Comparison of experimental data on photon polarization obtained by Giessen group and theory developed by Olsen and Maximon using two different ways of screening: complete screening and arbitrary screening (Thomas-Fermi model).

First, let's look at the experimental data obtained by Giessen group [1] (*Fig. a* below).

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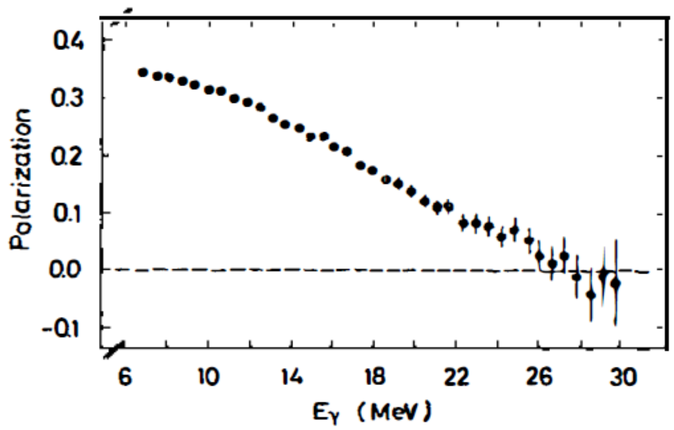

Figure 13 Degree of polarization of off-axis bremsstrahlung as a function of the photon energy ($E_0 = 30$ MeV, $\theta = 1.4°$) (49).

Fig. a. Experimental data by Giessen group [1].

Now let's compare the experimental data to the theoretical data [2] calculated for the same conditions.

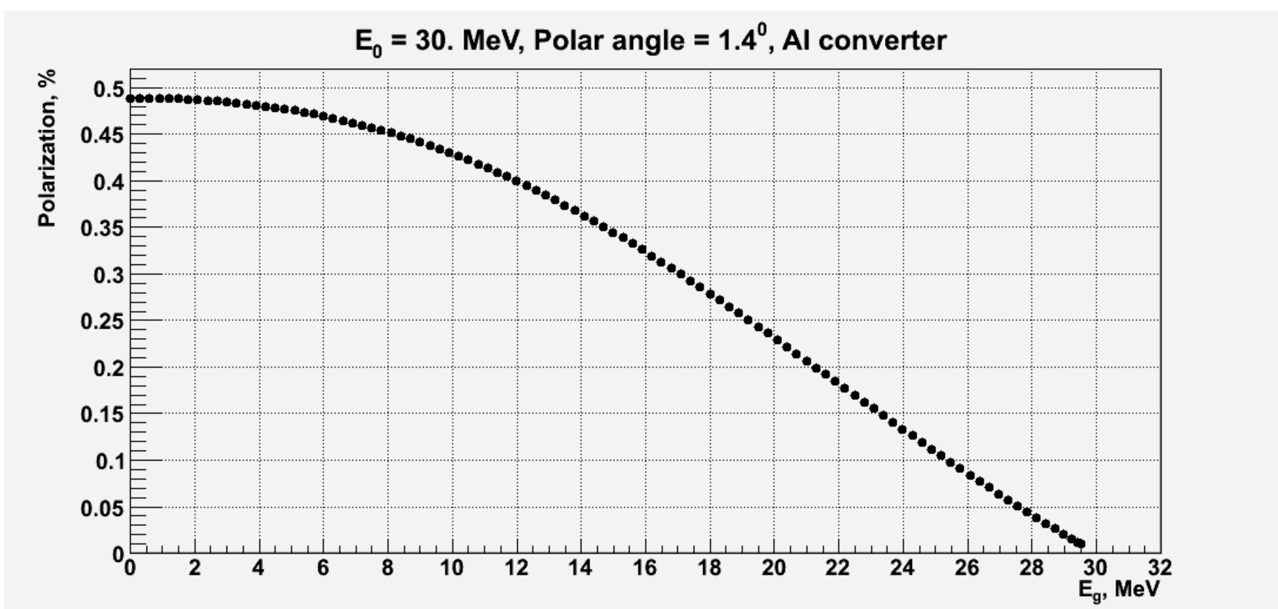

Fig. b. Polarization degree of photon beam at the emission angle 1.4 degree produced by 30.0 MeV electrons on Al (Z=13) converter. **Complete screening.**

Comparison of the two figures gives one systematic 10.0 % discrepancy in photon polarization. The theory gives ~10.0 % polarization higher in the whole range of photon energies.

The deviation may be explained by finite collimation angle in the experiment and admixture of photons with different polarizations hitting analyzing target.

Using different way of screening [2] (Thomas-Fermi model as used by Molière) we got the following result for electron energy 30 MeV and photon emission angle 1.4 degree (again reproduction of Giessen data):

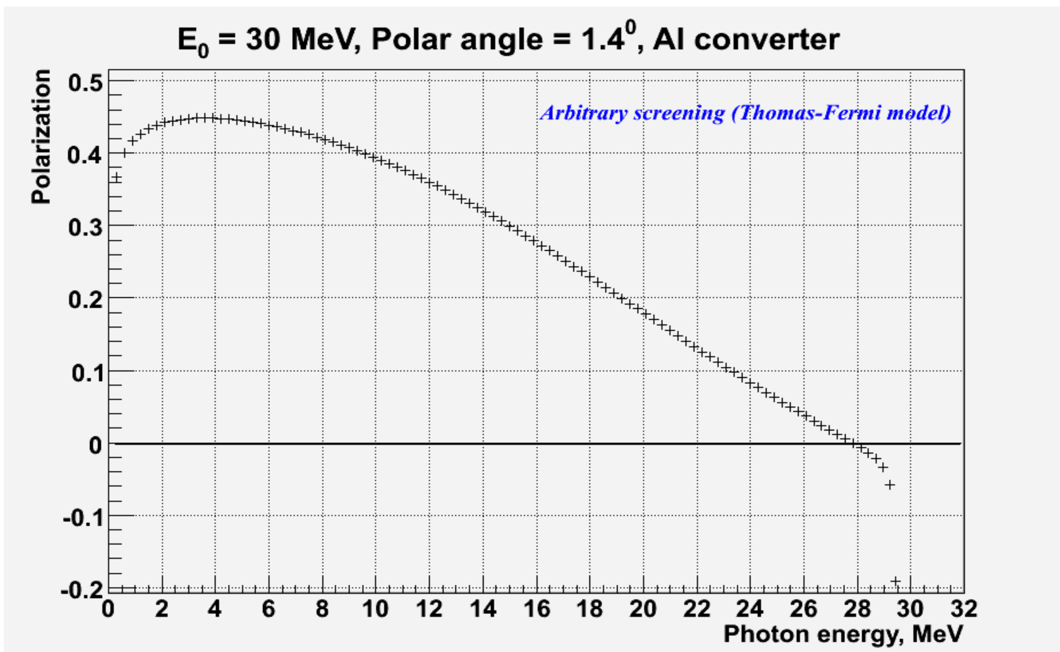

Fig. c. Polarization degree of photon beam at the emission angle 1.4 degree produced by 30.0 MeV electrons on Al (Z=13) converter. **Arbitrary screening (Thomas-Fermi model).**

Arbitrary screening gives less discrepancy (~ 5 %) in the agreement of theory and experiment. Also one can observe a different behavior of the polarization at high and low energies of bremsstrahlung photons.

According to [3] the effect of screening should be considered only for recoil momenta (gained by nucleus?)

$$q < Z^{1/3}/137 \quad .$$

Minimum value of the recoil momentum can be defined by

$$q_{min} = k/2 \cdot e_1 \cdot e_2 \quad .$$

Maximum value of q may be infinite. For Aluminum $Z^{1/3}/137 = 0.017$.

Plotting the recoil momenta values vs. scattered electron momentum we have (see *Fig. d*):

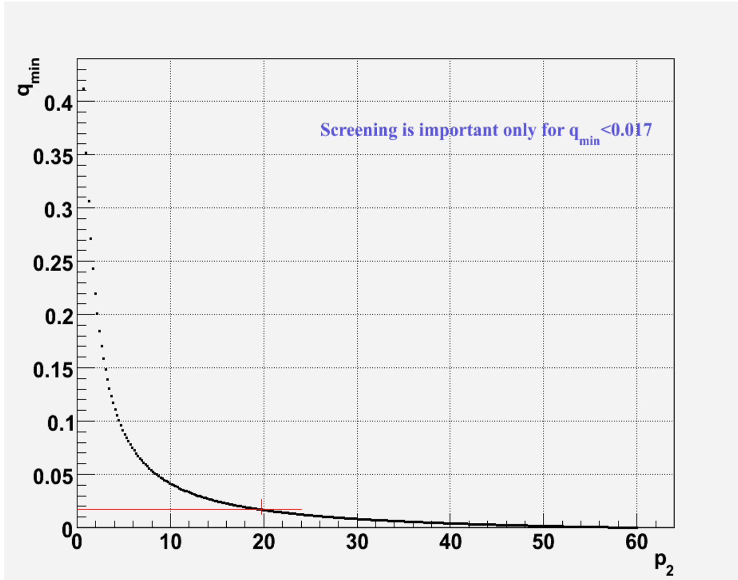

Fig. d. Recoil momentum vs. momentum of scattered electron.

For q_{min} = 0.017 we have p_2 = 19.8 . The result of combination of the two models is presented in *Fig. e* below.

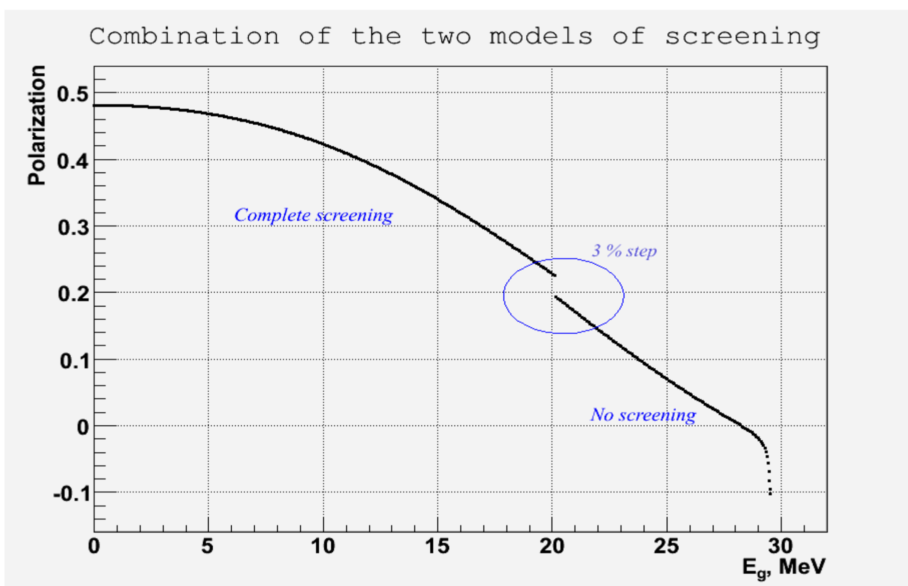

Fig. e. Polarization as a function of bremsstrahlung photon energy
for the case of two model combination: complete screening + no screening.
Ee=30MeV, emission angle 1.4 degree.

There is a step of about 3 % at the connection point 20.02 MeV (q=0.017).

If we use Thomas-Fermi model instead of "no screening" model, we obtain the following:

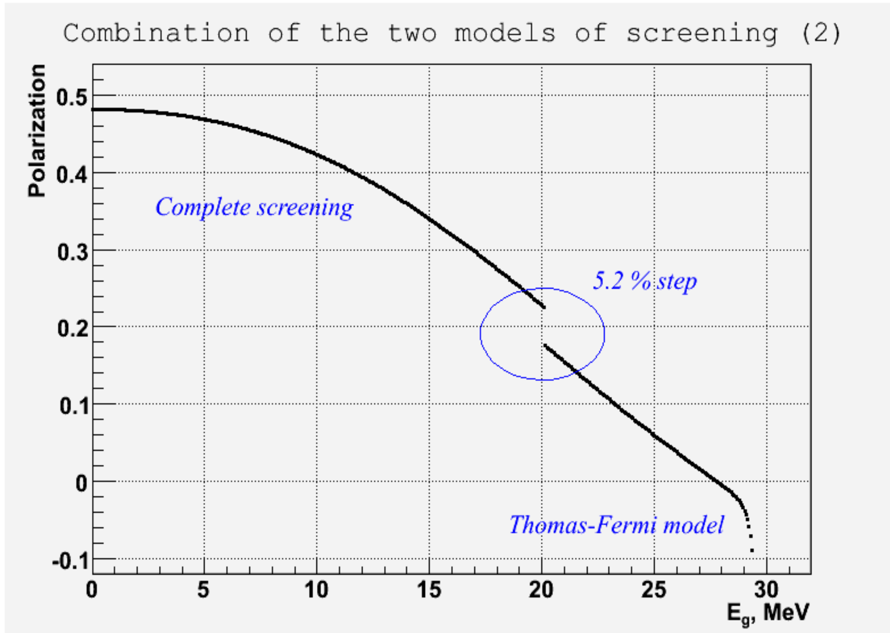

Fig. f. Polarization as a function of bremsstrahlung photon energy
for the case of two model combination: complete screening + Thomas-Fermi model.
Ee=30MeV, emission angle 1.4 degree.

In this case we have a step of about 5.2 % at the connection point 20.02 MeV (q=0.017).

References.

[1]. Ulrich E. P. Berg, Ulrich Kniessl, *Recent Progress on Nuclear Magnetic Dipole Excitations*, Ann. Rev. Nucl. Part. Sci. 1987.37:33-69

[2]. Haakon Olsen, L.C. Maximon, *Photon and Electron Polarization in High-Energy Bremsstrahlung and Pair Production with Screening*, Phys. Rev. **114**, 887 (1959)

[3]. Handel Davies, H. A. Bethe, L. C. Maximon, *Theory of Bremsstrahlung and Pair Production. II. Integral Cross Section for Pair Production*, Phys. Rev. **93**, 788 (1954)