

# Simulations of the Secondary Electron Emission Detector for PALS Measurements

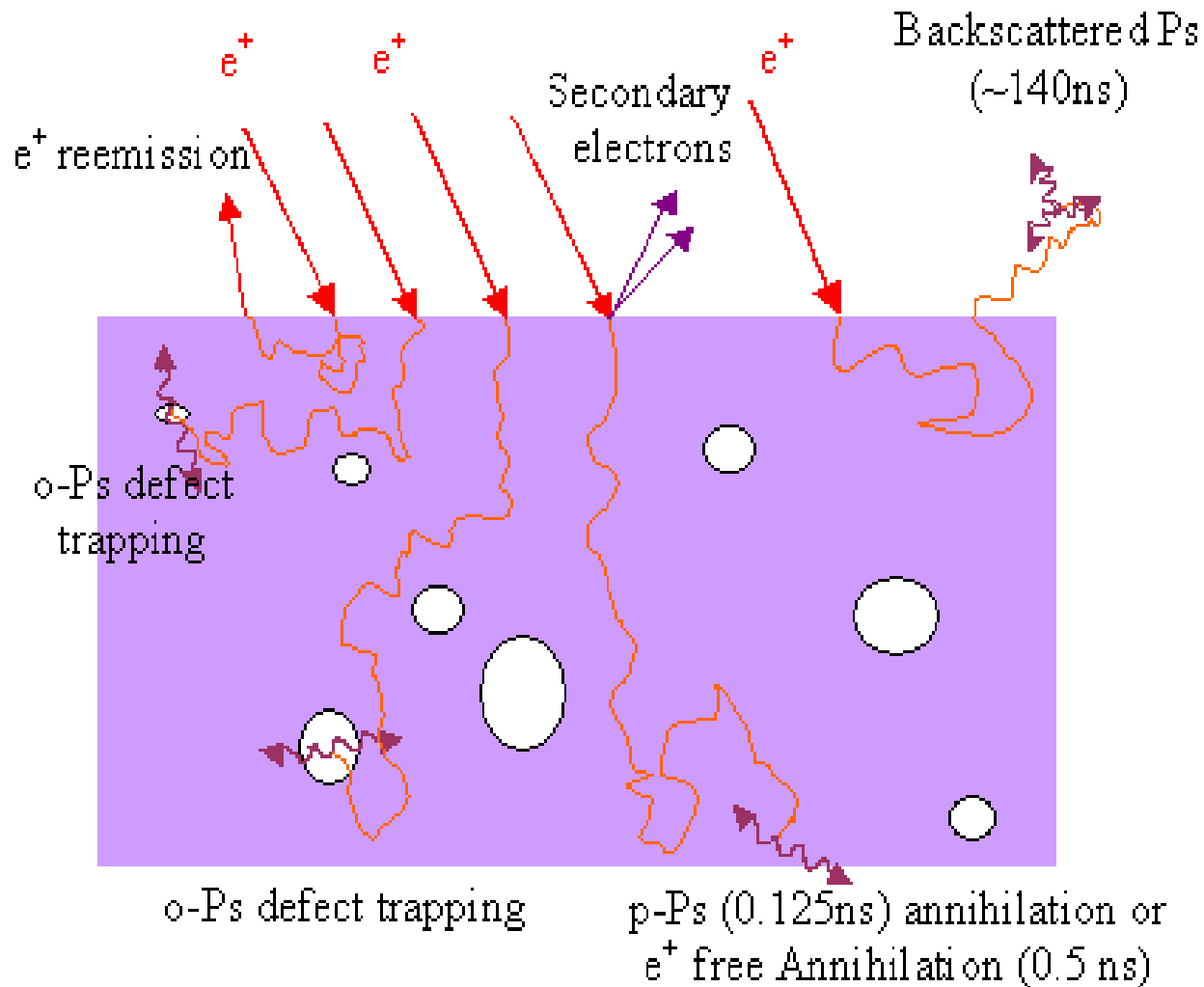
M.M. Kirsanov  
INR RAS, Moscow

Workshop on Positron and Positronium  
LAPP, Annecy  
20-21 November 2007

# Plan:

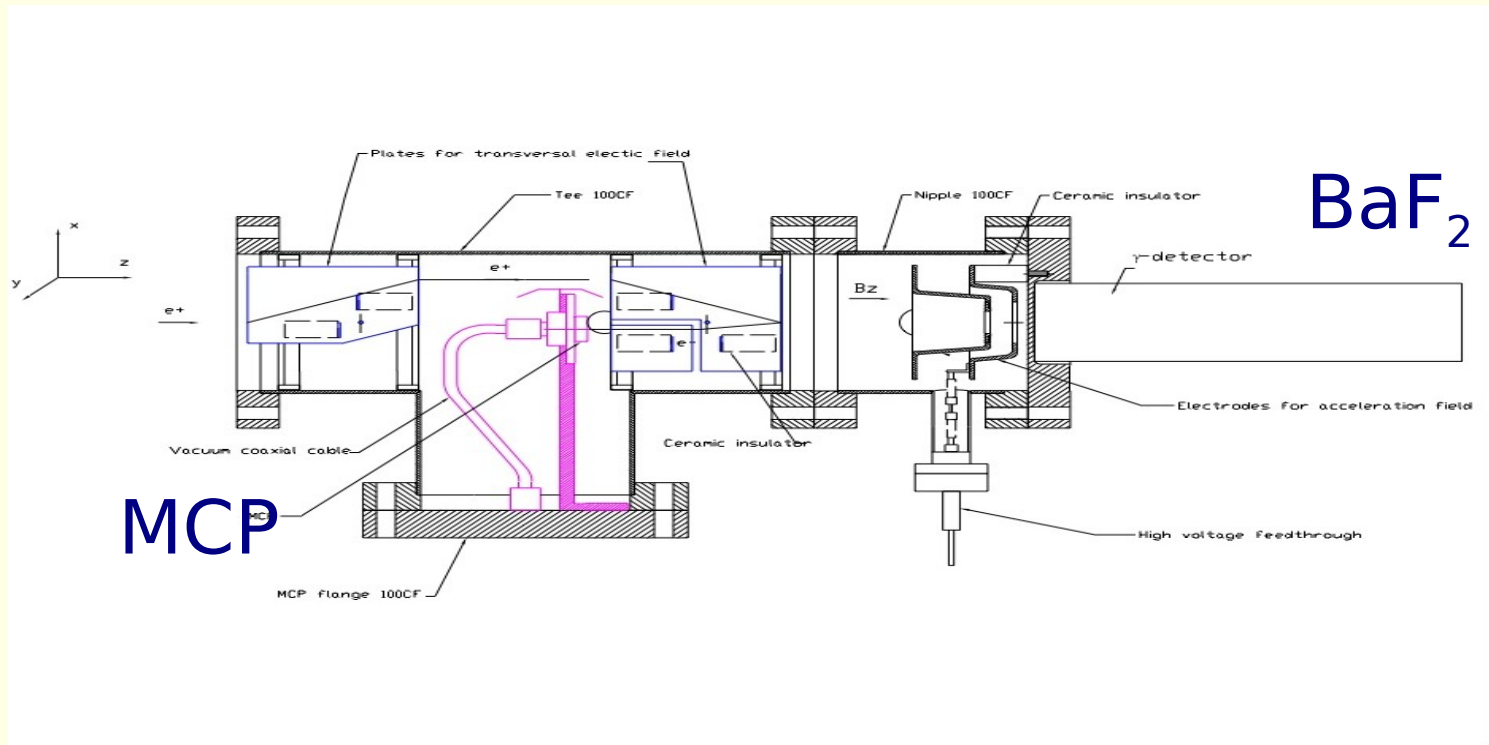
- PALS technique and its challenges
- High efficiency pulsed slow positron beam
- Positron lifetime spectrometer based on secondary electron emission
- Applications to thin films measurements
- Summary

# Positron interactions with the surface



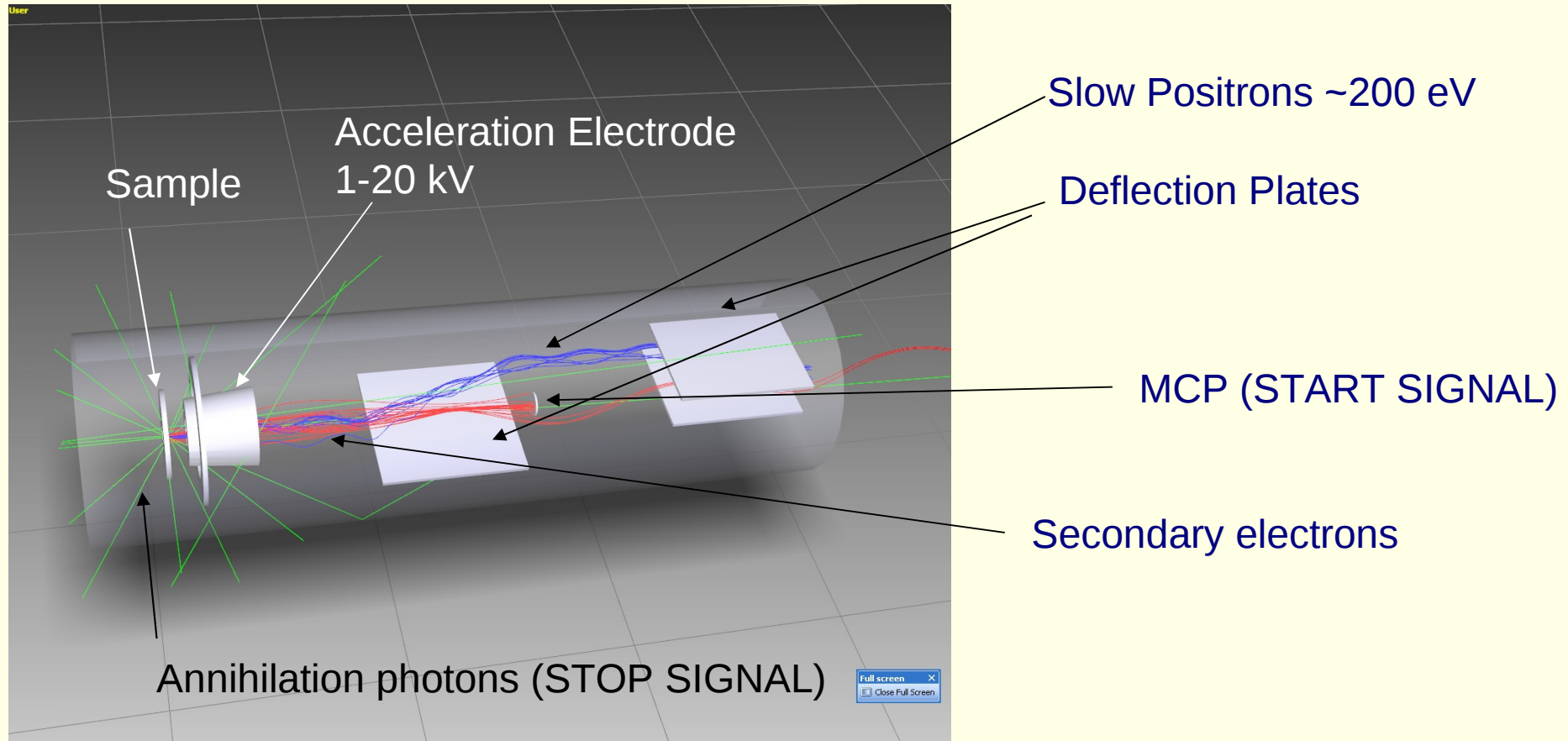
# Secondary Electron Emission Detector

START: secondary electrons, STOP: annihilation gammas

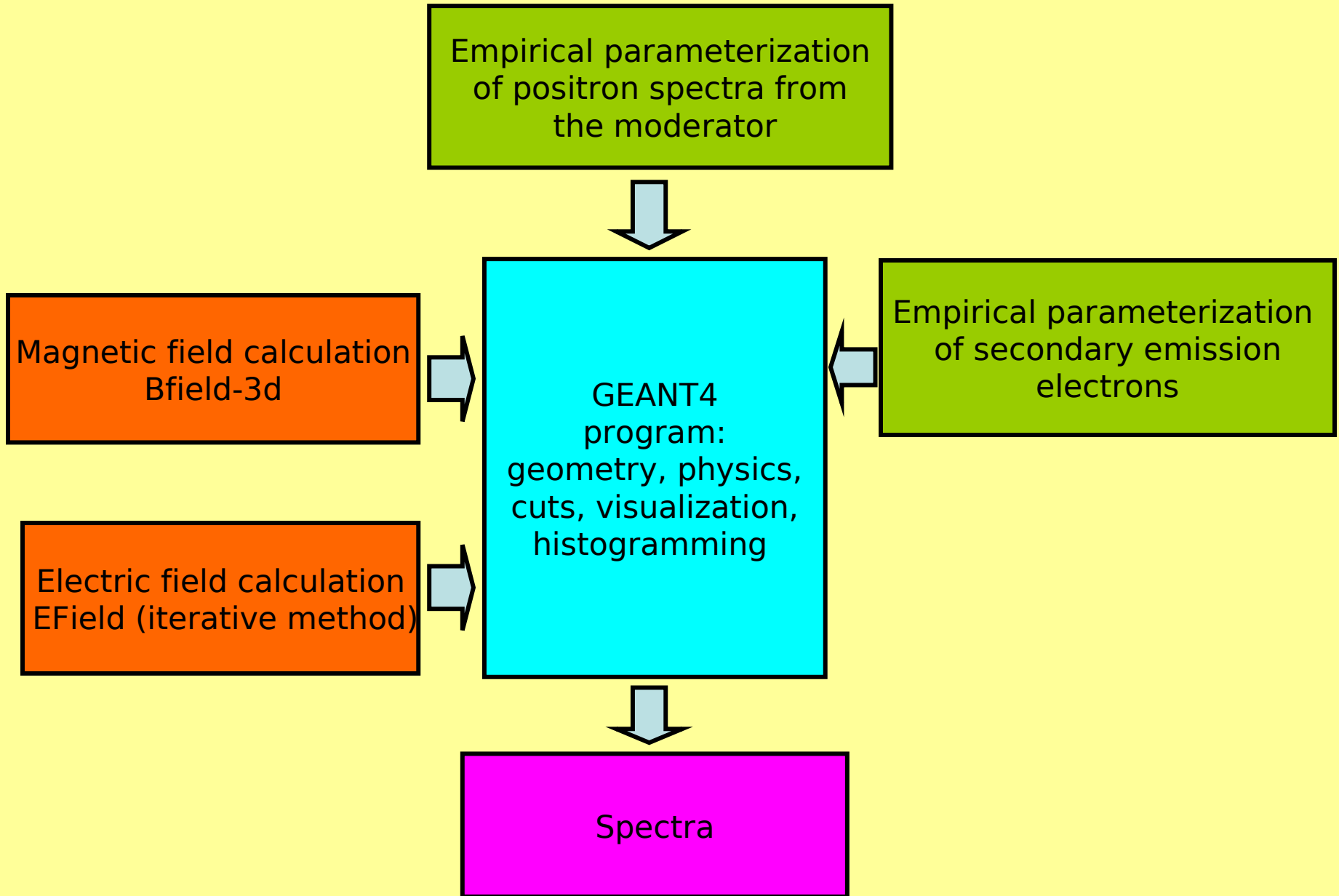


# Secondary Electron Emission Detector

Simulation of SEED extraction optics:



# Simulation scheme



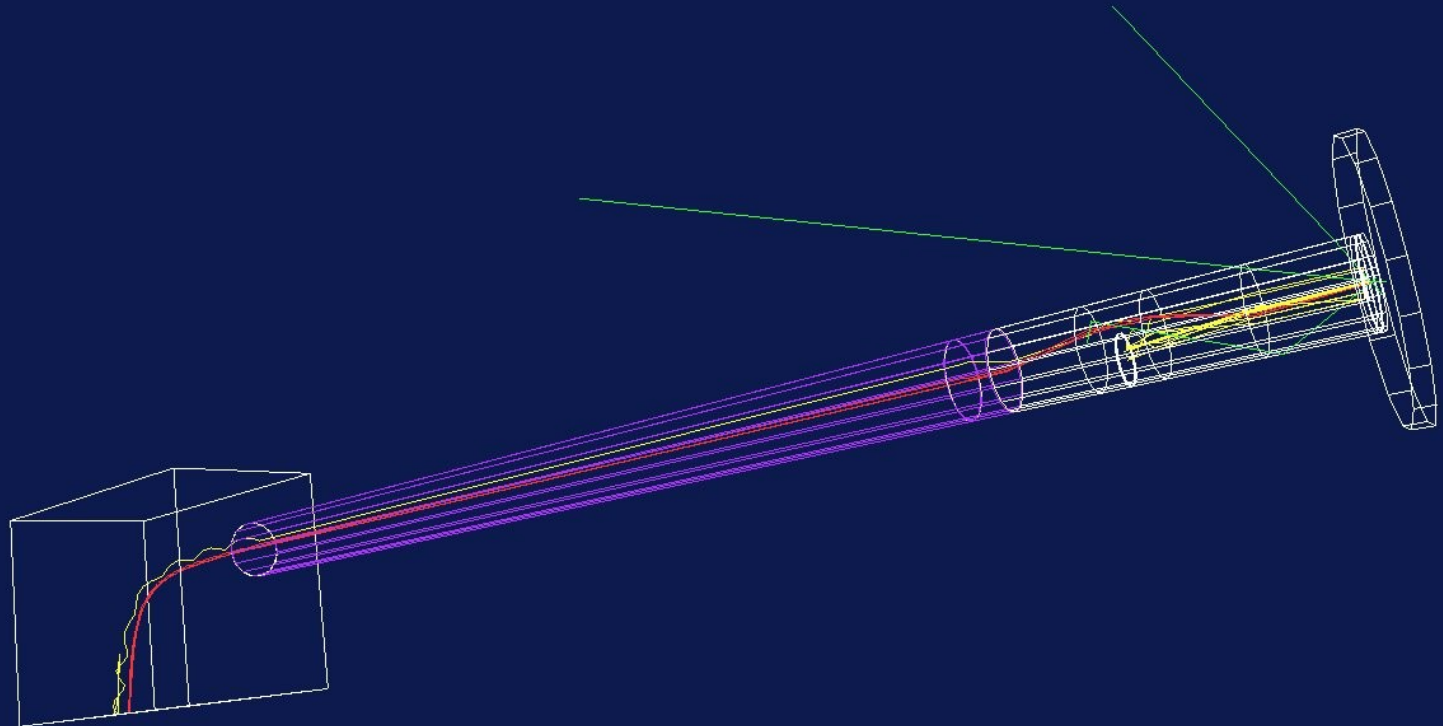
# GEANT4

- Can simulate in the same program low, medium and high energy physics
- Is well supported on the modern computer platforms
- Many physicists are familiar with the GEANT4 toolkit
- We are in live contact with the authors of GEANT4, many of whom are based at CERN

# Simulation geometry of the setup

File View SpecialFX Settings Camera Lights Windows

Help

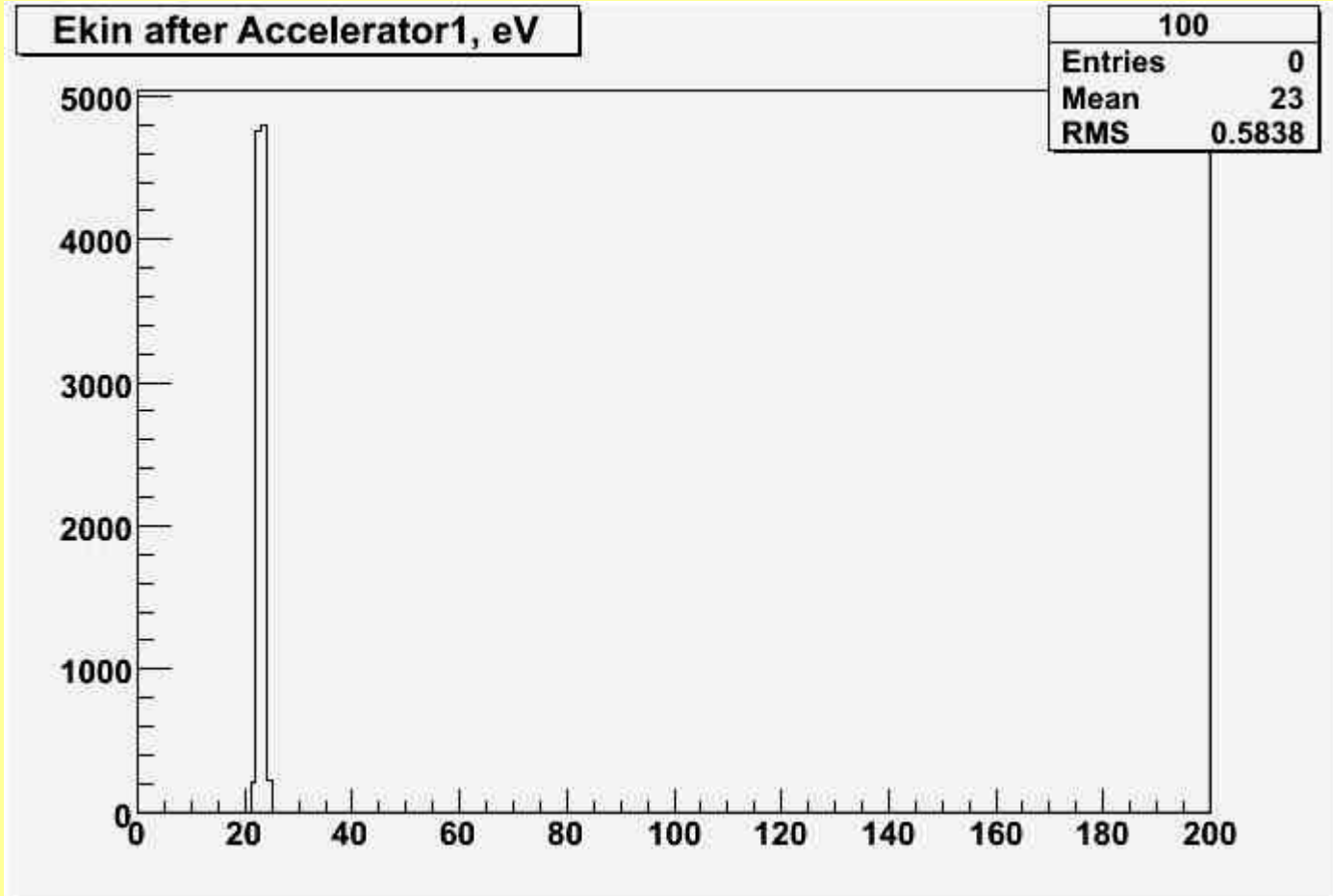


Cylinders : 194  
Cubes : 182  
Lines : 2388

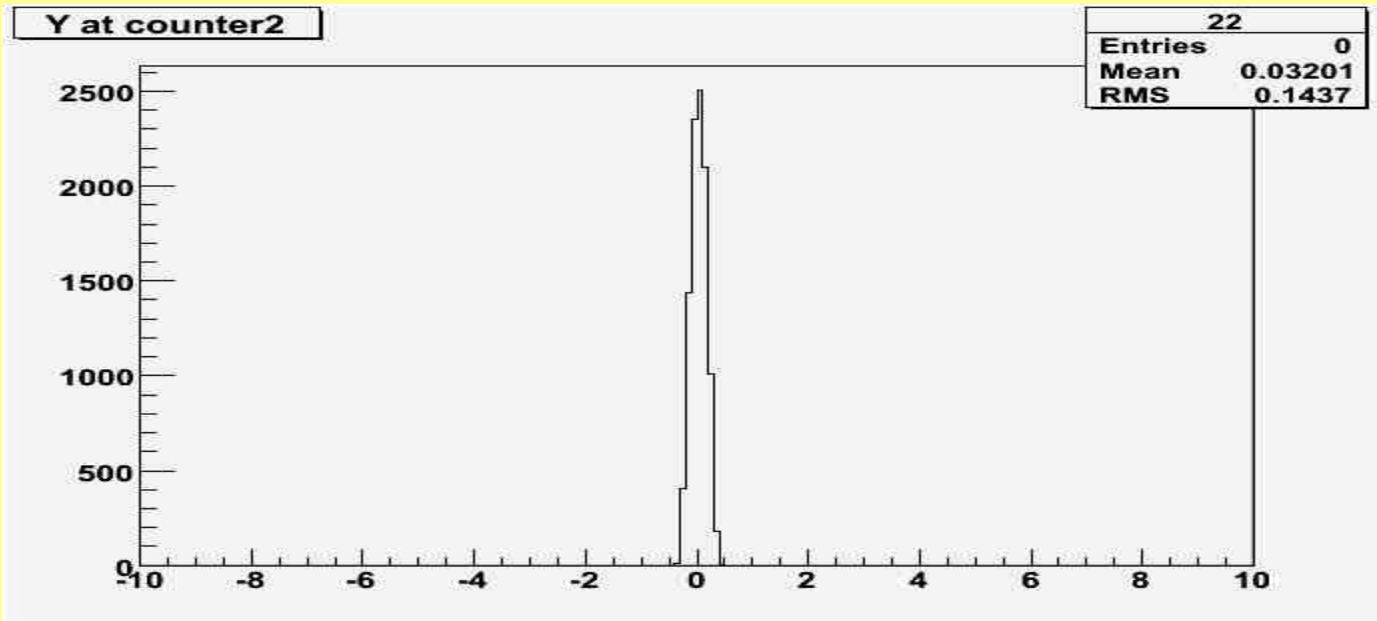
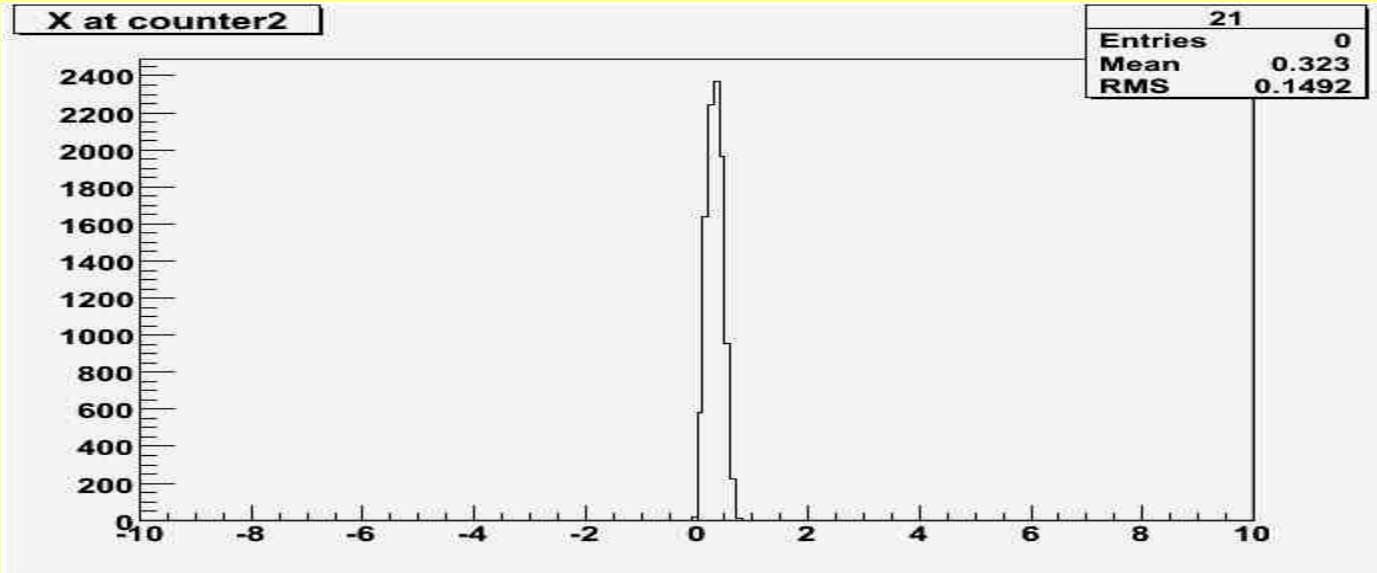
Ready!



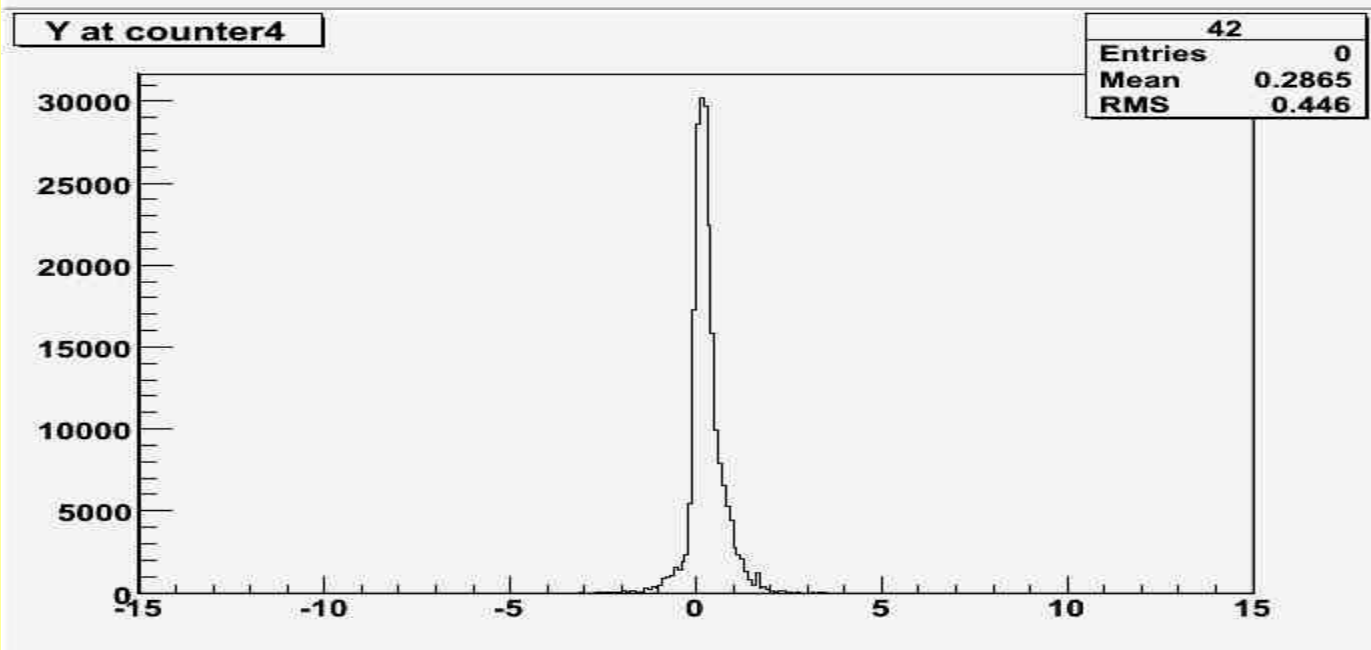
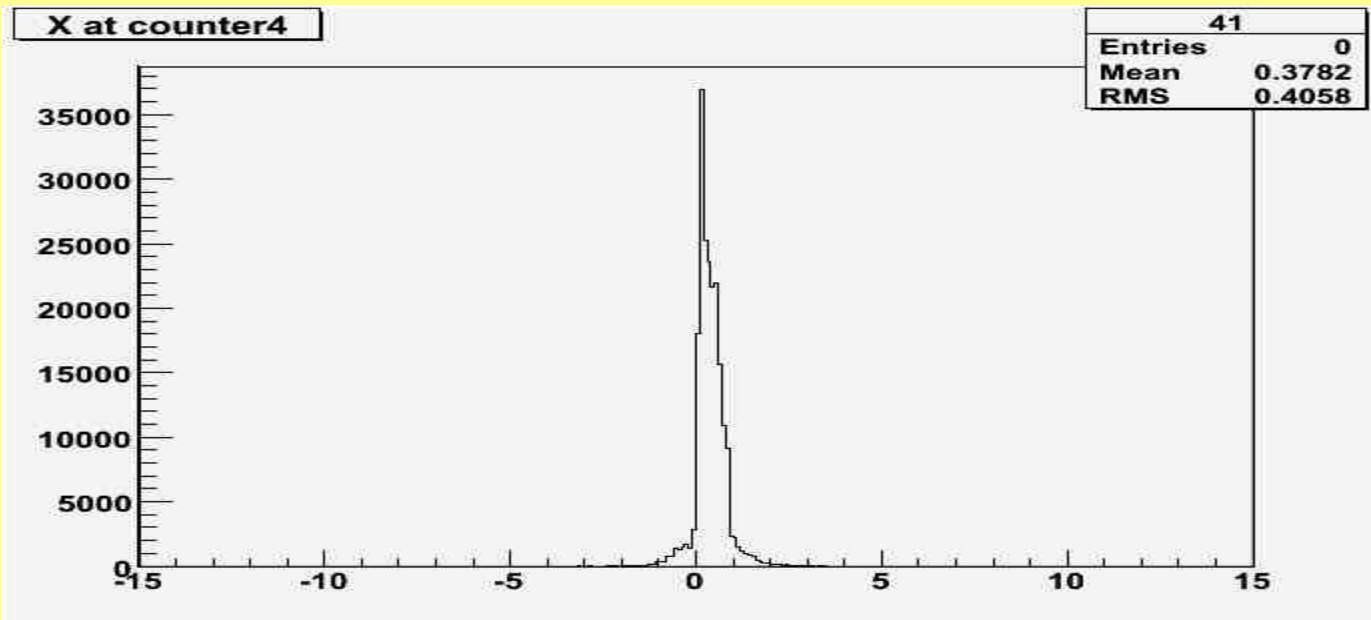
# Positron energy after preliminary acceleration



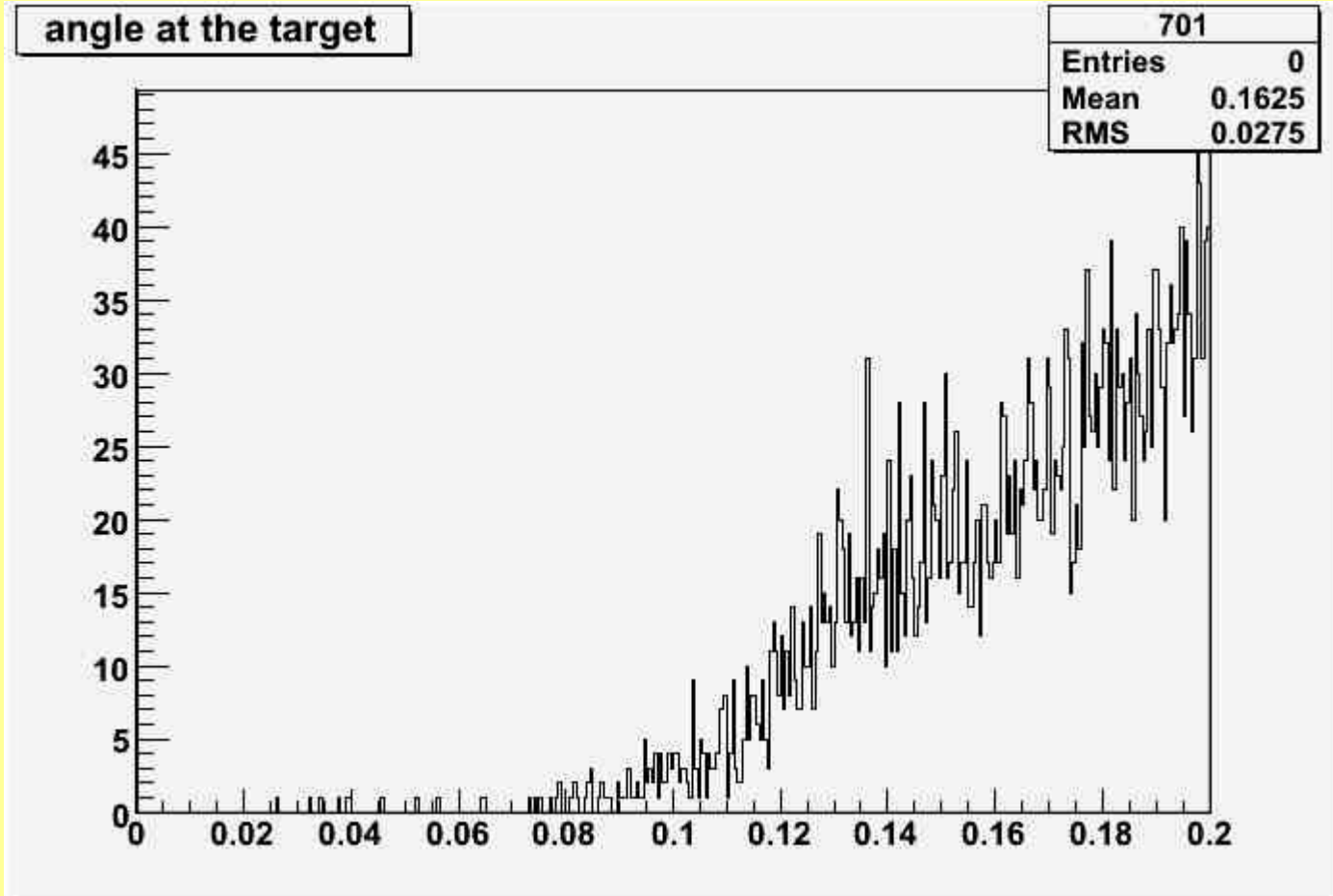
# XY at the entrance



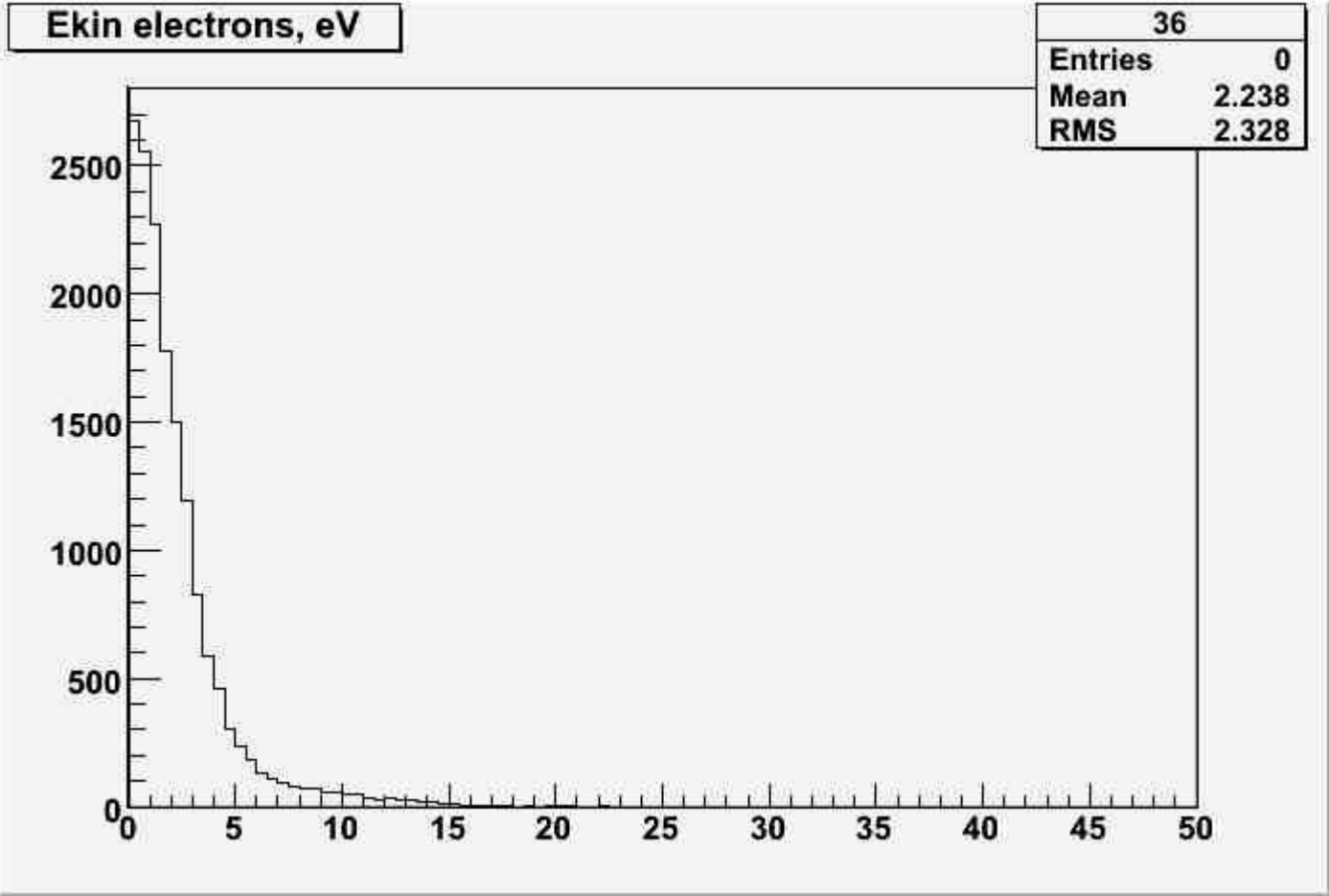
# XY at the sample



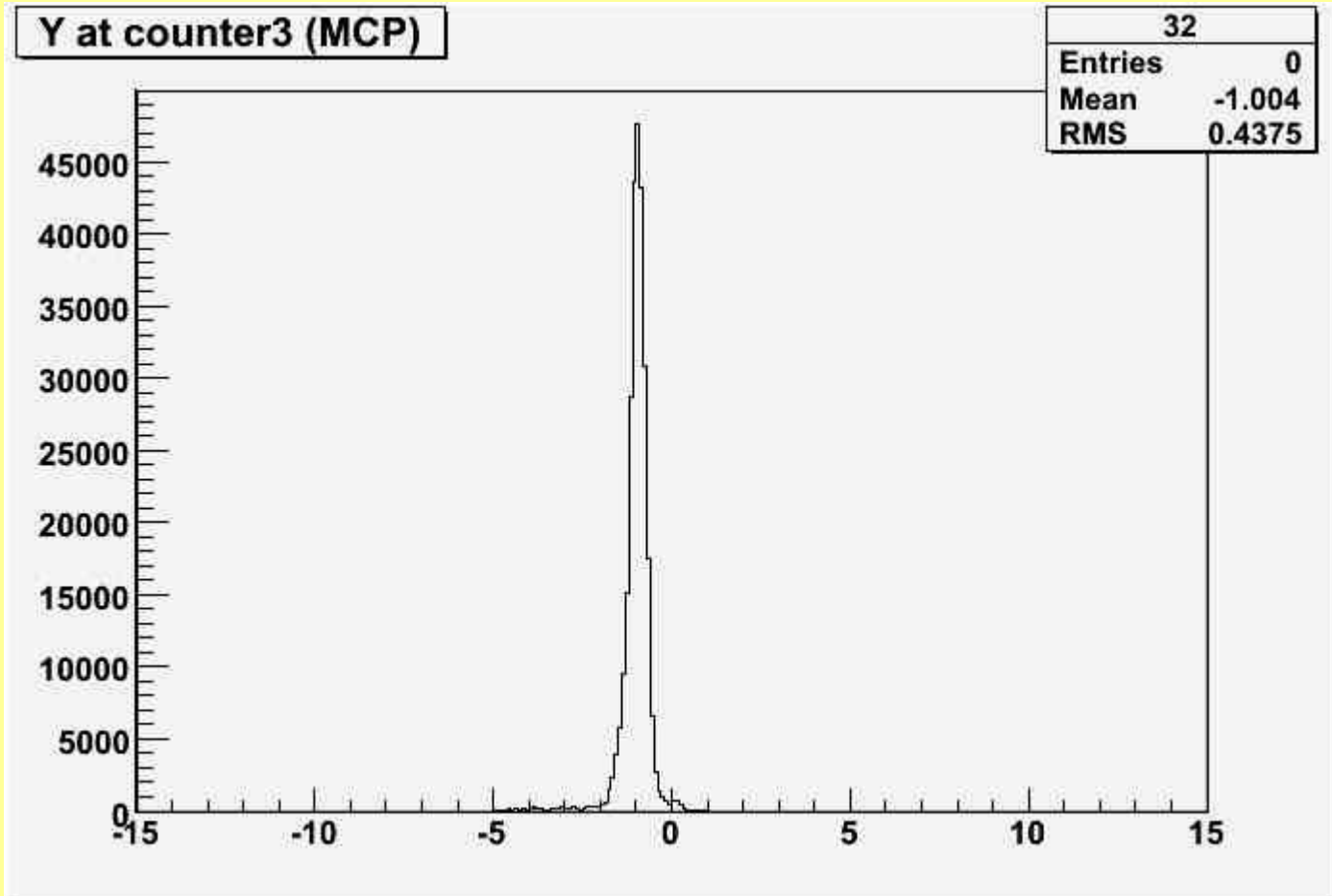
# Positron incident angle at the sample



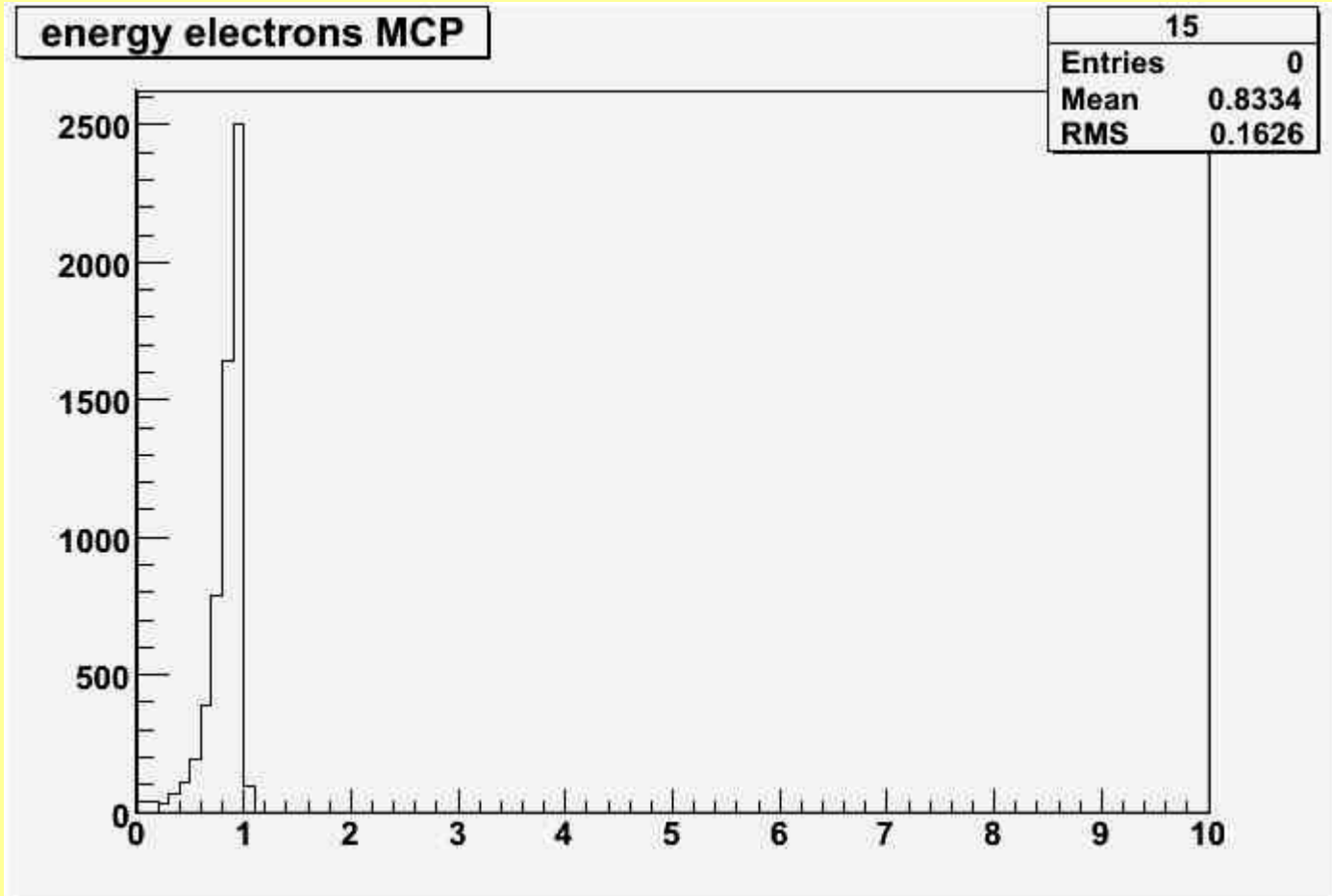
# Energy of secondary emission electrons



# Secondary electrons at MCP



# Secondary electrons at MCP: longitudinal energy of the first electron

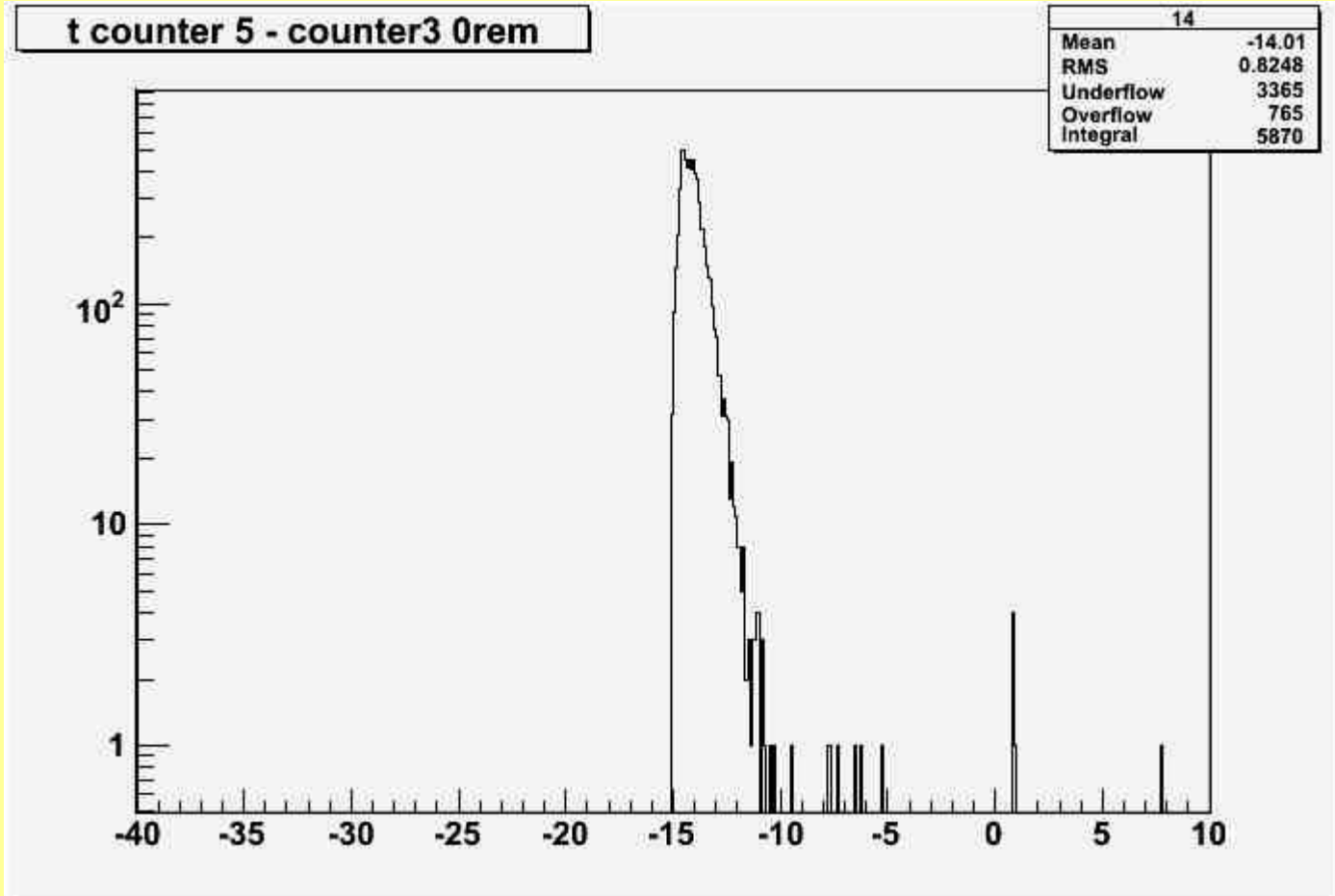


# Systematics sources (tails)

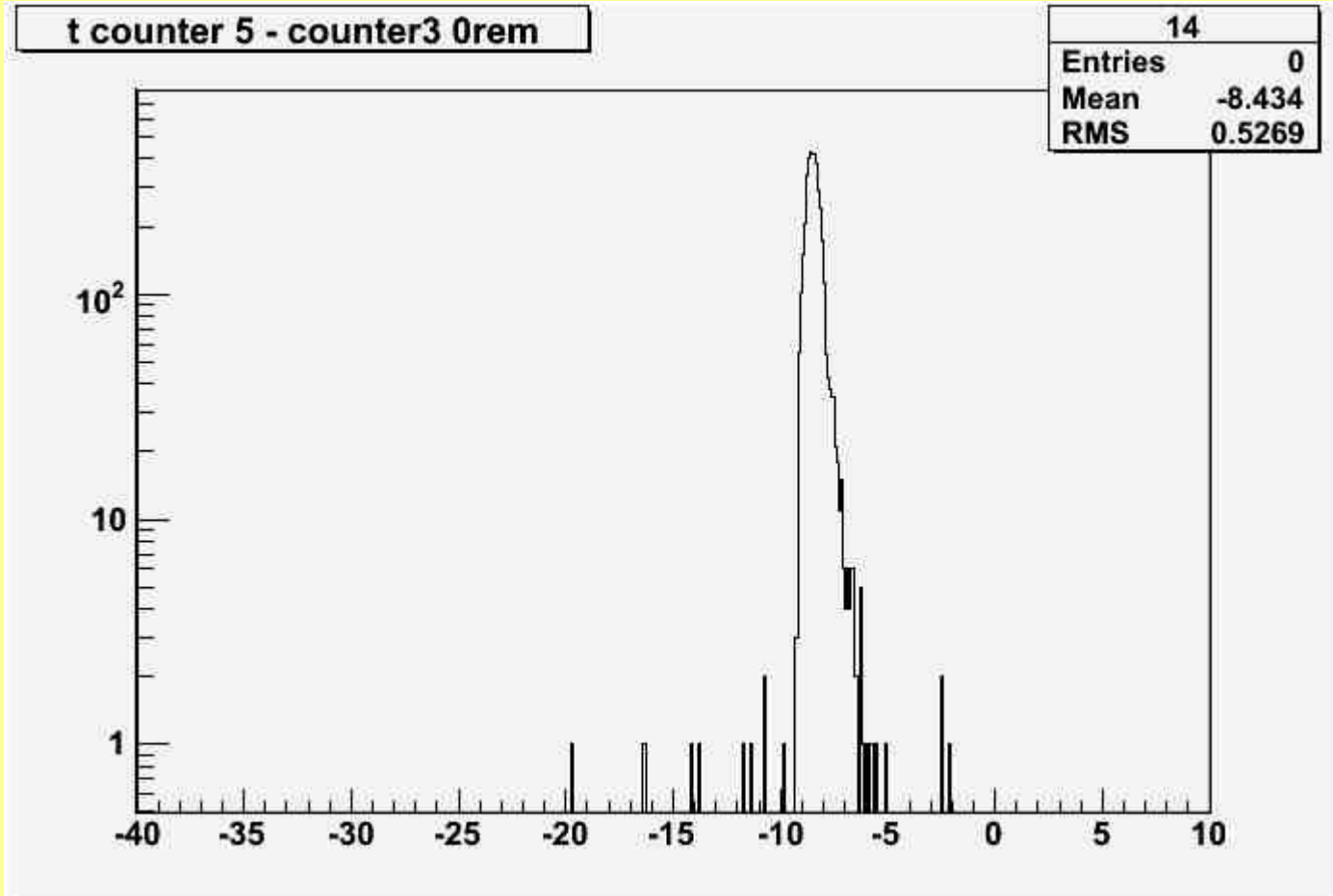
- scattering of secondary electrons at the mesh
- backscattered positrons
- positron annihilation not at the sample



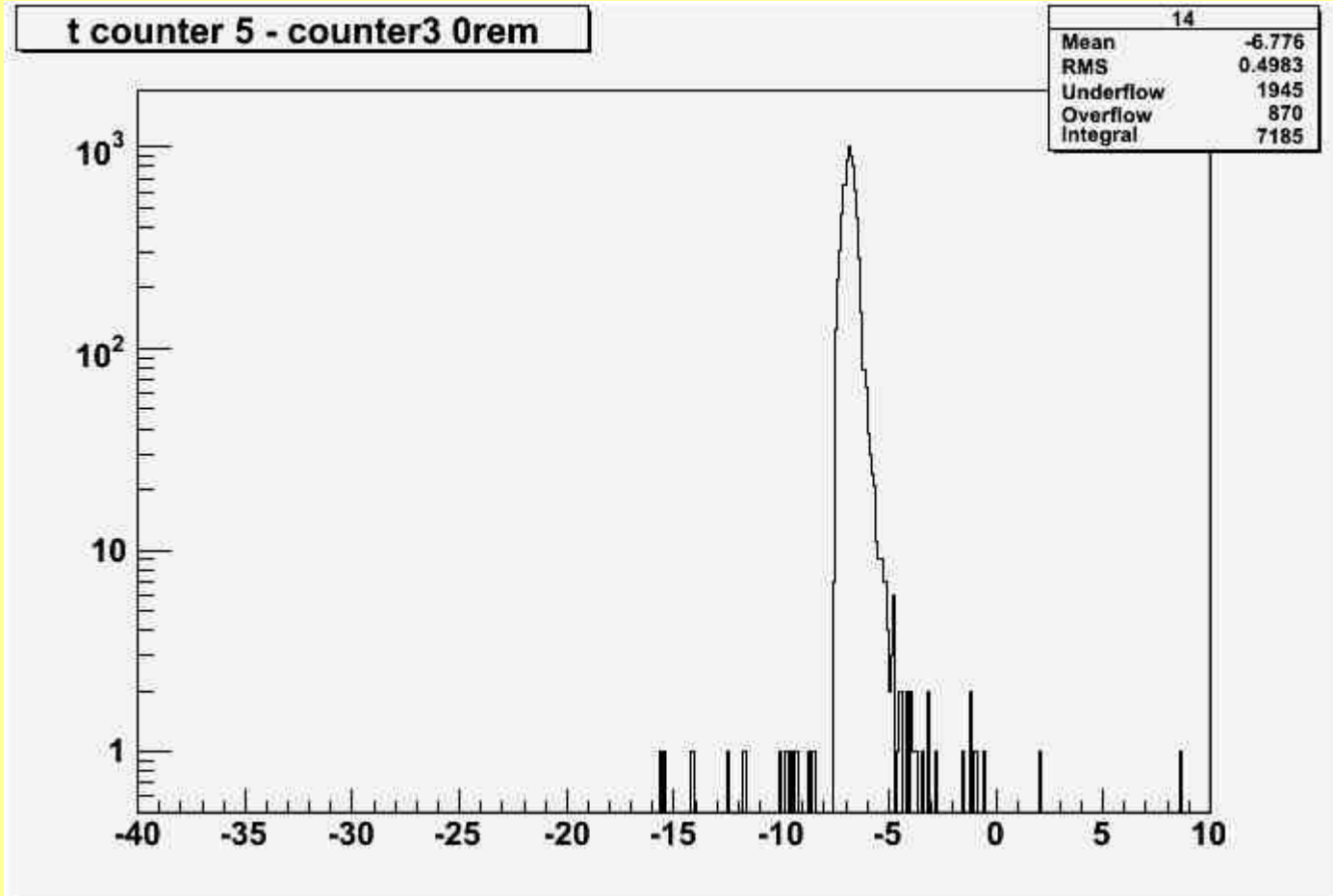
# Time spectrum for 1000 V at the sample



# Time spectrum for 3000 V at the sample



# Time spectrum for 5000 V at the sample



# Summary

We have designed and constructed  
-high efficiency pulsed slow-positron beam, and  
-secondary electron emission detector  
for fundamental and applied researches.

SEED can be used for materials characterization.  
There is still room for improvements

The simulation by GEANT4 preliminarily  
describes the systematic effects in the setup