# Bhabha polarimeter update

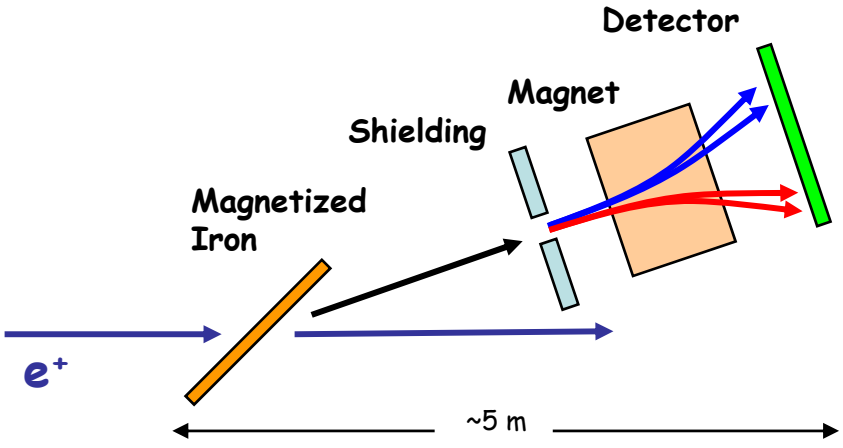
R. Dollan


# Bhabha-Polarimeter Update

- $E_{beam}$: after pre acceleration ~ 400 MeV
- cross section:

$$\frac{d\sigma}{d\Omega} = r_0^{\,2}\,\frac{(1+\cos\theta)^{\,2}}{16\gamma^2\sin^4\theta}\left\{\left(9+6\cos^2\theta+\cos^4\theta\right)-P_{e^+}P_{e^-}\left(7-6\cos^2\theta-\cos^4\theta\right)\right\}$$

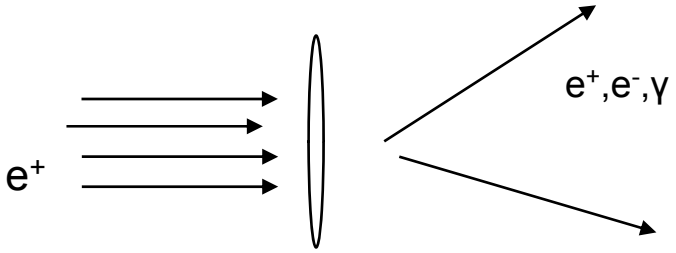
- theor. max. asymmetry bei 90°(CMS) ~ 7/9 ≈ 78 %
- example: $P_{e+}$= 80%, $P_{e-}$= 7% $A_{max}$ ~ 4.4 %



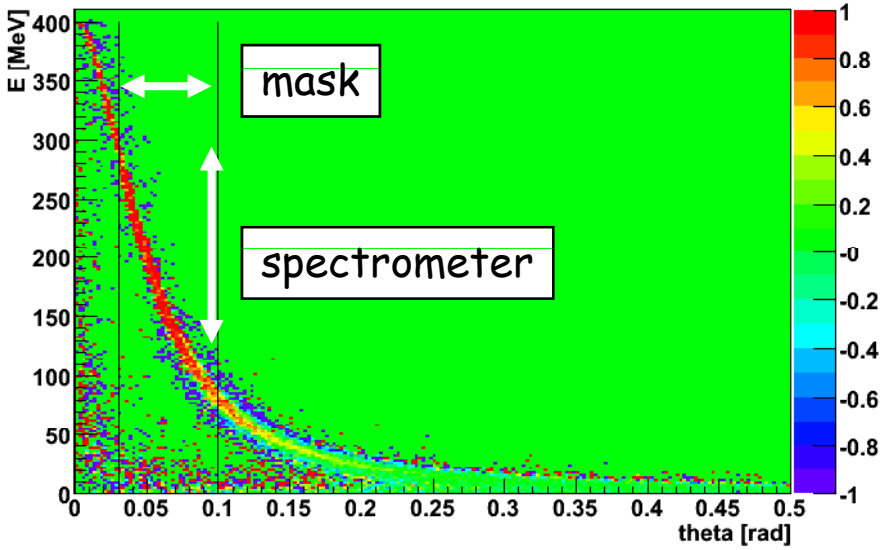

- Mask/shielding selects angular range with max. asymmetry
- spectrometer -> particle separation, energy selection
- Polarization measurements
  -> Asymmetry measurements of opposite polarization states of the target

# $e^-$ produced the target

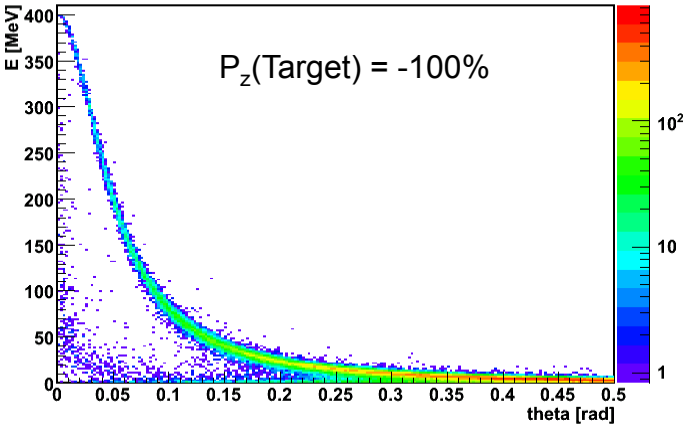
- 30 µm magnetized Fe-Foil
- $E_{beam}$ : 400 MeV (10 % spread)
- Ang. Spread : 0.5°

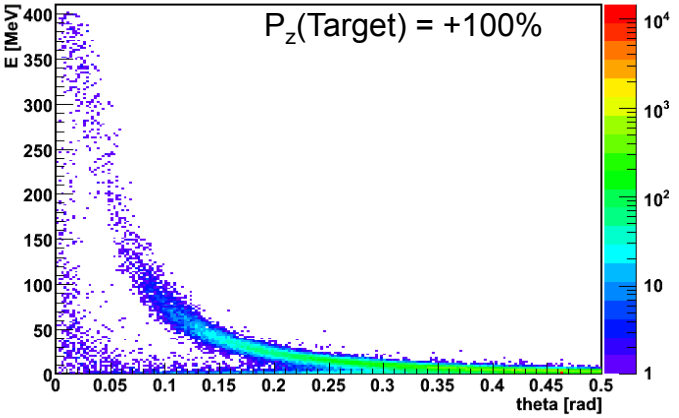



asymmetry (analyzing power)



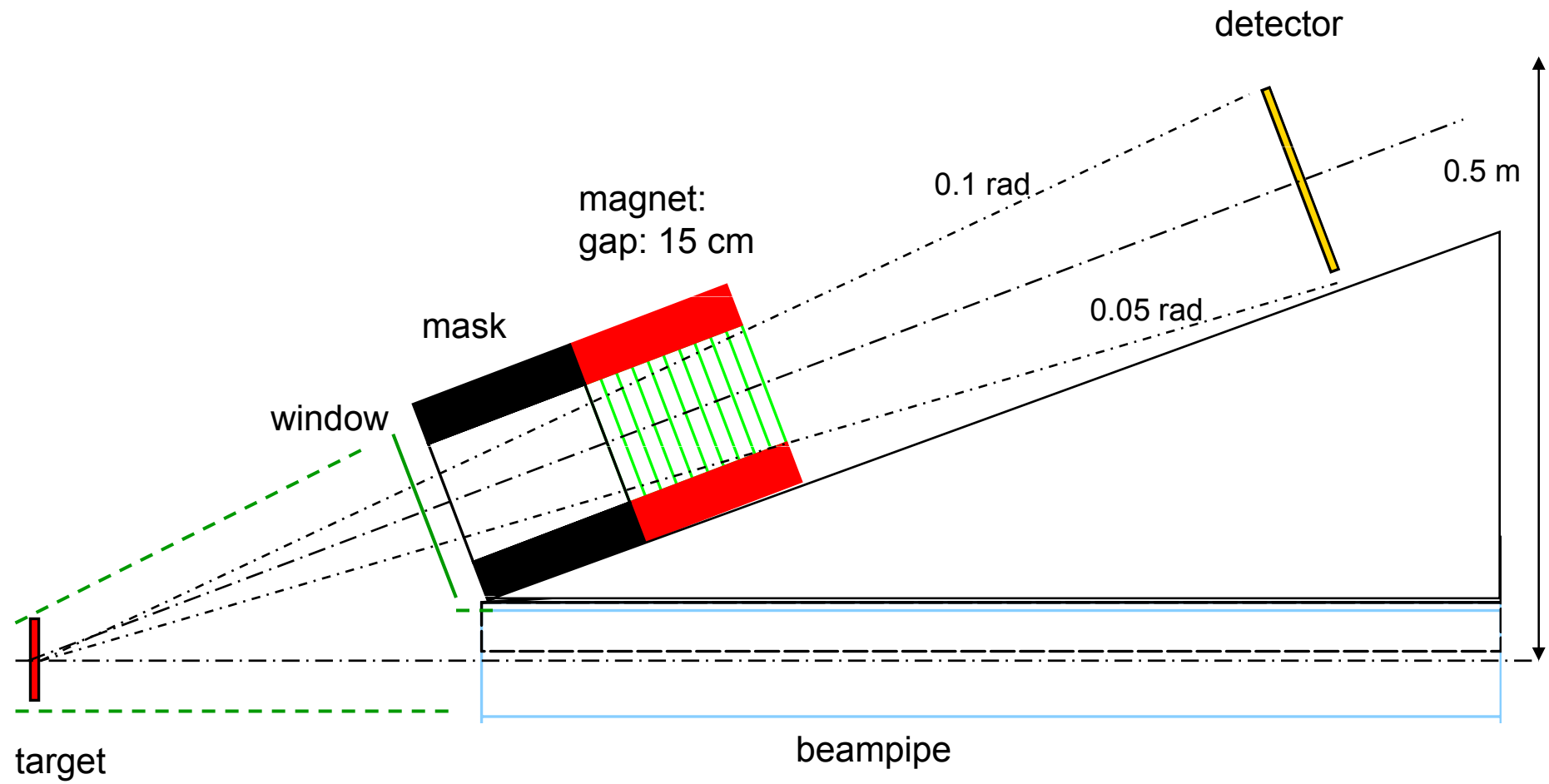

$e^-$ distribution



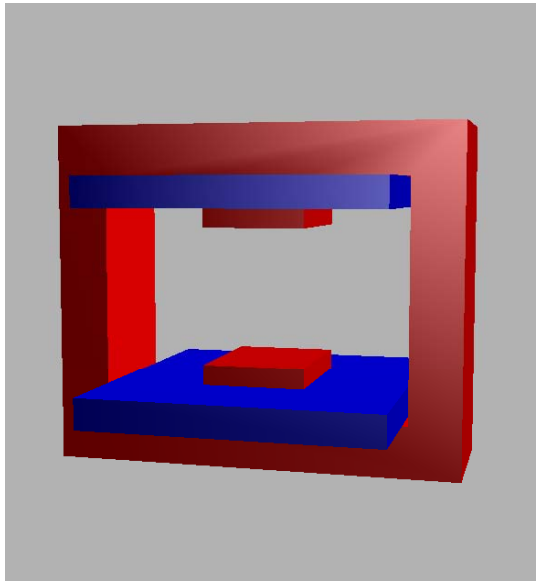

ang. range of interest: 0.03 – 0.1 rad
-> Asymmetry in the ang. range: $A_{e-}$ ~50 %
($A_{e+}$ ~5%, $A_\gamma$ ~-15%)

# "spring" geometry




not to scale

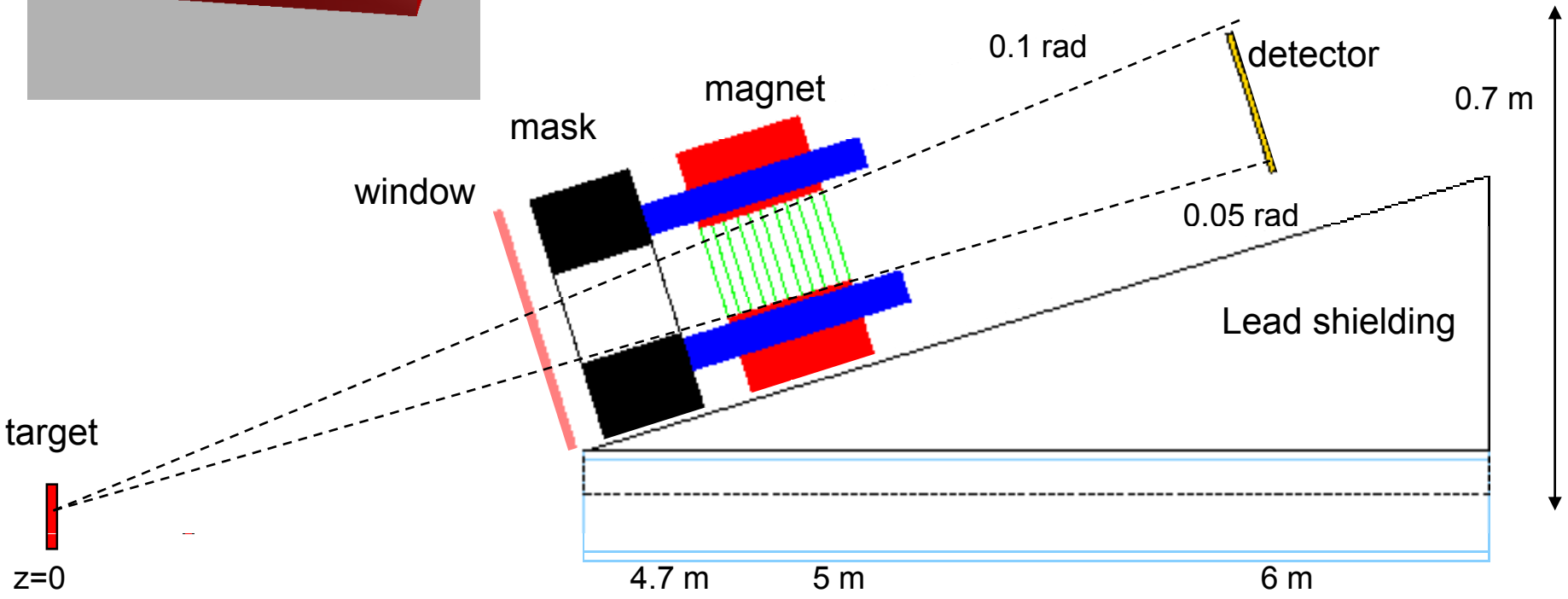
# Changed geometry



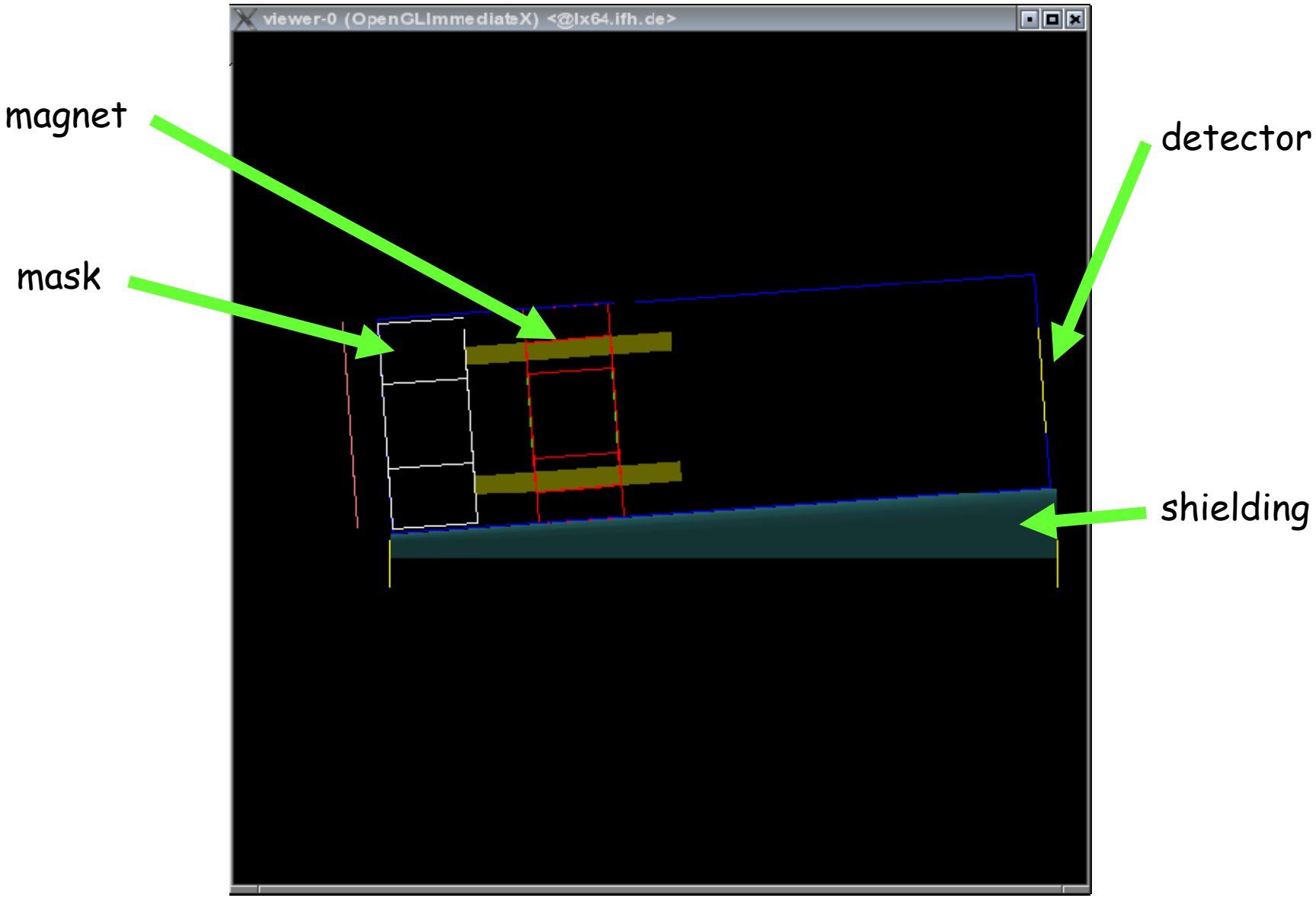
Magnet:

- BdL: 0.1 Tm
- gap: 20 cm
- length in z 20 cm
- yoke thickn.: 7.5 cm
- coil: ~ 80 000 Amp turns

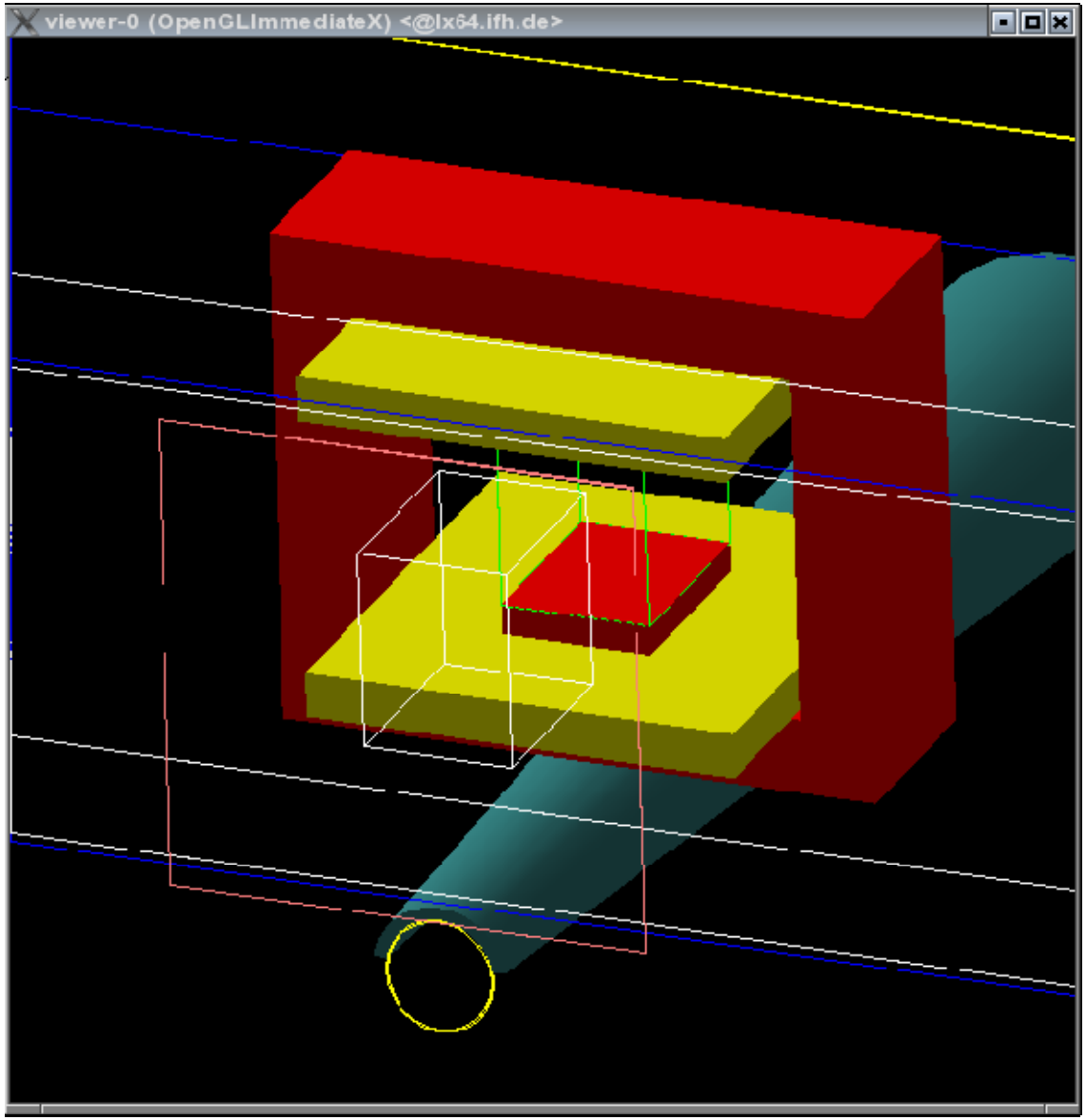
(-> ~100 turns w. 400 A, curr. density ~6.3/mm$^2$, water cooling assumed…)



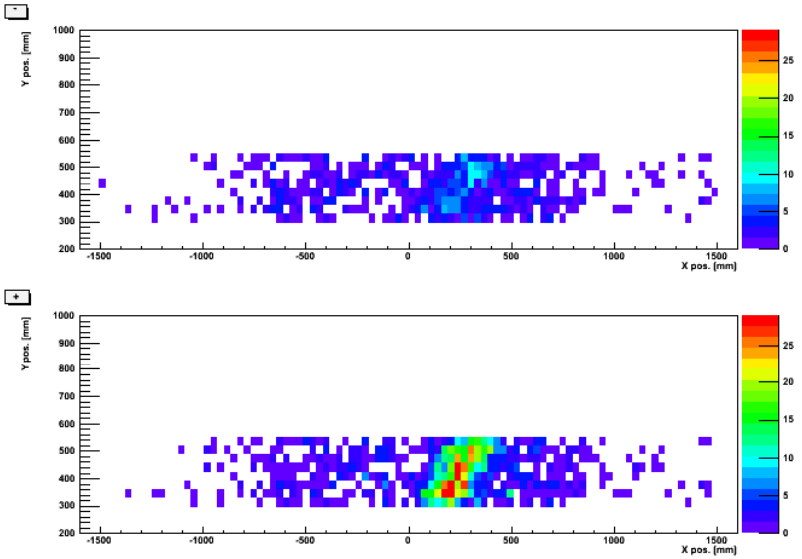
# New geometry in G4



# New geometry in G4

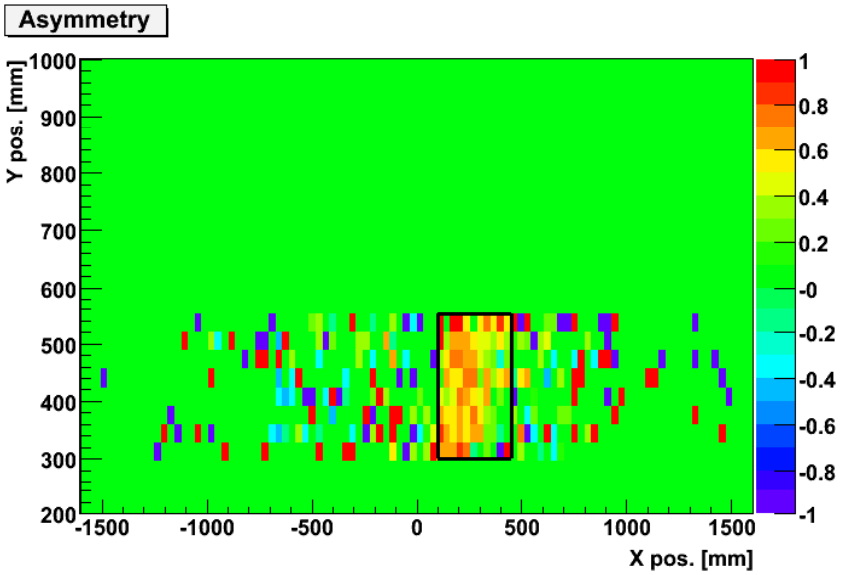


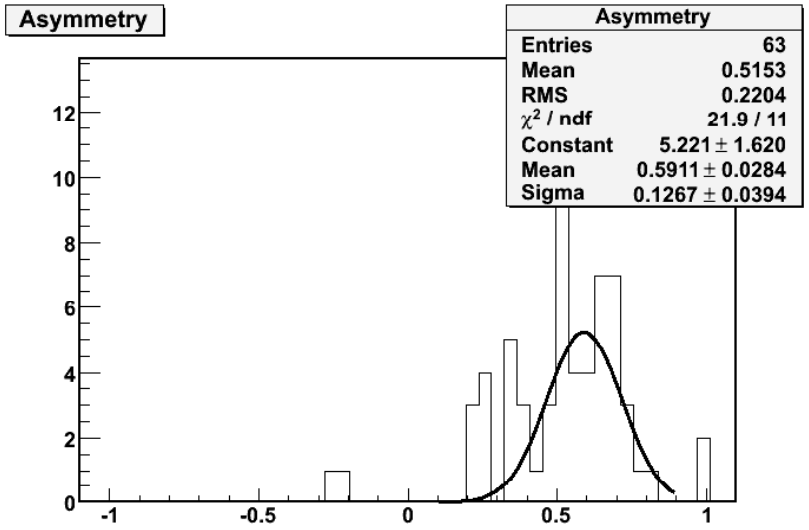
# Results ($e^-$ only)




- Distribution of electrons and the asymmetry (analyzing power)
- Target 30 $\mu$m Fe
- $E_{beam}$ 400MeV
- New magnet
- BdL 0.1 Tm
- P(100%/100%)

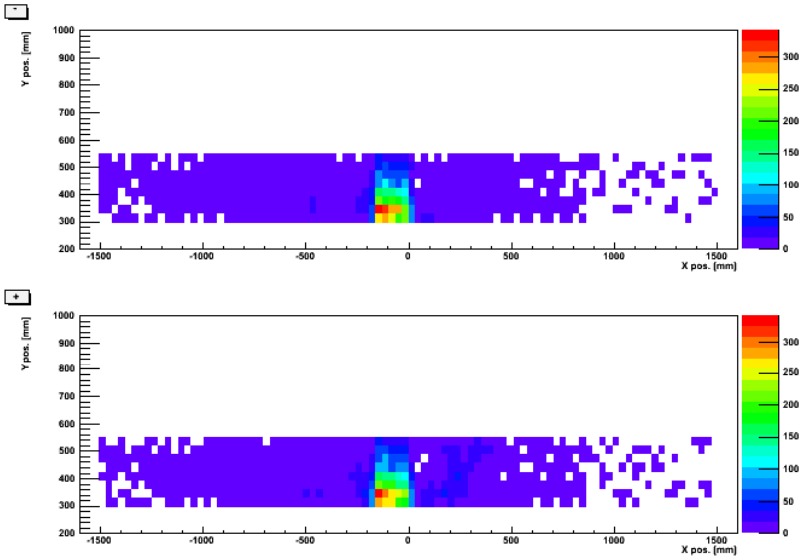
- 1.6 x $10^9$ positrons on target
- *A* ~ 51% (RMS 22%)



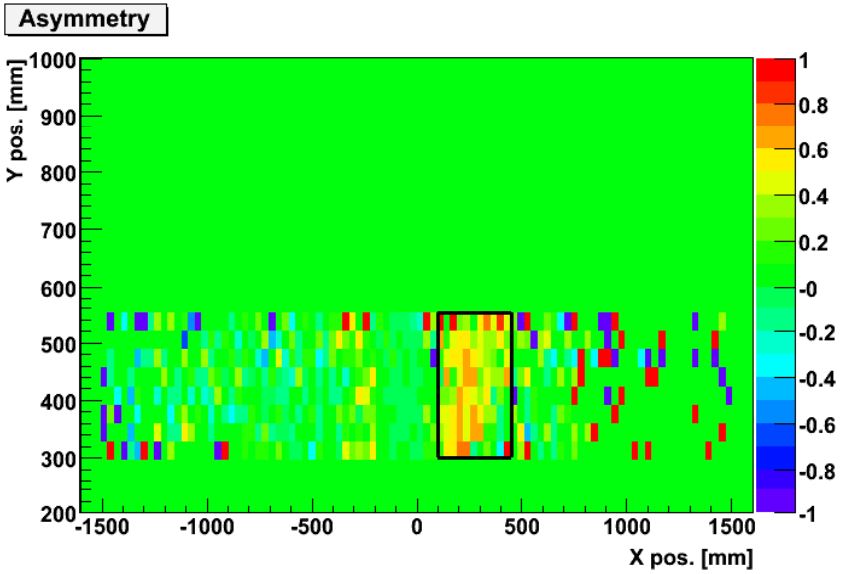

pol. G4 results

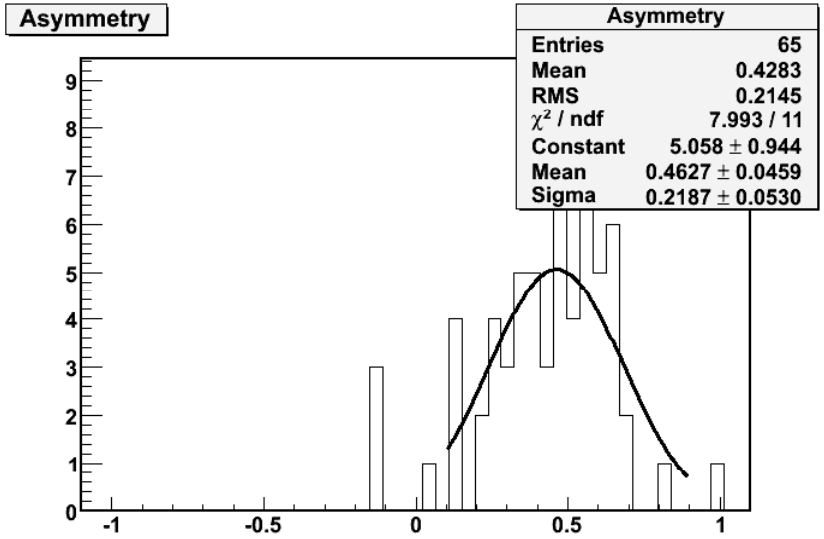
# Results ($e^+$ and $e^-$)




- Distribution of both, positrons and electrons and the asymmetry (analyzing power)
- Target 30 $\mu$m Fe
- $E_{beam}$ 400MeV
- New magnet
- BdL 0.1 Tm
- P(100%/100%)

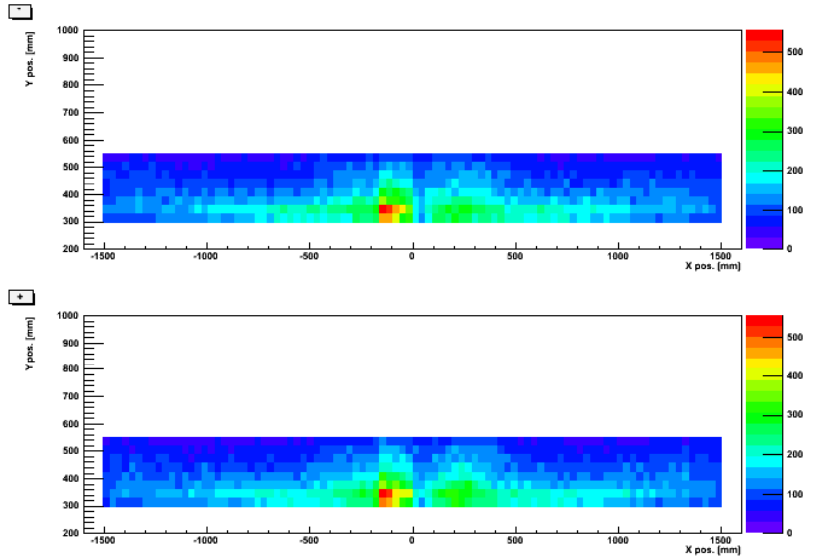
- 1.6 x $10^9$ positrons on target
- $A$ ~ 43% (RMS 21%)

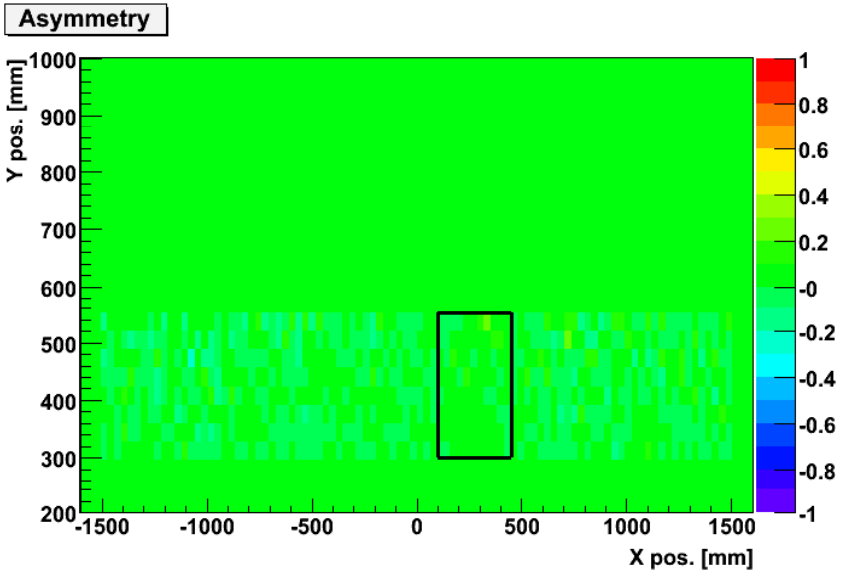



pol. G4 results

# w. BG (beam pipe interactions)

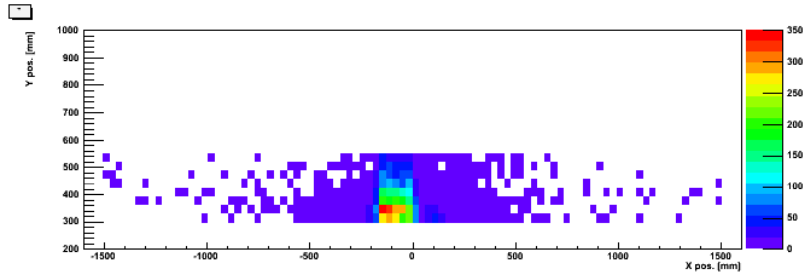


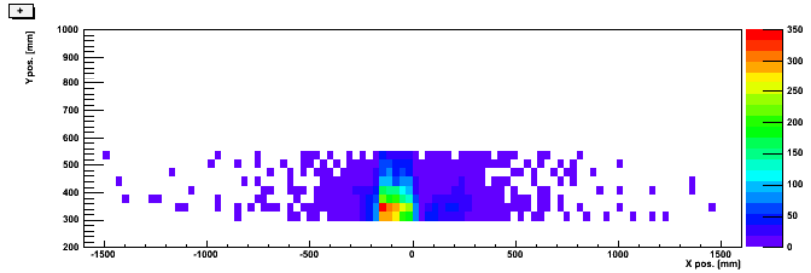



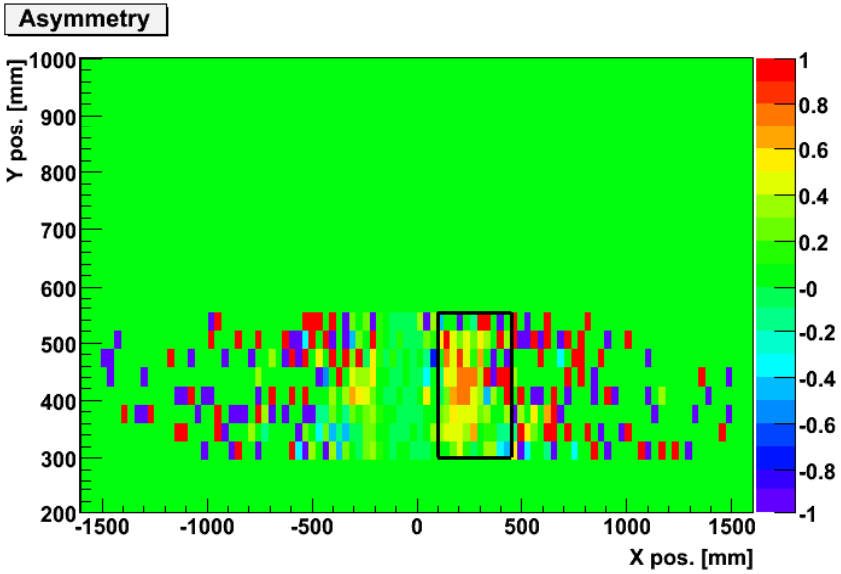

- Distribution of both, positrons and electrons and the asymmetry (analyzing power)
- Target 30 $\mu$m Fe
- $E_{beam}$ 400MeV
- New magnet
- BdL 0.1 Tm
- P(100%/100%)

- 1.6 x $10^9$ positrons on target

# w. BG and Energy cut




- Distribution of both, positrons and electrons and the asymmetry (analyzing power)
- Target 30 $\mu$m Fe
- $E_{beam}$ 400MeV
- New magnet
- BdL 0.1 Tm
- P(100%/100%)

- 1.6 x $10^9$ positrons on target
- Energy cut: 100 MeV

# Update Summary

- new (adaptive) geometry with a more realistic magnet implemented
- asymmetries as expected

- background studies ongoing (shielding of low energy electrons from beampipe interactions – difficult -> not much space)
- implementation of real beam (much lower background expected)

- simulation of lower target polarization ($P_{e^-}$7%) and target inclination is ongoing in parallel (question of computing time and statistics)