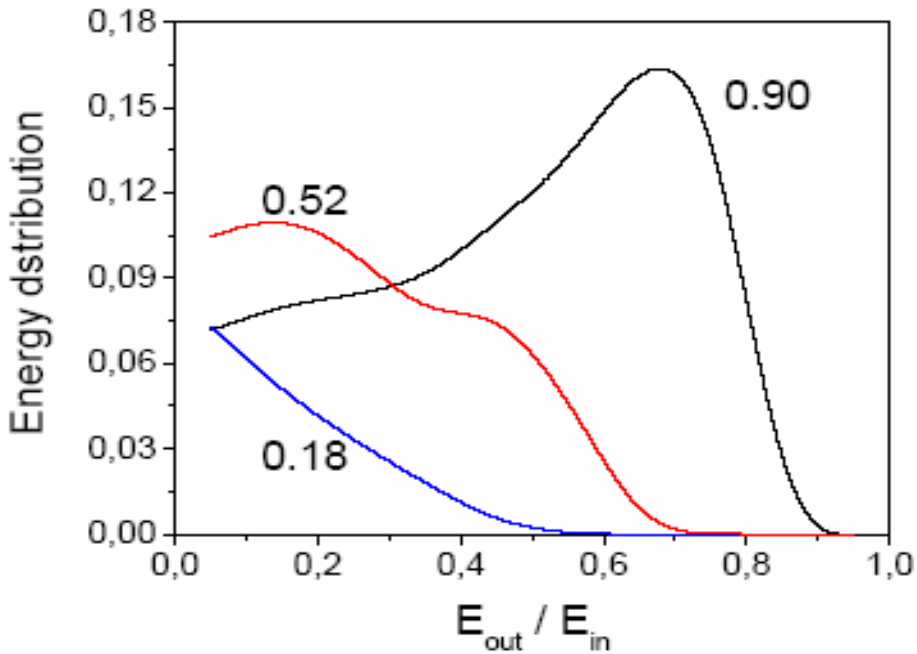


$$\sin\psi = (1-\gamma^{-1})\frac{\cos^2\frac{\theta}{2}+\gamma^{-1}\sin^2\frac{\theta}{2}}{\cos^2\frac{\theta}{2}+\gamma^{-2}\sin^2\frac{\theta}{2}}\cdot\sin\theta$$

During single scattering spin vector $\vec{\zeta}$ rotates around $\vec{\nu}$ like $\vec{p}$

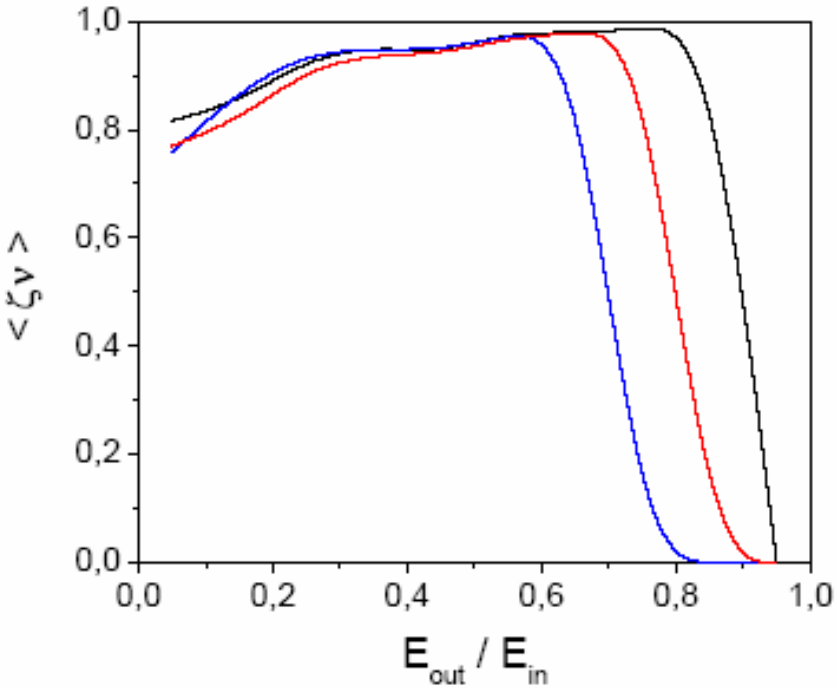
Depolarization of positrons in bremsstrahlung

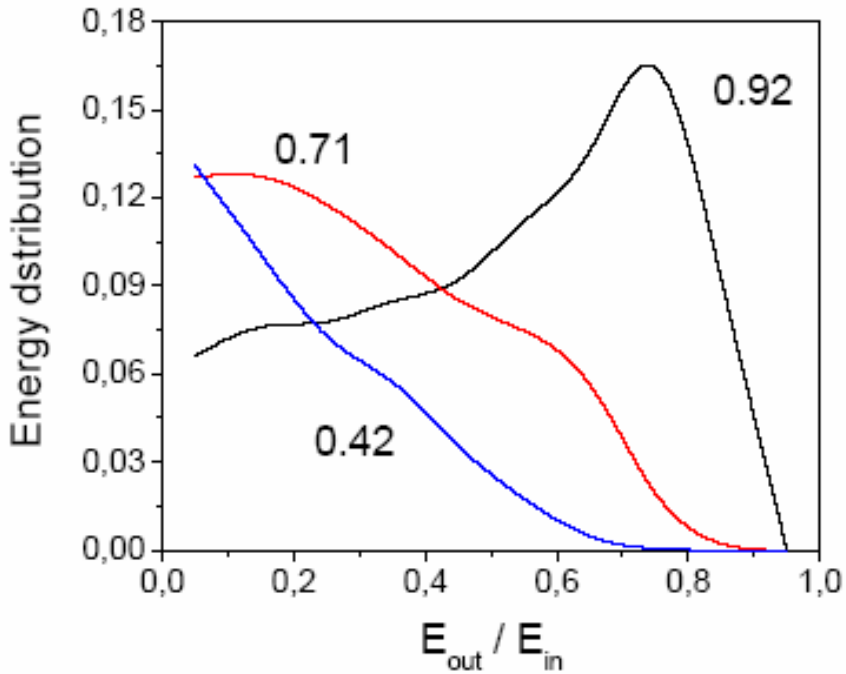




X=0.175 cm(black) X=0.35cm (red) X=0.525 cm (blue)

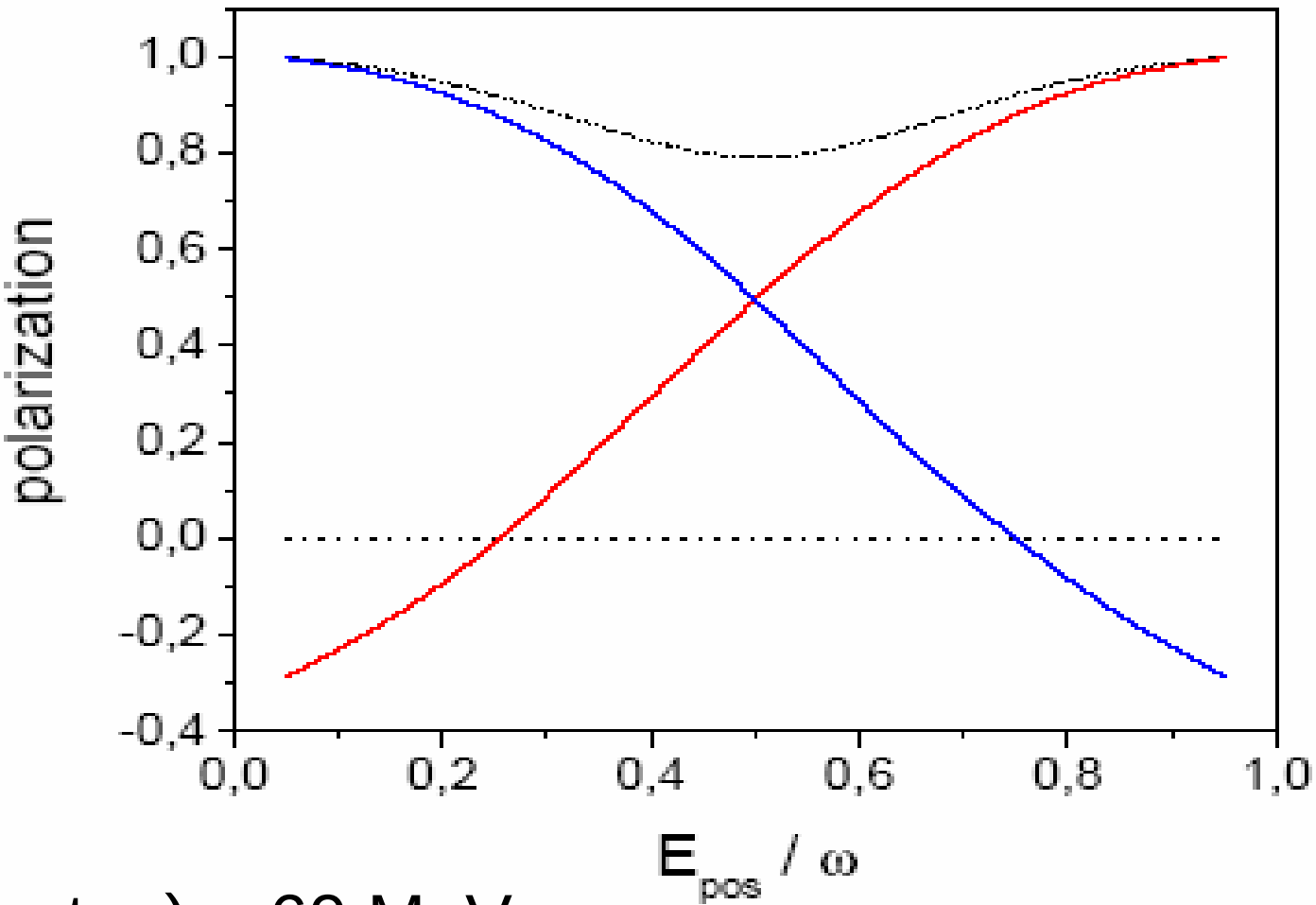
Numbers give the ratio N(out) / N(in) E(in) =30 MeV


1,0
0,8
0,6
0,4
0,2
0,0
0,0
0,2
0,4
0,6
0,8
1,0
< ζν >
E_out / E_in


0,18
0,15
0,12
0,09
0,06
0,03
0,00
0,0
0,2
0,4
0,6
0,8
1,0
Energy dstribution
0.92
0.71
0.42
E_out / E_in

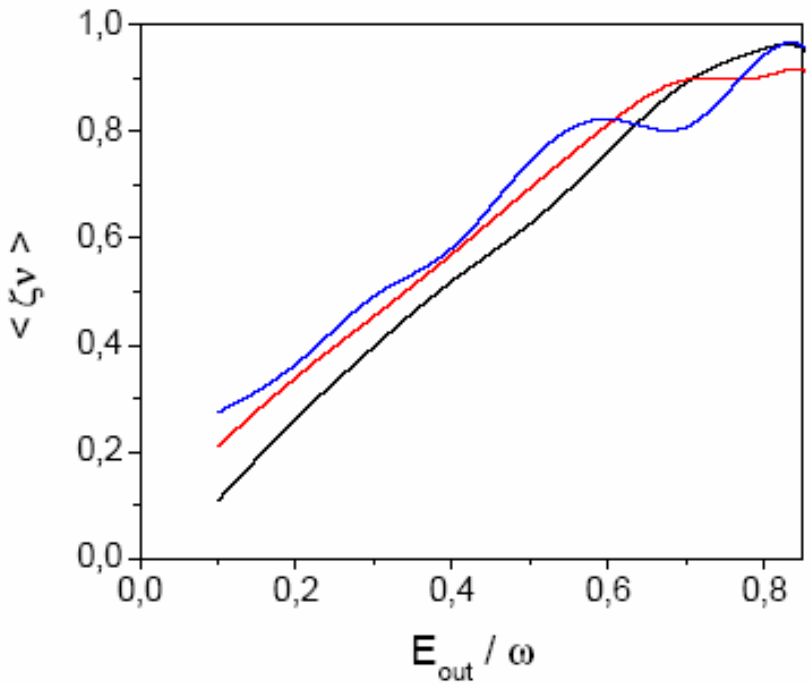
E(in) = 60 MeV

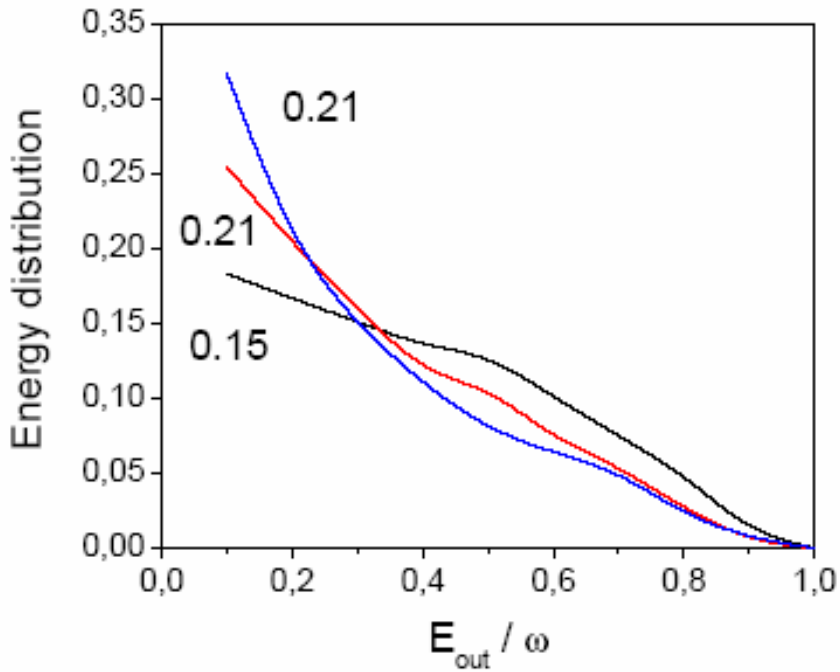
Pairproduction



E(photon) = 60 MeV

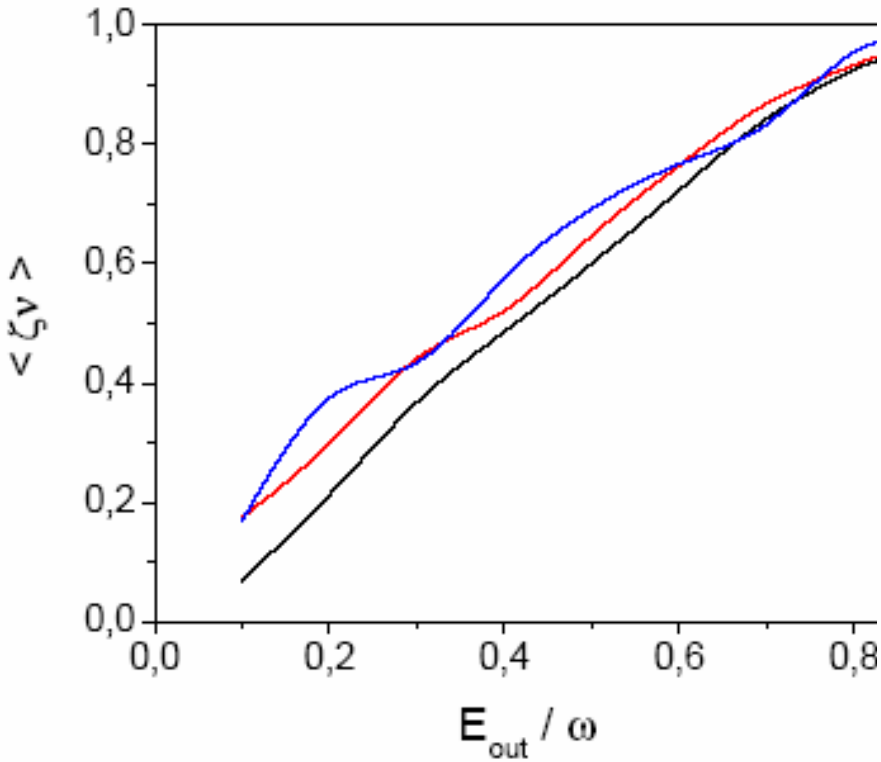
Shower initiated by completely circularly polarized photon (simplified illustration)

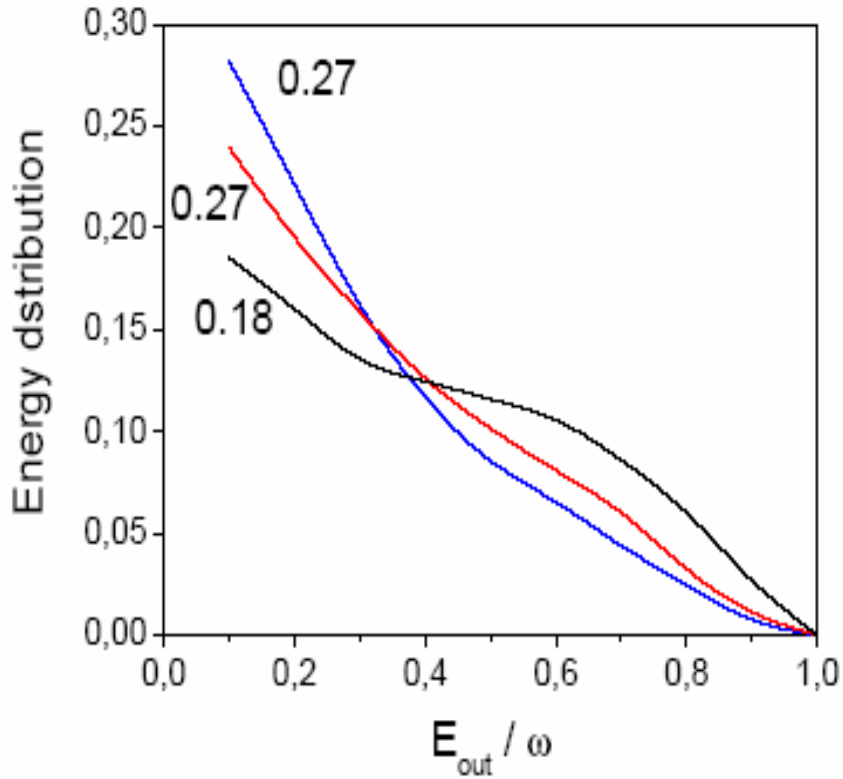




E(photon) = 30 MeV

Shower initiated by completely circularly polarized photon (simplified illustration)





E(photon) = 60 MeV

Conclusion

The code describing electromagnetic shower development with an account for polarizations of all the involved particles is practically completed