

PEPPO: USING A POLARIZED ELECTRON BEAM TO PRODUCE POLARIZED POSITRONS



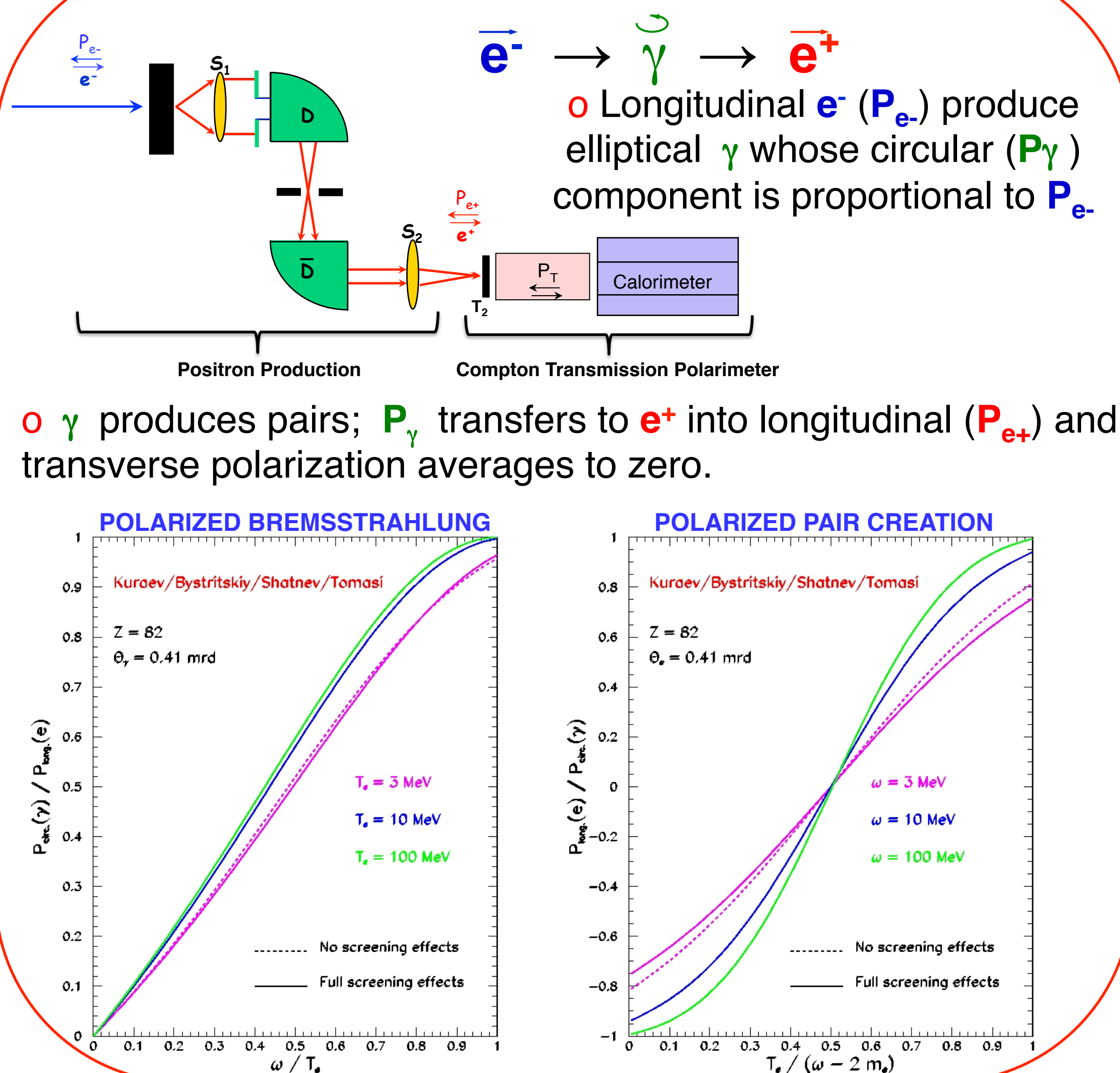
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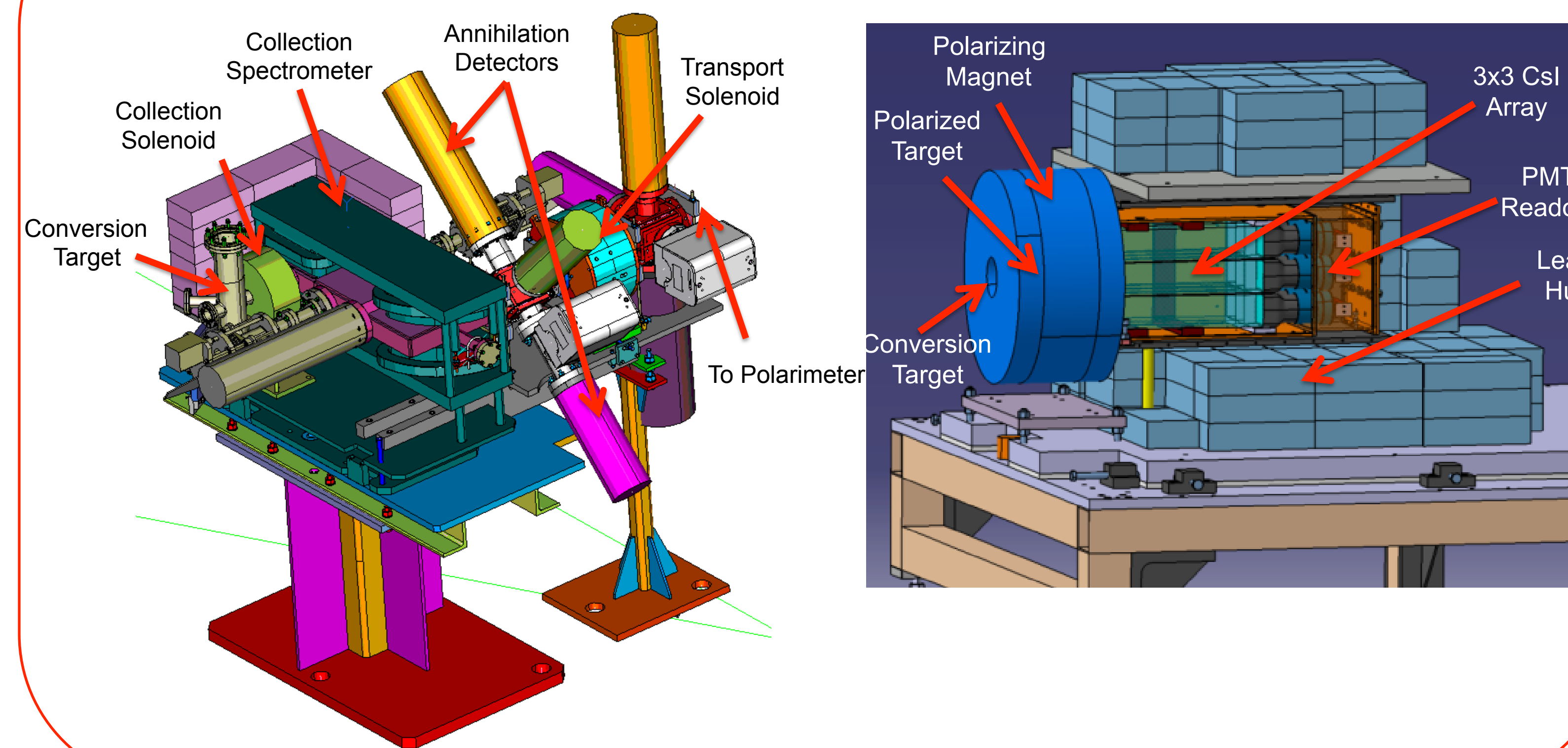
Abstract

The PEPPO (Polarized Electrons for Polarized Positrons) experiment was conducted in the injector of the CEBAF accelerator at Jefferson Lab to demonstrate a new technique for the production of polarized positrons. It involves a two-step processes : the creation of circularly polarized photons from the bremsstrahlung interaction of longitudinally polarized electrons in a target followed by the creation of polarized e^+e^- pairs via the pair production from the photons, within the same target.

Principle of Operation

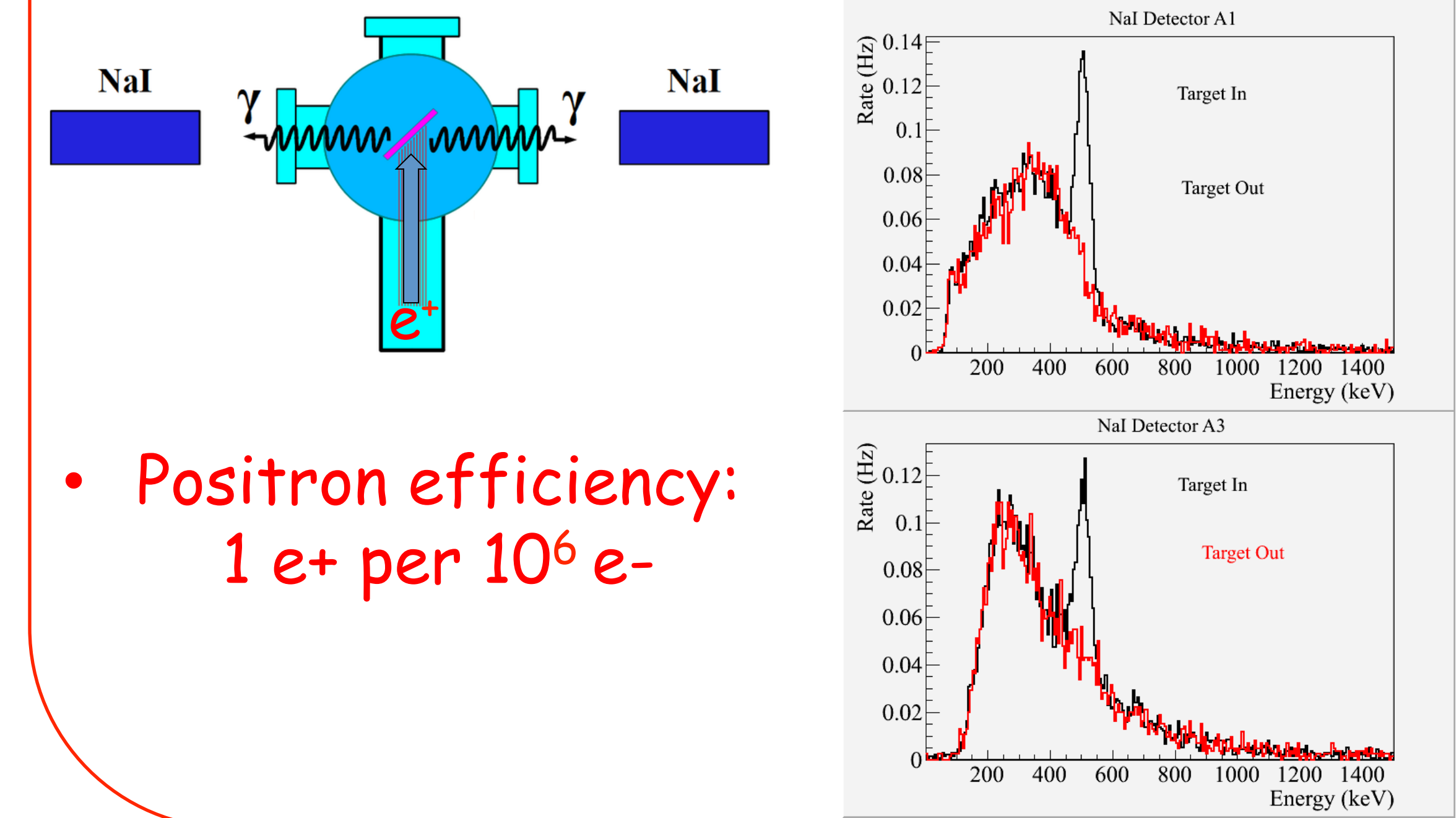


Experimental setup



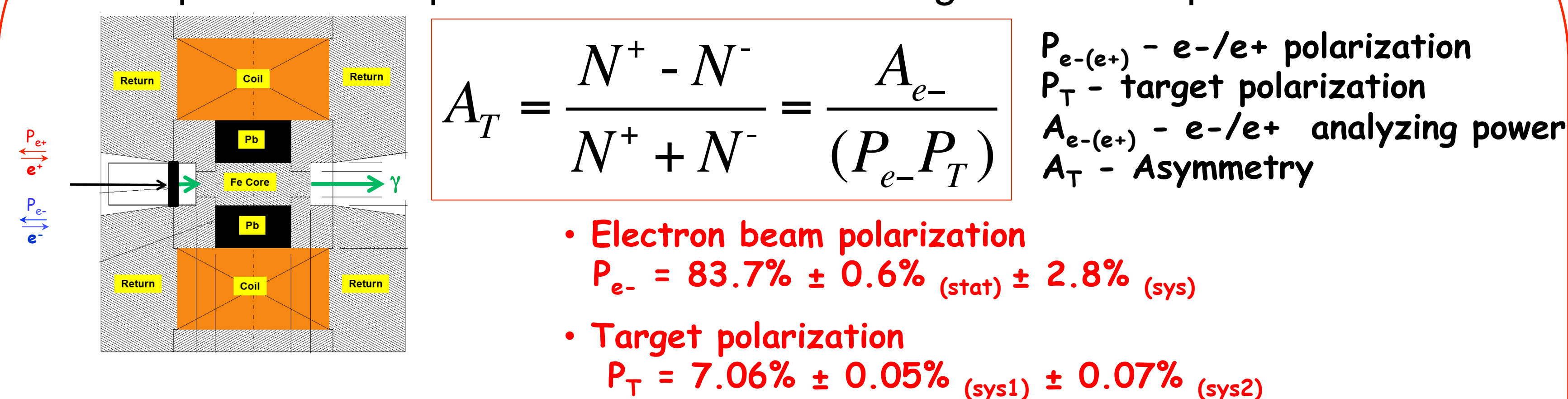
Positron detection

The positrons produced in the PEPPO experiment are detected using a set of two annihilation counters. The positrons stopped in an insertable 0.011" chromox target and the corresponding 511 keV photons detected in coincidence with two NaI detectors.

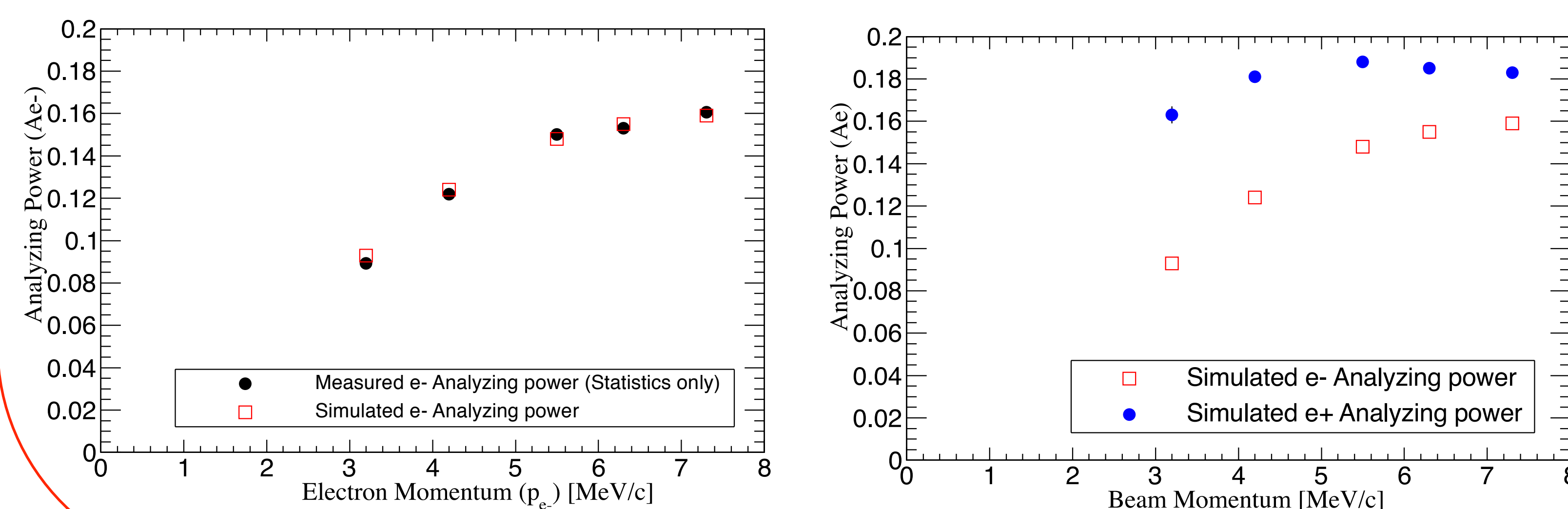


Compton polarimeter calibration

The Compton scattering of photon transmitted through the polarized target corresponds to the polarization of the incoming electron or positrons



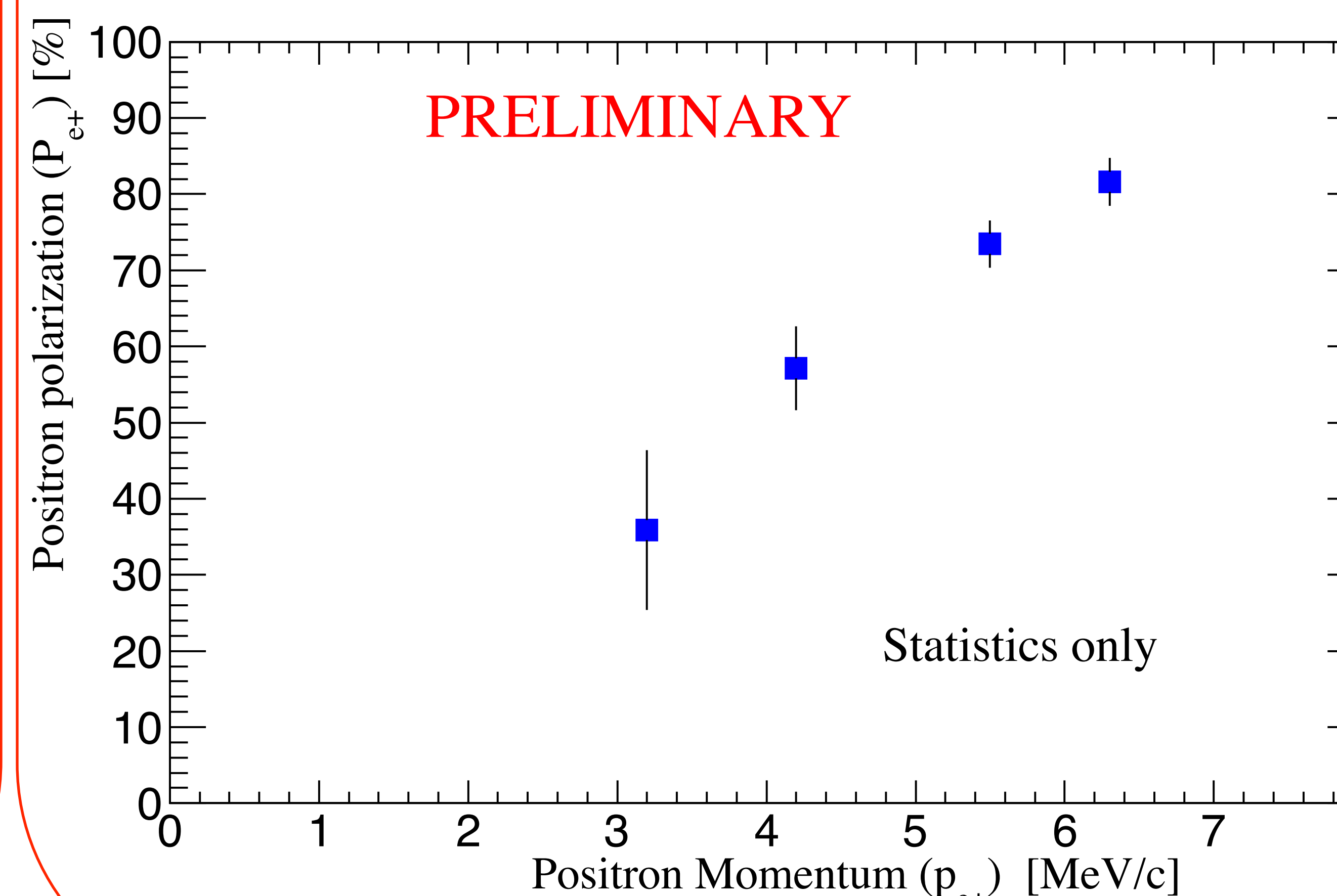
The calibration of the analyzing power for the PEPPO experiment relies on electron experimental data and the positron analyzing power is obtained directly from the simulations.



Positron polarization

With the measured asymmetry of positrons (A_T) the target polarization (P_T) and the simulated positron analyzing power (A_{e^+}), the positron polarization is calculated.

$$P_{e^+} = A_T / (A_{e^+} P_T)$$



Conclusions

- Used an 8.2 MeV/c electron beam with polarization 84% to generate positrons by successive polarized bremsstrahlung and polarized pair production in a 1mm tungsten foil.
- Detected and estimated positron yield with an annihilation detector.
- Used a Compton transmission polarimeter and benchmarked a Geant4 model of polarimeter with a known electron polarization in order to calculate the analyzing power for positrons.
- Collected positrons in the range of 3.1-6.2 MeV/c and measured their polarization as high as 80%.