SuperB positron injection scheme proposed by the LAL

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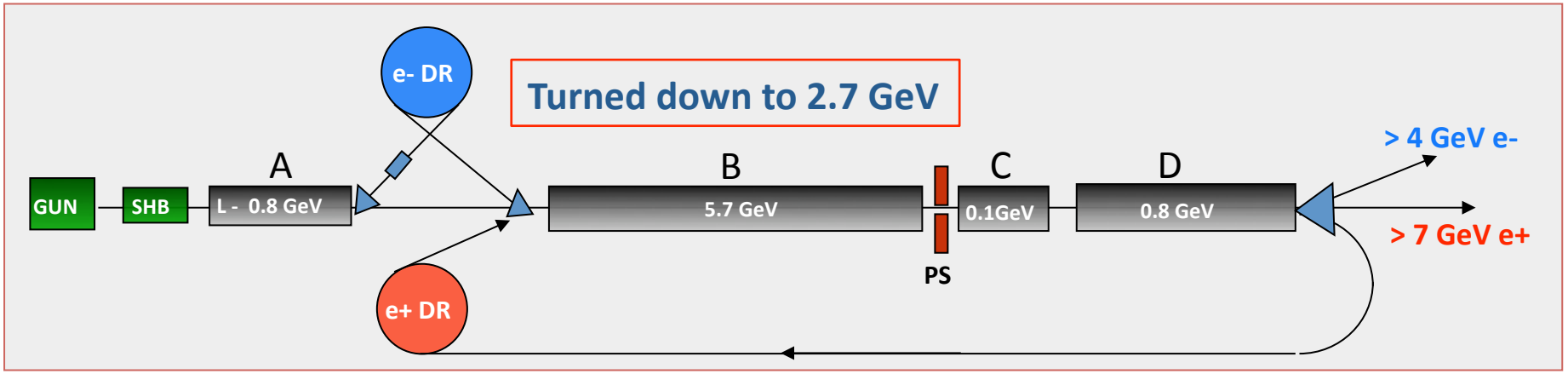
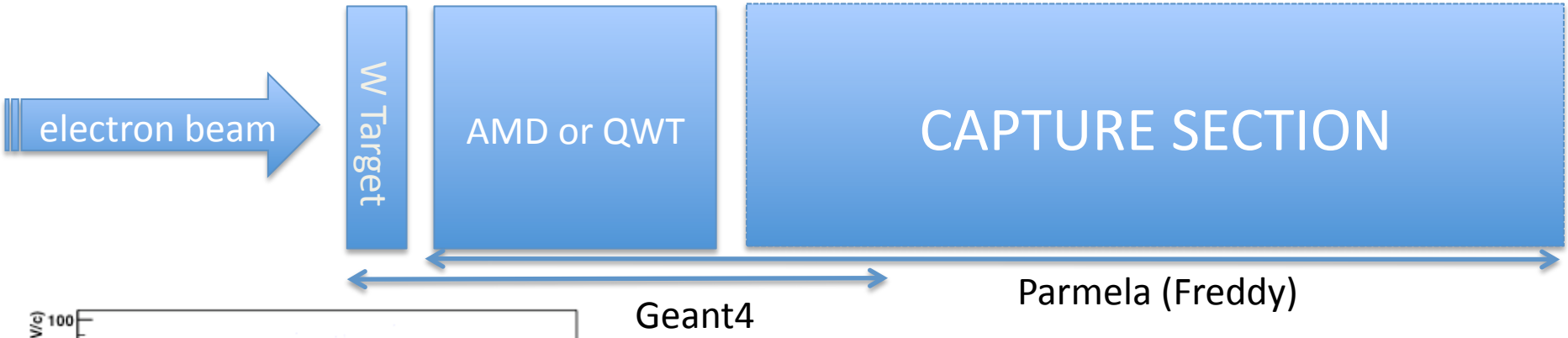
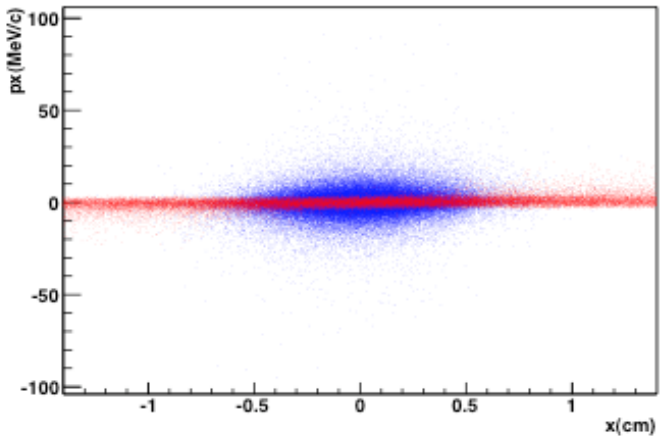
Injector RF Layout

(Boni, Guiducci, Seeman)







AMD effect : the positron emittance is described by an ellipse with large radial dimension and small transverse momentum easier to transport

Needed injection rate

- $N = 6 \times 10^{10}$
- $n = 1600$
- Lifetime = 5 min
- $dN/dt = 1600 \times 6 \times 10^{10}/(5 \times 60) = 3.2 \times 10^{11}/s$

We will used the SLAC Gun, from pep (polarized e^-)

- $10\ nC \approx 6.25 \times 10^{10}$ e-
- Inject each beam at 25 Hz
- Inject, say, 5 bunches per pulse

For safety reason let say 40% (pessimistic case)

$$25 \times 5 \times 6.25 \times 10^{10} \times \alpha \times Yield_{target} \times Trans_{target\text{-}catpure}\ Trans_{capture\text{-}DR}$$

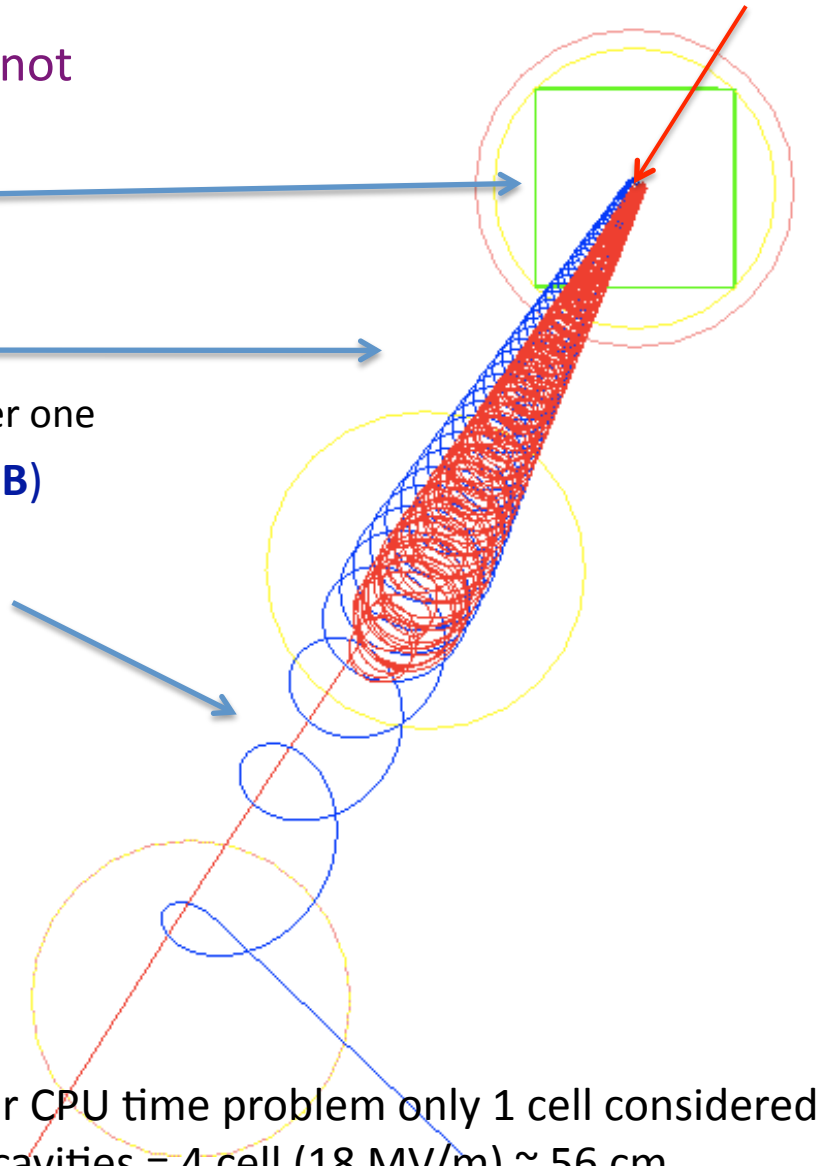
$$Yield_{target} \times Trans_{target\text{-}capture} \sim 20\%$$

50% (pessimistic case)

One world on simulation

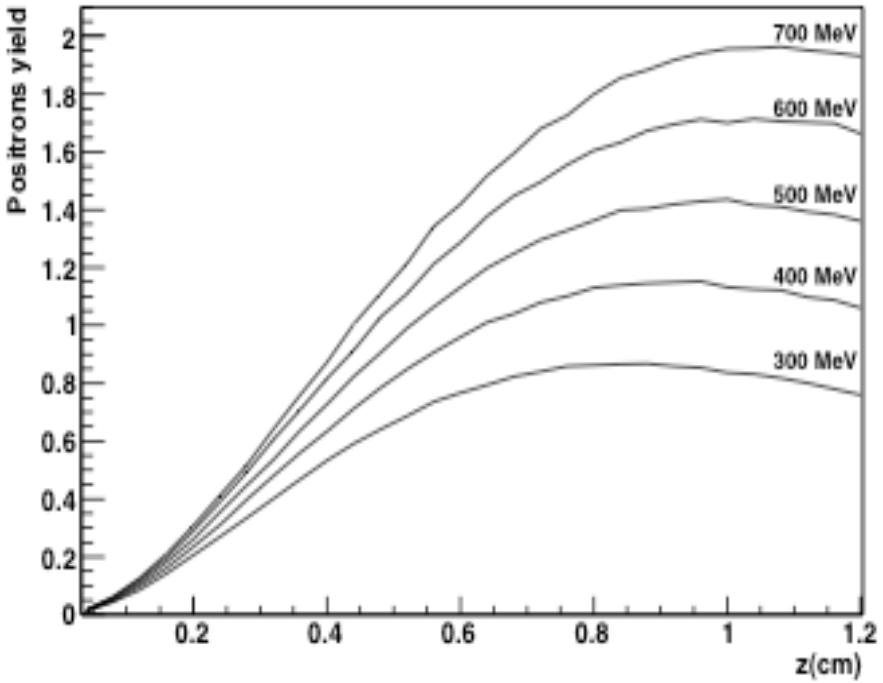
- Geant4 based
  - Production of the positron polarized or not
    - Total Power deposited
    - Sliced for PEDD calculation
  - Capture section
    - AMD & QWT (Analytic form)
      - transform large momentum into smaller one
    - First cell of the acceleration (Map field **E**, **B**)
      - Described by SuperFish file
  - Root Ouput file

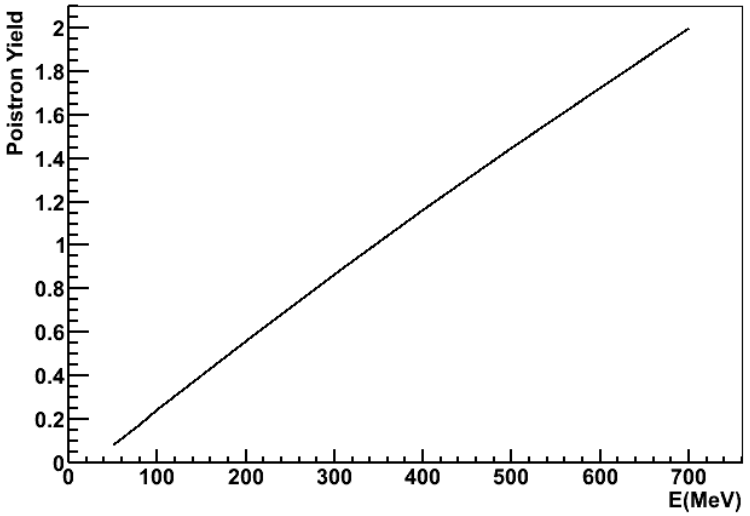
```
TFile**         6T/30cm/300.MeVppsim_8.8_6_30.root      PPSim output file
 TFile*         6T/30cm/300.MeVppsim_8.8_6_30.root      PPSim output file
  KEY: TTree    Sampler0;1      Sampler output
  KEY: TTree    Sampler1;1      Sampler output
  KEY: TTree    Sampler2;1      Sampler output
  KEY: TTree    Sampler3;1      Sampler output
  KEY: TH3F     histo_pedd3D;1  histo 3D Pedd
  KEY: TH1F     ElossHisto;1    Energy Loss
  KEY: TGraph   EMSuperFish;1   Graph
  KEY: TGraph   EM_hSuperFish;1 Graph
  KEY: TGraph   EMSeenFromParticles;1   Graph
  KEY: TGraph   EM_hSeenFromParticles;1 Graph
  KEY: TObjString
##################################################
# Particles Types     :       11
# Number of particles which impinged the target       : 50000
# Particles was shoot at Z0   =   -0.000010 m
# Particles Mean Energy               : 300.000000 MeV
# Material: G4_W    size(x,y,z)=(25.000000,25.000000,8.800000) mm
# Number of slices(nx,ny,nz)=(50,50,10)
# RMS :2.500000 mm
# Capture Length : 0.861219, radius (cm): 2.000000
# AMD B0 : 6.000000 tesla , length: 0.300000 m and alpha :    36.666667 m-1
# Acceleration Field : 18.000000 , length: 0.561219 m
##################################################
```

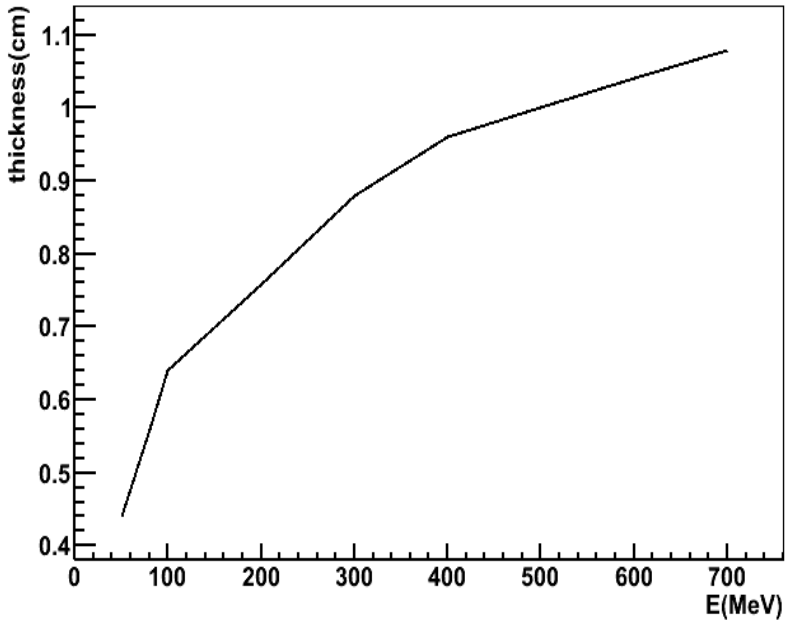


For CPU time problem only 1 cell considered
1 cavities = 4 cell (18 MV/m) ~ 56 cm

Yields Studies

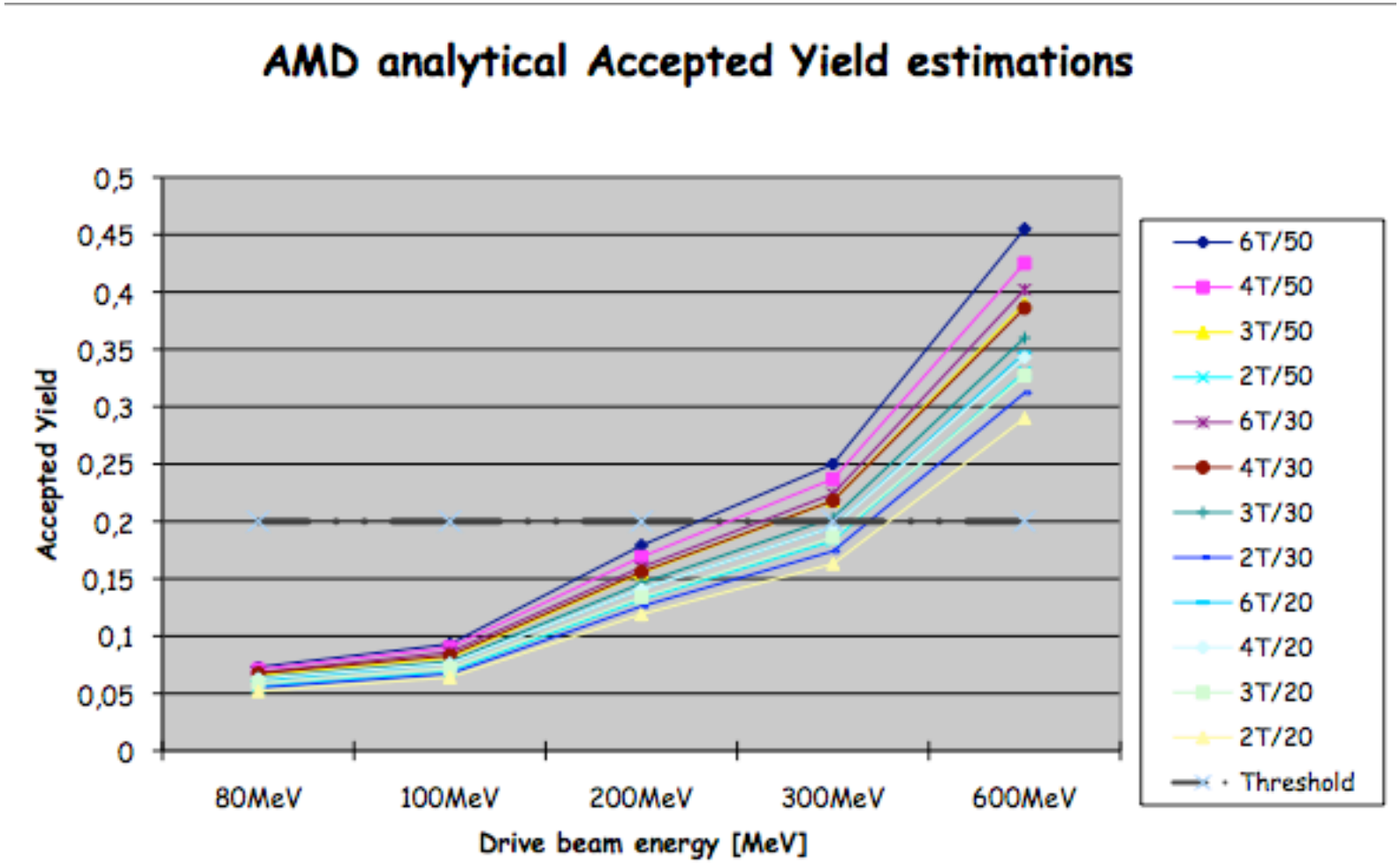






Seems to have a reasonable yield > 300 MeV
What about the capture ?

Analytic simulation from Alessandro



Results

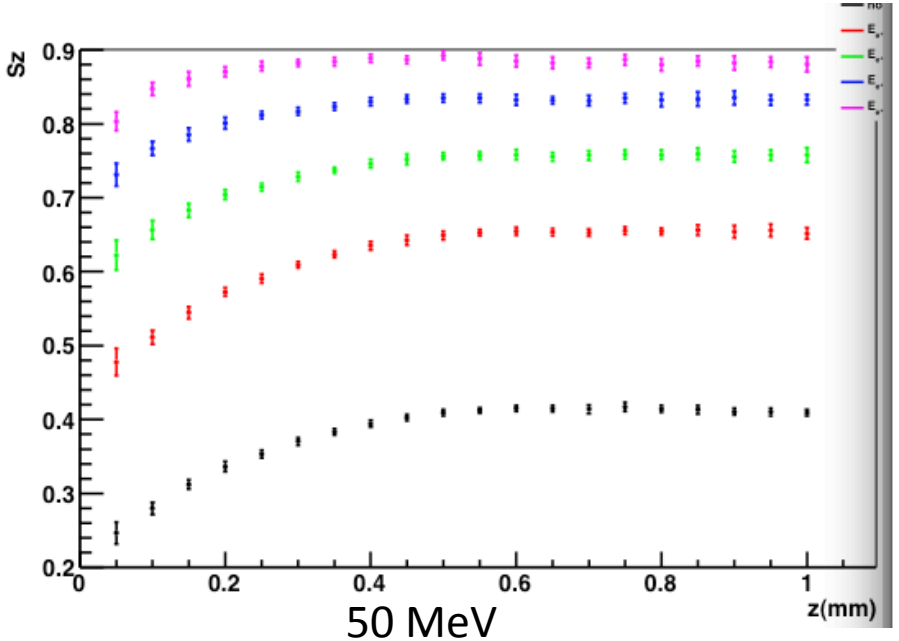
E(MeV)	Yield (%) [geant4] @ exit target	Yield (%) [geant4] @ exit AMD	Yield(%) @ after 40 m
200 (t=0.76 cm)	55.6	12.1 AMD: 6T, 50cm	4.48 (G4 11. after 1 cell)
300 (t=0.88 cm)	86.3	17.6 AMD : 4T, 30cm	6.3 (G4 15. after 1 cell)
500 (t=1 cm)	142.5	28.2 AMD 2T, 30 cm	9.7 (G4 22. after 1 cell)

1 cavities = 4 cell (18 MV/m) ~ 56 cm

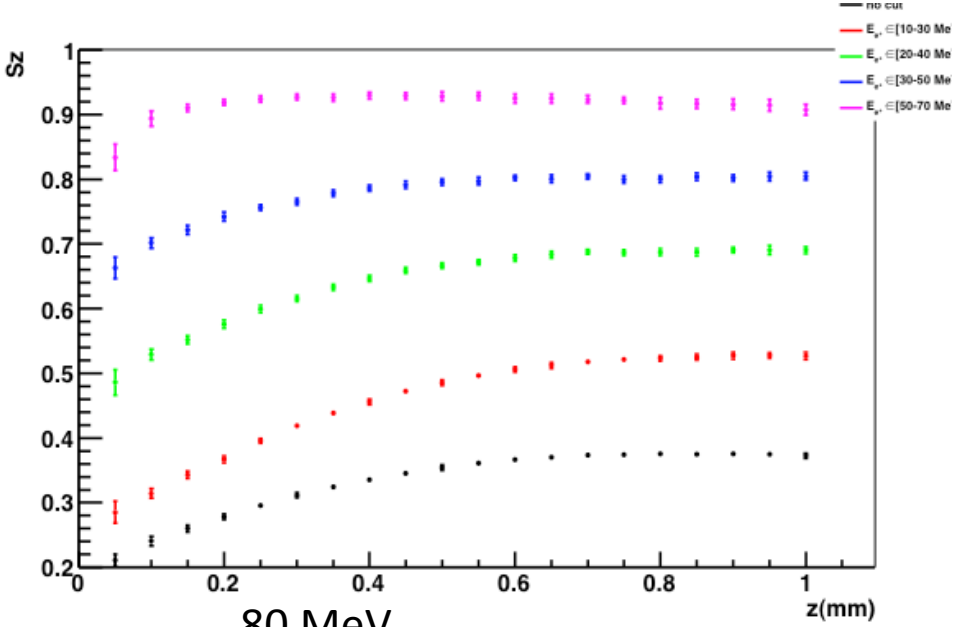
Conclusion

- It seems that we can achieved the positron yield requirements @ SuperB running at lower energies
  - Actual baseline > 2GeV our proposition around 500 MeV
  - Without recirculation line
  - Less expensive
- Study thermal dissipation
- No problem concerning the PEDD constraints (35 J/g)
  - In the worst case at 500 MeV we have 1.1 J/g
- Icing on the cake (Cerise sur le gateau):
  - We have polarization for FREE. Need to run at lower energies
  - Need to assure the polarization at the IP
- Need to understand the difference between Parmela – Geant4

Backup slide – Polarization



50 MeV



80 MeV