Positron **P**roduction **SIM**ulation Geant4 based

1. Presentation of PPSim
2. Polarized positron using Bremstralhung process
3. First results on the positron production using gamma from channeling
4. Conclusion & prospects

ILC-CLIC e+ studies

Phone Meeting 05/03/2009

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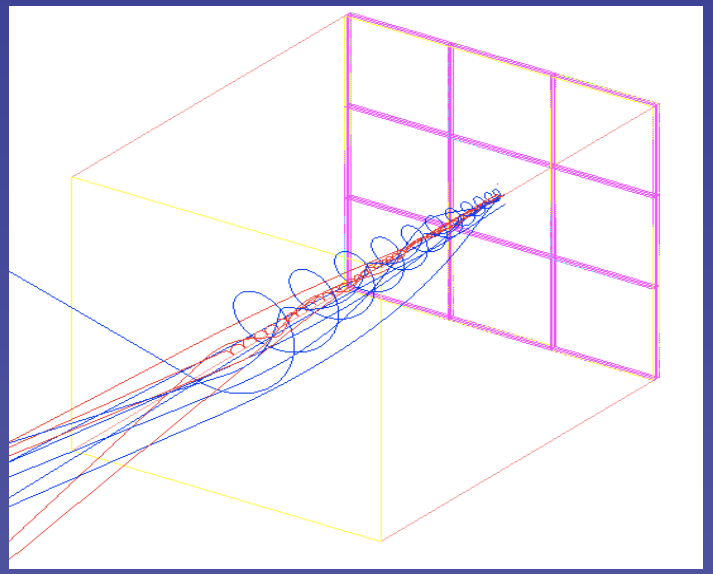
PPSim a Geant4* based Positron Production SIMulation

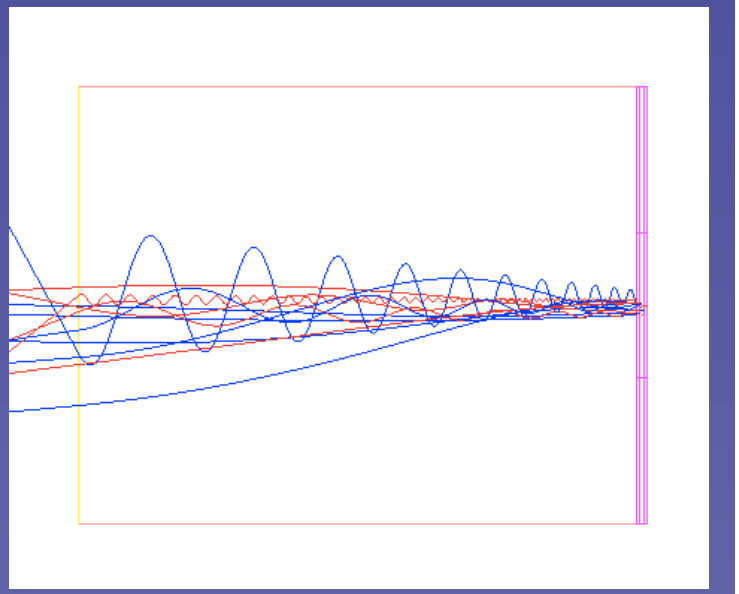
- Segmented target for power deposition calculation

  (for display reason here only 1×3×3)
  depESum[NrZ][NrY][NrX] += edep
  (edep = aStep➔GetTotalEnergyDeposit())
- Magnetic field at the exit of the target

$$B = \frac{B_0}{1 + \alpha z}$$

- Root output file :
  - 2 trees after the target and after the AMD to store events (pdg, **X** , **P, S** …)
  - 3D histo for power deposition
- Only EM process taking into account
  - No neutron production





*See talk on EGS4/Geant4 Benchmark POSIPOL 07 @ LAL Orsay

PPSim a Geant4 based Positron Production SIMulation

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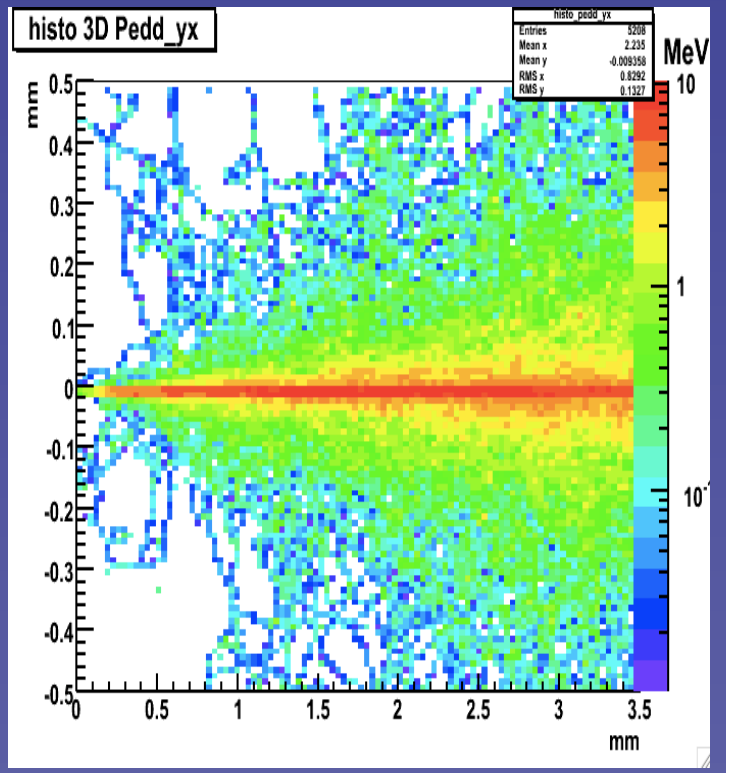
1000 gamma of 100MeV in 3.5mm W
Energy deposition per incident gamma 5,2 MeV



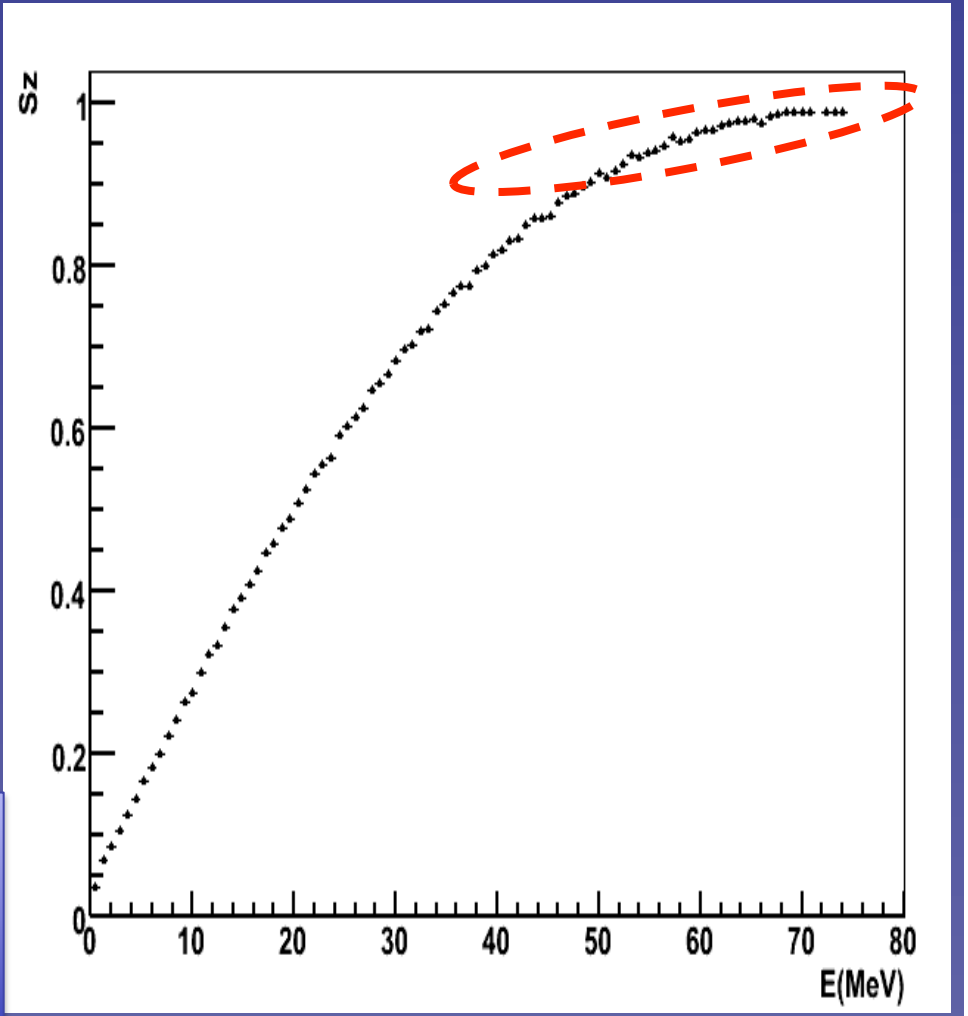
Polarized positron using Bremstralhung process

- Initial parameters :
  - e^- beam 80 MeV **S** (0,0,1)
  - Tungsten target of 1×X0=3.5 mm (Z=74, ρ = 19.3 g/cm^3)
- Stat. 10^6 e^-
- Positron Yield = Ne^+/Ne^-
  ~ 15 %

  Energy deposited ~ 14 MeV

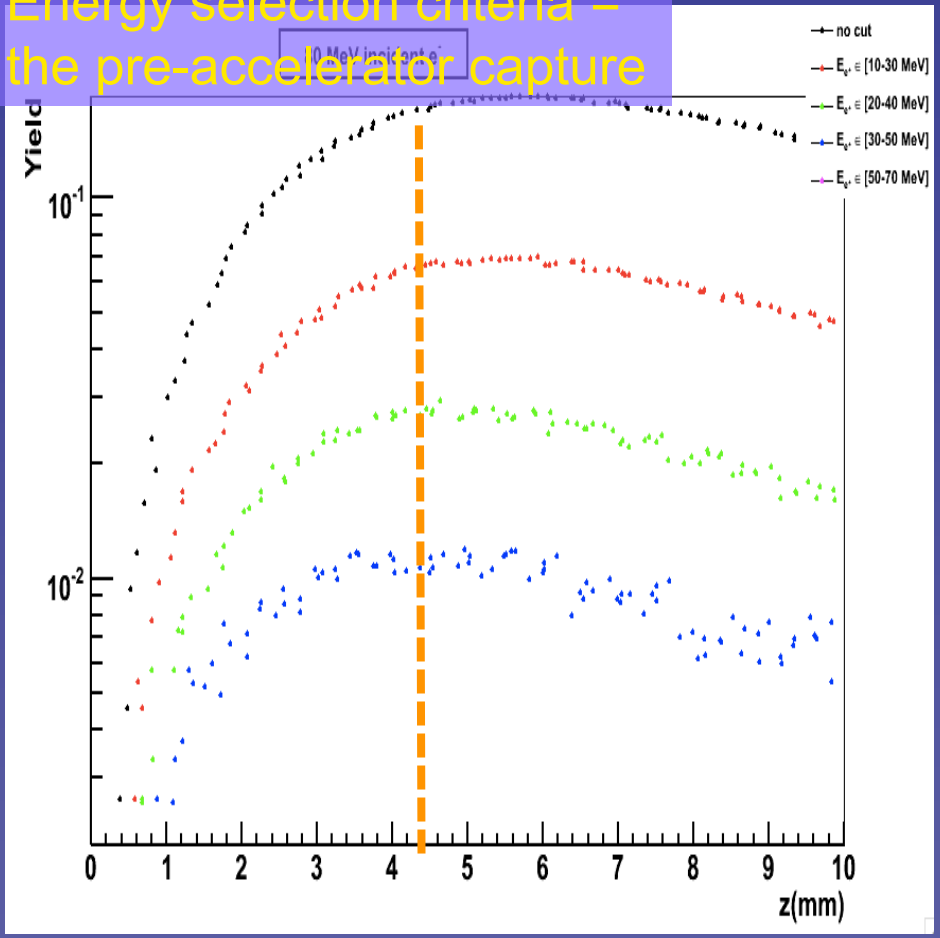
  Sz ~ 30 %
- ↗ E ↗ Sz yes but yield ↘

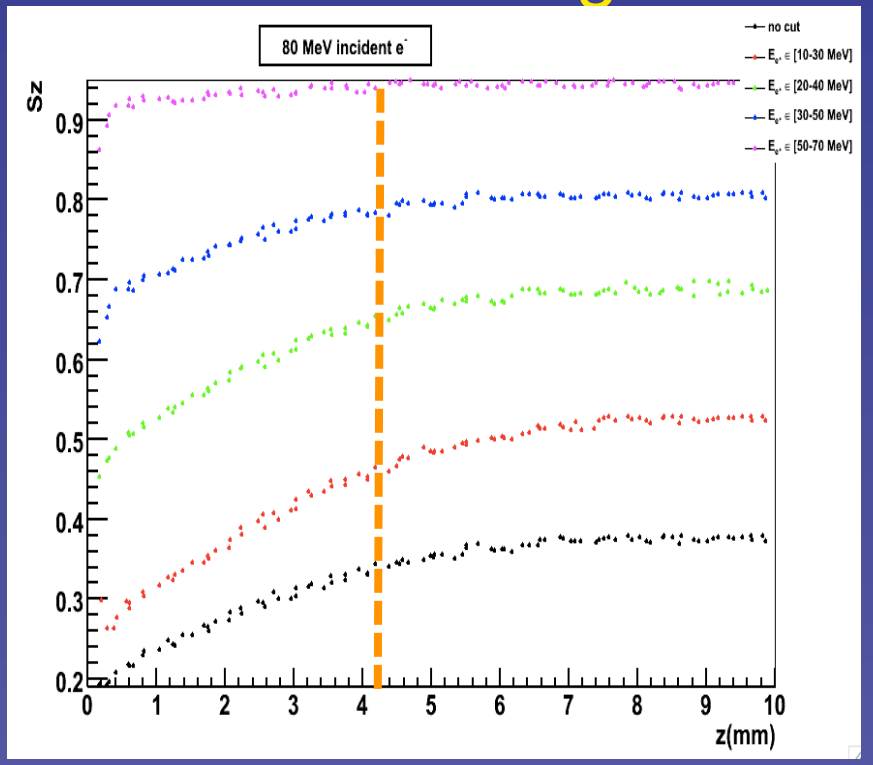
We need to find a compromise between yield, polarization and power deposition

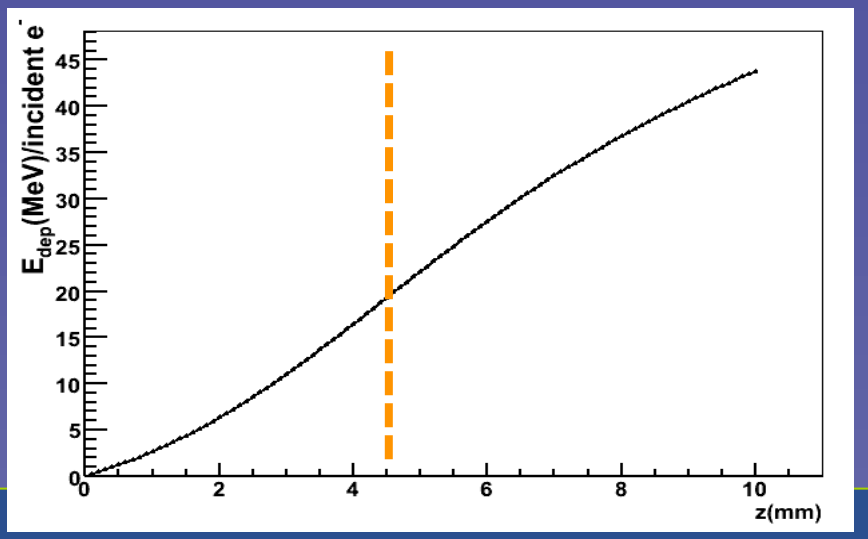


Study of target size with 80 MeV incoming e-

Energy selection criteria = the pre-accelerator capture

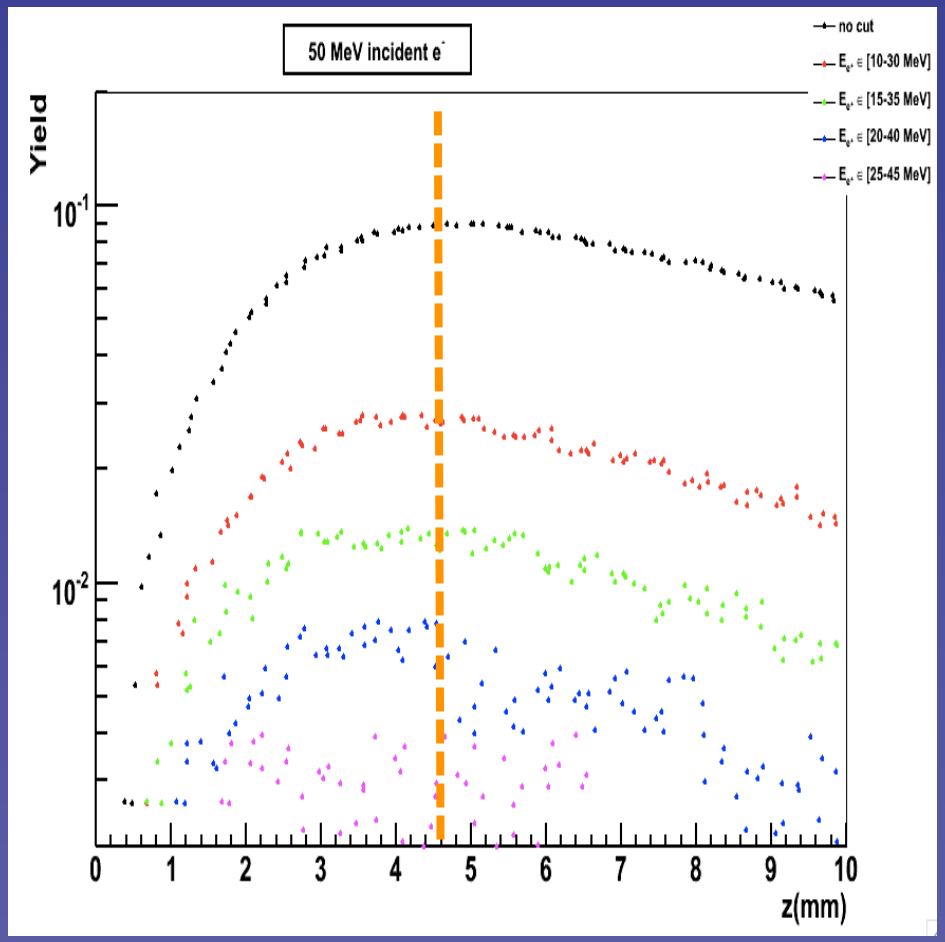


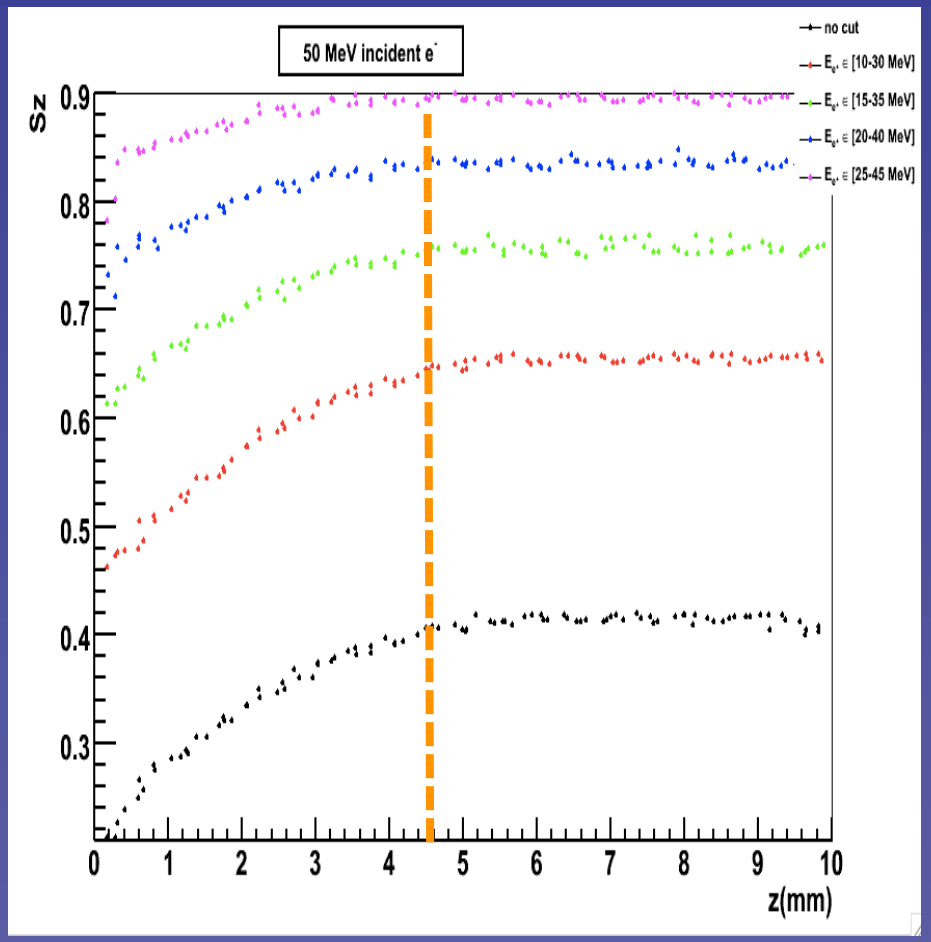




With 80% of e^- polarisation (at least)
We can have 6% yield with more than 40%×80% of polarized positron

Study of target size with 50 MeV incoming e-

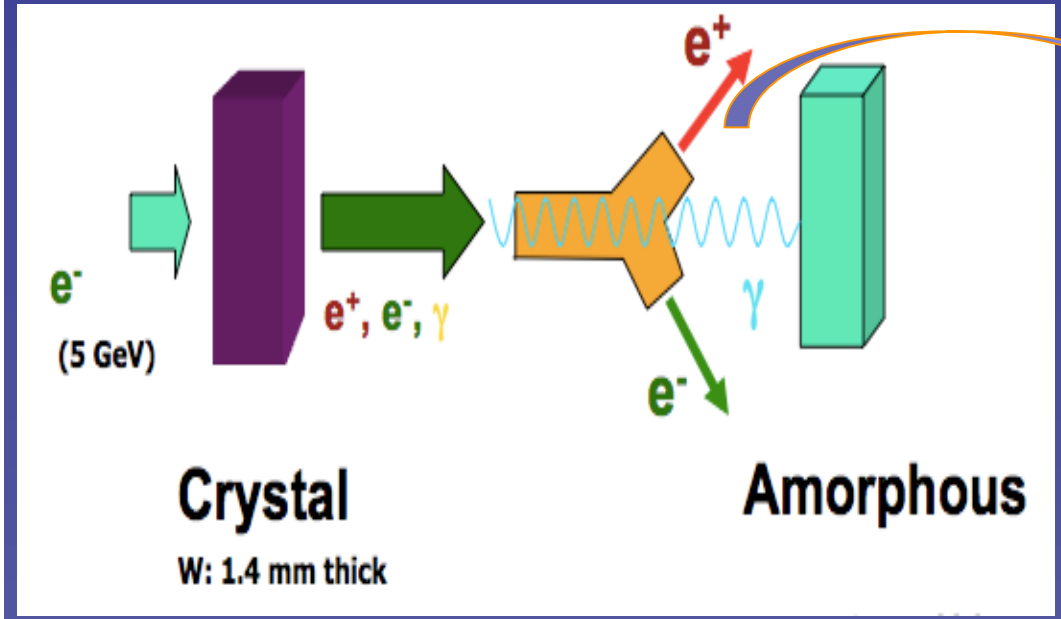


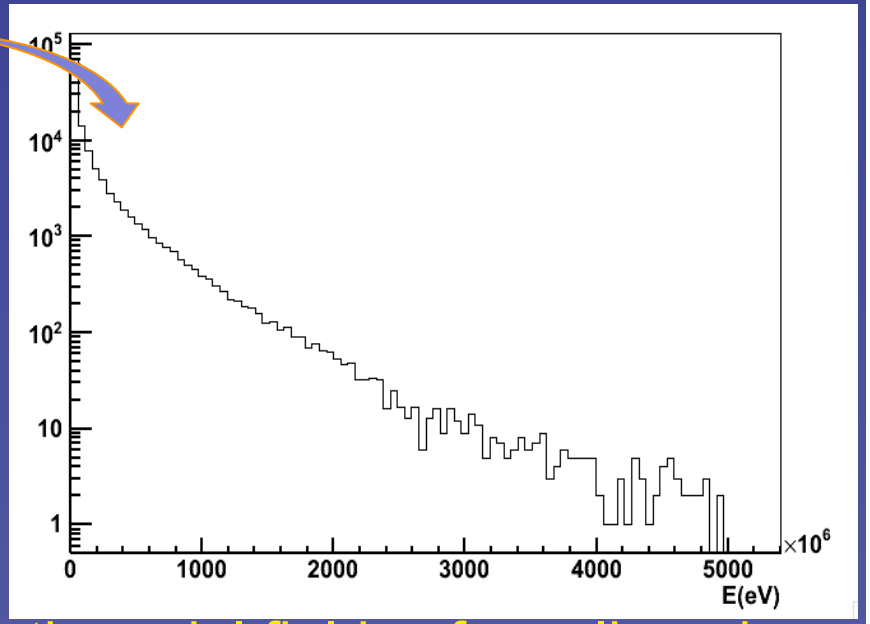


We can have 2% yield with more than 60%×80% of polarized

Positron source using channeling

- Tungsten crystal of 1.4mm impinged by e^- at 5 GeV (stat. 119 806)





- Basically the GeV electron motion in the axial fields of an aligned crystal will generate photons (+charged particles)
- Strakhovenko's files provided by Vivoli : use only photons
- Studying different
  - amorphous target thickness
  - distance between crystal and amorphous : 2m & 1m
- AMD : L=50 cm, B_0=6 T, α=22m^{-1}

$$B = \frac{6}{1 + 22z}$$

Positron yield

l(mm)	Yield* (target) 1m	2m	Yield* (after AMD r=5cm) 1m	2m
	6.15%	5.20%	5.64%	4.68%
0.8	7.91%	7.80%	7.04%	6.88%
1.	9.59%	9.41%	8.32%	8.10%
1.2	11.02%	11.25%	9.35%	9.37%

*Yield = $Ne^{+}/N\gamma$

I took wrong thickness target:
For sure we don't need such thin target !!

- We don't see any different between positron yield with different distance between crystal and amorphous this must be checked
- Need to study the PEDD

Positron yield

l(cm)	Yield* (after target)		Yield* (after AMD r=5cm)	
	1m	2m	1m	2m
0.6	35.90%	34.90%	22.87%	22.60%
0.8	39.52%	39.75%	25.10%	25.09%
1.	42.22%	41.68%	26.56%	25.97%
1.2	41.97%	42.35%	26.26%	26.51%

*Yield = $Ne^{+}/N\gamma$

- We don't see any different between positron yield with different distance between crystal and amorphous this must be checked
- Need to study the PEDD

Conclusion

- Polarized positron using Bremstralhung process is interesting source (for CLIC not ILC)

Channeling:

- Check the positron yield variation versus distance between crystal and amorphous
- Study carefully the power deposition (does the target survive)
- Add hadronic process in the Physics List
  - Activation problem ..