

PPS-Sim Simulations of the Source with the AMD

A. Ushakov, S. Riemann, A. Schällicke

DESY

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Compare PPS-Sim with EGS/Elegant* and Geant4/Astra

- Source parameters
 - Geometry model
 - AMD and cavities fields
- Positron Yield
 - 6 T AMD. Optimal phase of E-field
 - Initial AMD field
 - AMD taper parameter
- Peak Energy Deposition Density (PEDD)
- Summary

* Wanming Liu and Wei Gai simulation results

Source Parameters

- 100 m **undulator** at 150 GeV and 250 GeV, $K = 0.92$, $\lambda = 11.5$ mm
- 500 m distance from middle of undulator to target
- no photon **collimator**
- 1.42 mm pure Ti **target**
- 14 cm **AMD** (adiabatically falling down B-field from 6T to 0.5 T)
- 12.5 MV/m **RF** cavity embedded into 0.5 T **solenoid**
- 3 cm aperture radius of AMD and RF cavities
- no free space between target, AMD and RF
- **DR** long. acceptance: 1% energy spread (≈ 1 cm bunch length, 15 deg of E-phase)
- **DR** transverse acceptance: 0.09 m rad

Differences between Software

- PPS-Sim: E-phase scans could be done semi-automatically (via scripts). It requires relatively high statistics (relatively slow).
- PPS-Sim: Only 1st RF cavity implemented, $E(0,0,E)$ field is a simple harmonic function
- Astra: optimal phase defined automatically (very fast)
- Astra: fields imported from external files (could be scaled)

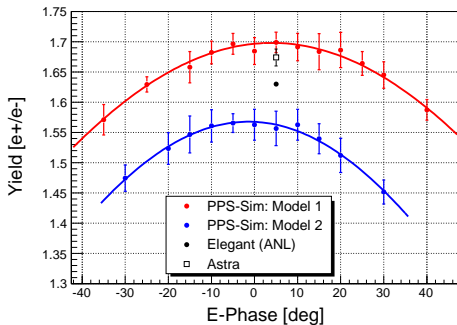
DR acceptance

Elegant, Astra: applying cuts at 125 MeV

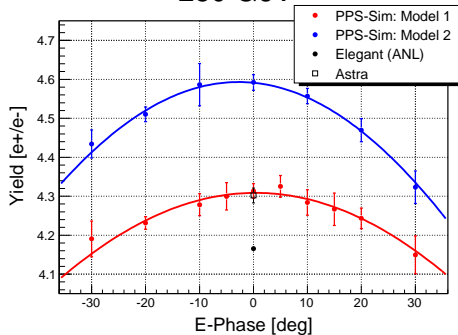
PPS-SIM: ... after 1st cavity

E-field Phase Scan

150 GeV



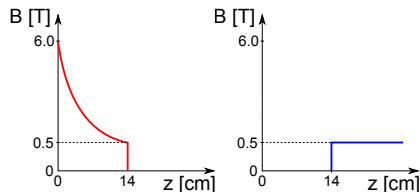
250 GeV



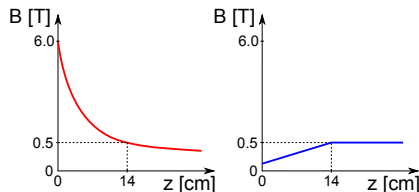
Elegant	0
Astra	+2.7%
PPS-Sim 1	+4.2%
PPS-Sim 2	-4.1%

Elegant	0
Astra	+3.3%
PPS-Sim 1	+3.6%
PPS-Sim 2	-10.3%

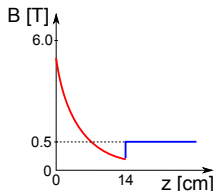
Elegant, Astra, PPS-Sim: Model1



PPS-Sim: Model2

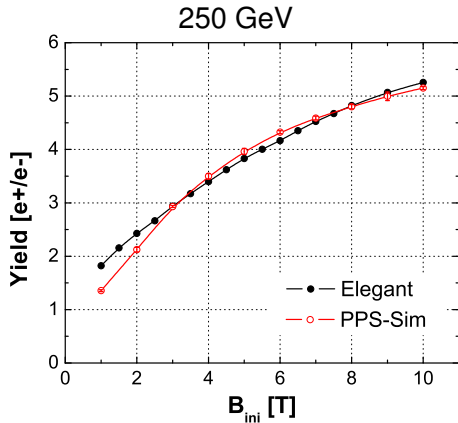
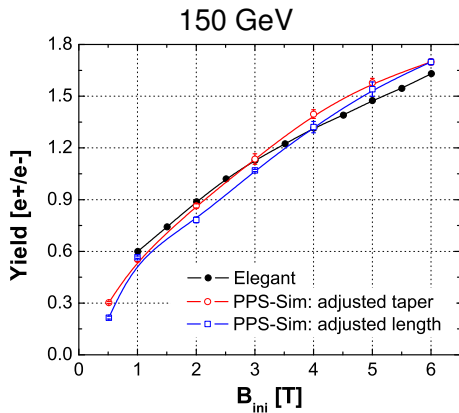


Mismatching Fields



- More “smooth”
- $R_{solenoid} = 30$ cm (?!)
- Fringe Field of Solenoid

Initial AMD Field



Positron Losses (Astra)

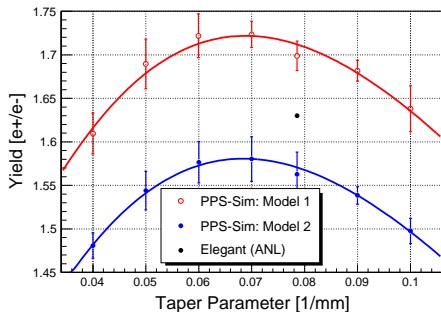
- AMD initial B-field: 6 T
- Average E-field (1st & 2nd cavities): 12.5 MV/m
- Number of primary e^- : 10^6

Number of positrons

	150 GeV		250 GeV	
after Target	22912	100%	70079	100%
at 125 MeV	18145	79.5%	42209	60.2%
Long. DR Acceptance	8893	39.0%	23627	33.7%
Long. & transv. DR Acceptance	8583	37.6%	22064	31.5%

AMD Taper Parameter

150 GeV

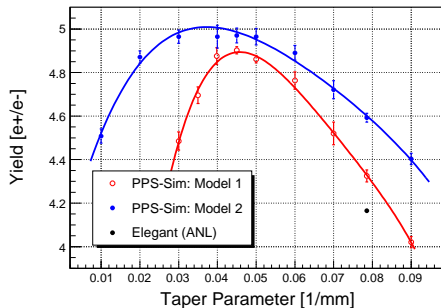


taper = 0.07 mm^{-1}

$L_{AMD} = 15.7 \text{ cm}$

Yield: $\sim 104\%$

250 GeV



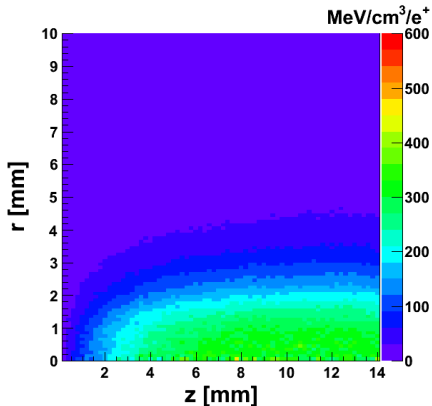
taper = 0.045 mm^{-1}

$L_{AMD} = 24.4 \text{ cm}$

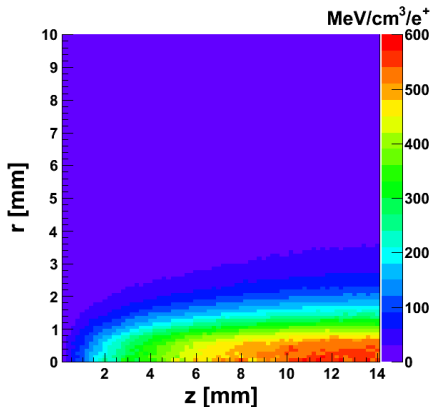
Yield: $\sim 113\%$

Energy Deposition Density. $B_{ini} = 6$ T

150 GeV



250 GeV



Total Energy: 92.7 MeV/e^+
PEDD: 320.8 $\text{MeV}/\text{e}^+/\text{cm}^3$

Total Energy: 60.4 MeV/e^+
PEDD: 547.0 $\text{MeV}/\text{e}^+/\text{cm}^3$

PEDD Comparison Results

Elegant (Wei Gai, ALCPG, Albuquerque, 2009)

	150 GeV	250 GeV	
Total Deposited Energy	101 MeV/e ⁺	62.8 MeV/e ⁺	62%
PEDD			160%

PPS-Sim

	150 GeV & 5 T	250 GeV & 6 T	
Total Deposited Energy	100.4 MeV/e ⁺	60.4 MeV/e ⁺	60%
PEDD	348.8 MeV/e ⁺ /cm ³	547.0 MeV/e ⁺ /cm ³	157%

- Results of PPS-Sim and EGS/Elegant simulations of source with AMD are in agreement
 - Difference in Yield: $\lesssim 4\%$
 - Difference in Deposited Energy: $\lesssim 3\%$

Future Plans:

- Add possibility to import E and B fields
- Simplify finding of optimal E-field phase
- Add more cavities (extend source model up to 125 MeV)