Generation of polarized positrons in a target: photoproduction and related phenomena

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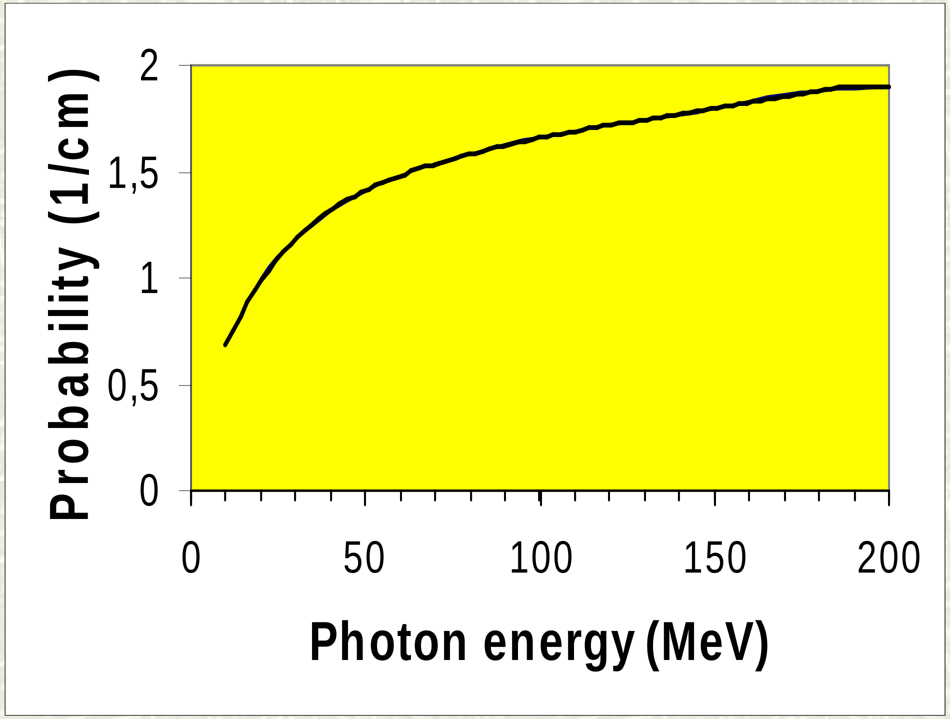
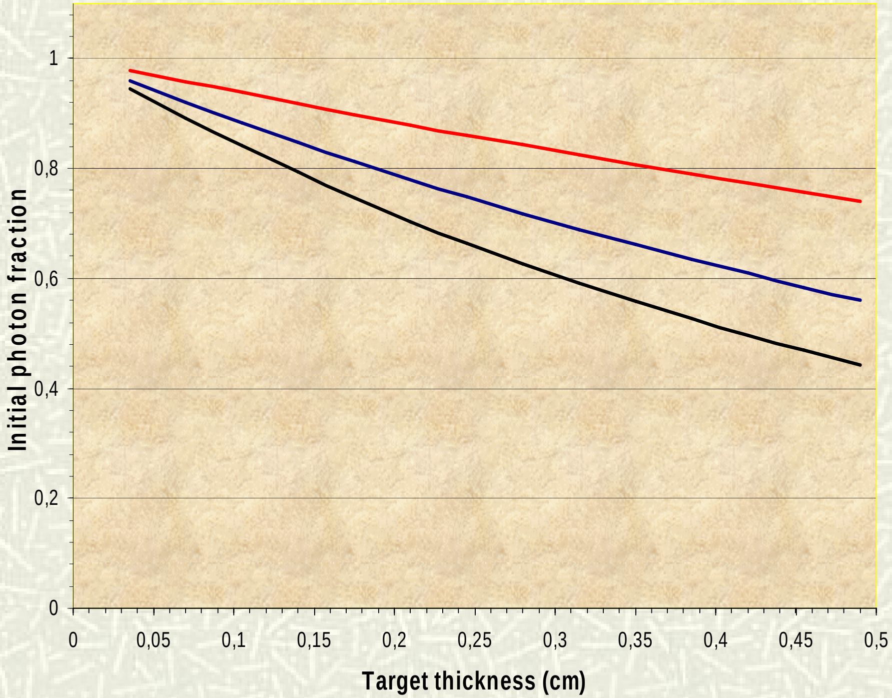
Introduction

- Longitudinally polarized positrons are produced during conversion of photons
- The energy decreases due to bremsstrahlung and ionization energy loss (target heating), the angular spread increases in multiple scattering
- Depolarization due to bremsstrahlung and multiple scattering should be estimated
- Nuclear photo-absorption leading to hadronic background should be avoided

Total cross section of photoproduction

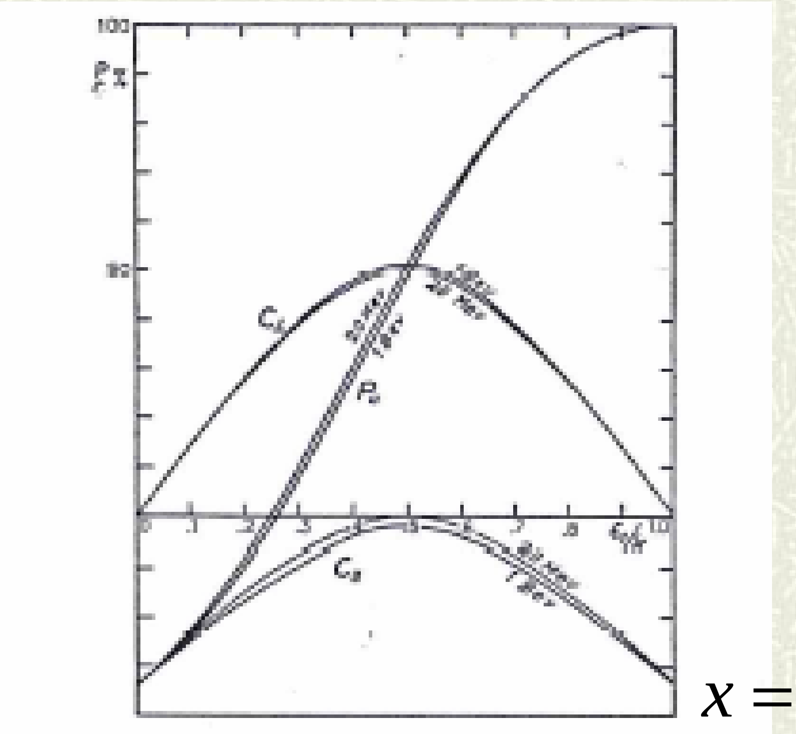
Description of both processes at high energy with account for all polarizations, screening and Coulomb corrections was obtained in H.Olsen and L.G.Maximon, Phys.Rev. **114** (1959) 887.



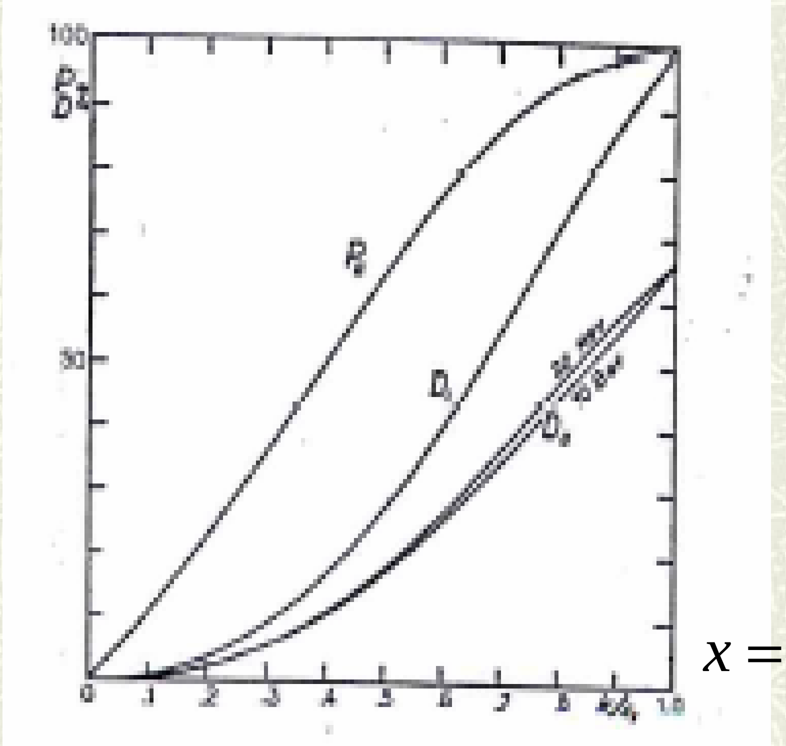


Spectral distribution of longitudinal (circular) polarization in PP and BRS

For both processes the helicity transfer is the most effective in the hard part of the spectra



$x = \varepsilon / \omega$



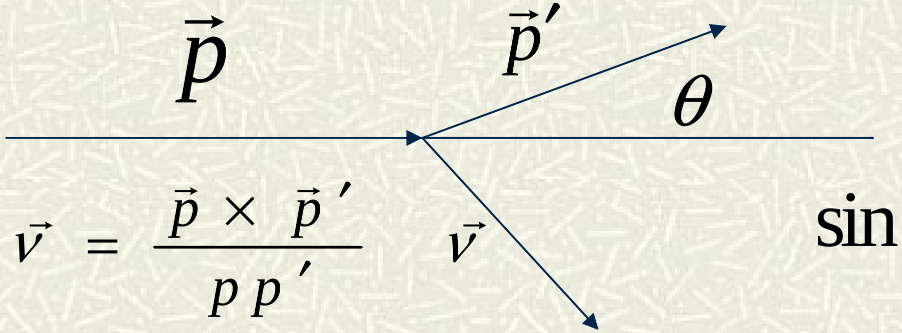
$x = \omega / \varepsilon$

Depolarization

For BRS depolarization length was estimated as (remember energy dependence of radiation length)

$$L_{dep}^{-1} = 2N_A\sigma_{flip}\ ,\ L_{dep} \approx 2L_{rad} \Big/ (1-\frac{1}{3}\zeta_{\square}^2)$$

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



$$\vec{v} = \frac{\vec{p} \times \vec{p}\,'}{p\,p\,'}$$

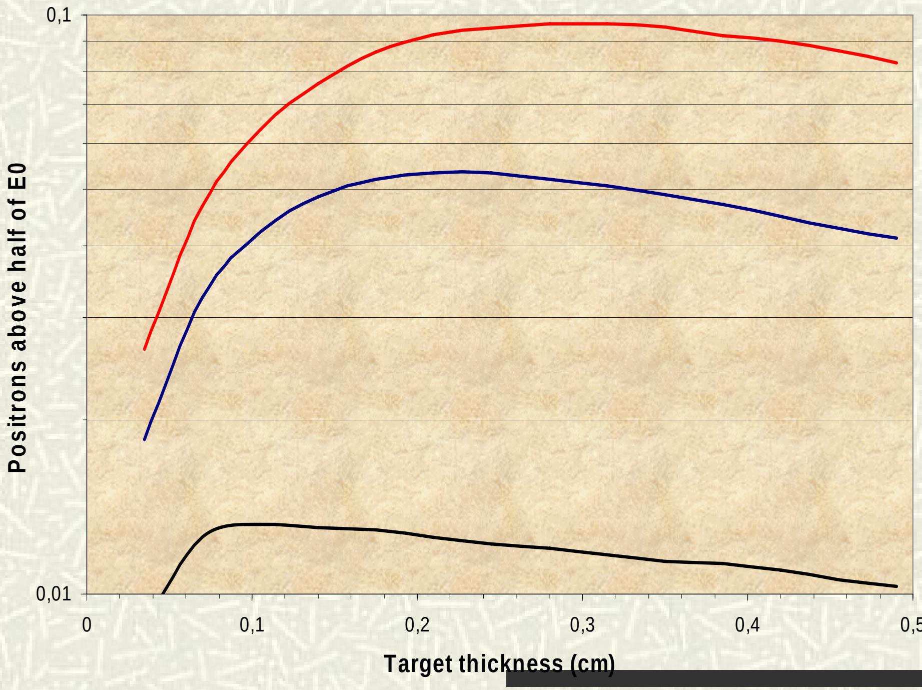
$$\sin\psi = (1-\gamma^{-1})\frac{\cos^2\frac{\theta}{2} + \gamma^{-1}\sin^2\frac{\theta}{2}}{\cos^2\frac{\theta}{2} + \gamma^{-2}\sin^2\frac{\theta}{2}} \cdot \sin\theta$$

Depolarization during multiple scattering is negligible at high positron energy

Simulation

Polarization variables should be simulated only for pairproduction and bremsstrahlung and ignored e.g. in multiple scattering etc.

Many issues can be investigated using existing codes



Conclusion

- Polarization variables should be simulated only for processes of photoproduction and bremsstrahlung
- Everything is going better in a target with an increase of the incident photon energy.
- Target material and thickness should result from some optimization procedure accounting for all important processes involved