

Status of Positron Source Simulation in Zeuthen

A. Ushakov, A. Schälicke, S. Riemann

DESY

POSIPOL 2010

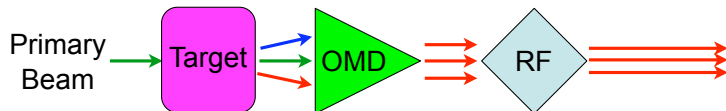
KEK, Tsukuba, 2 June 2010

- Polarized Positron Source Simulations (PPS-Sim)
 - General description
 - New features
- Simulation Results for Conventional Source
 - Positron yield
 - PEDD
- Summary

PPS-Sim is **Geant4-based application** for e^+ source modeling

- Electromagnetic and hadronic **shower development** in target
- Single **particle tracking** in electro-magnetic fields
- **Polarization transfer** in physics processes
- **Spin tracking** in electro-magnetic fields
- Powerful **geometry package**
- **Visualisation** of geometry model, particle trajectories and energy deposition
- Qt4-based **Graphical User Interface** (GUI)
- **ROOT**: analysis of results and input data (e.g. energy spectrum of primary beam)

Choice of Source Components



Primary Beam

- Photons from undulator
- Electrons (conventional source)
- Input file (Compton photons, channeling radiation)

Target

- Solid wheel (Ti- or W-alloy)
- Liquid Lead

Optical Matching Device (OMD) and Accelerating Cavity (RF)

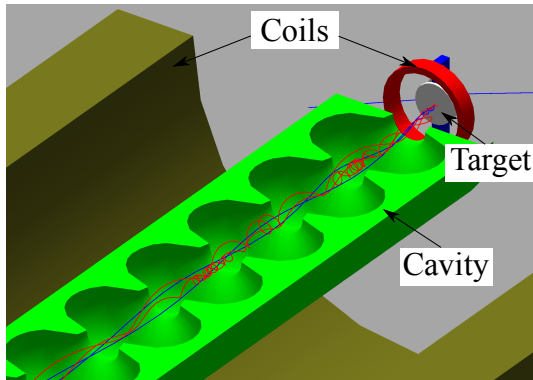
- Pulsed flux concentrator (AMD)
- Lithium lens
- Quarter-wave transformer (QWT)
- 1.3 GHz cavity embedded into solenoid

Acceptance of **Damping Ring**

Aperture of **Photon Collimator**

Visualization Example

Source Model with Liquid Lead Target and QWT

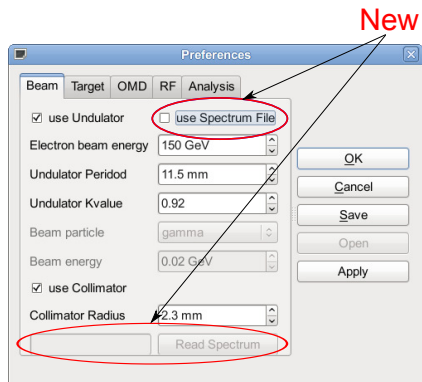


Source Configuration

Source can be configured via macro-commands (Geant4) or dialog “Preferences”

- Choice of source components
- Dimensions & relative positions
- Beam, field parameters
- ...

Dialog “Preferences”

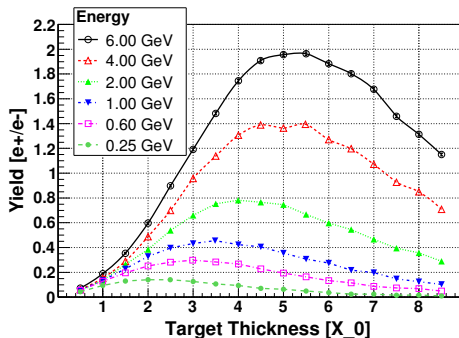


Positron Yield

Conventional Source with Liquid Lead Target and AMD

- Pb target, 3 mm BN window
- Pencil-like e^- beam
- AMD field: 6 T to 0.5 T
- **Optimized** AMD taper parameter
- E-field: 14.5 MeV/m
- DR acceptance: 0.09 m rad, 10 mm long. bunch size

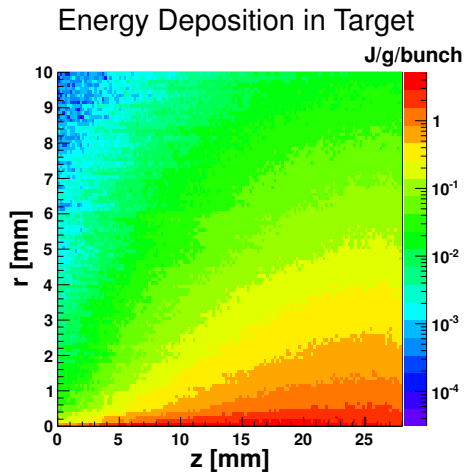
“Captured” Positron Yield



PEDD for 6 GeV e^- beam

Conventional Source with Lead Target and AMD

e^- beam energy	6 GeV
Beam size, σ_r	4.0 mm
Target material	Lead
Target density, ρ	11.35 g/cm ³
Target thickness	$5 X_0$
Number of e^+	$3 \cdot 10^{10}$ per bunch
Captured Yield	$0.84 e^+/e^-$
PEDD	4.54 J/g/bunch



Yield and PEDD for Conventional Source

Lead Target and AMD

e^- Energy	Thickness [mm]	Taper [m^{-1}]	Yield [e^+/e^-] $\sigma_r = 0$	Yield [e^+/e^-]	E_{dep}^{total} [MeV/ e^+] $\sigma_r = 4$ mm	PEDD [J/g/bunch*]
250 MeV	11.2	35	0.14	0.08	582	4.1
600 MeV	16.8	34	0.29	0.16	869	1.4
2 GeV	22.4	28	0.78	0.37	1267	0.4
6 GeV	28.0	12	1.96	0.84	1698	4.5

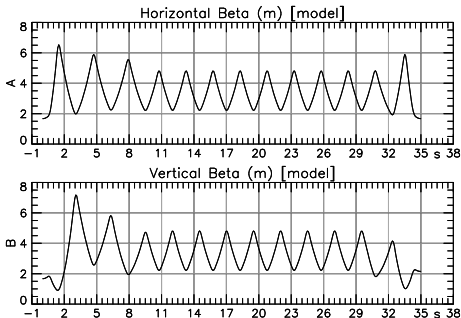
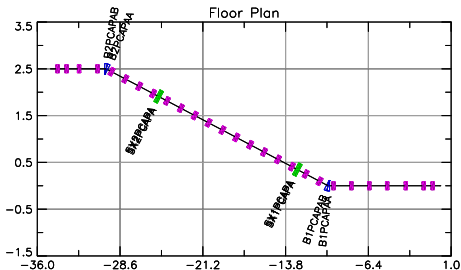
* $3 \cdot 10^{10}$ e^+ /bunch

Bmad Simulations

ILC e+ PCAPA beamline

Simulations ILC beamline downstream 125 MeV have been started

PCAPA (Positron CAPture system A) is the beamline that separates the positrons from the electrons and photons



Summary and Outlook

- Input data for primary beam (energy and spatial distribution) can be used in PPS-Sim
- Special running mode for the PEDD analysis is provided
- Optimization of positron source can be performed.
Some results for conventional source have been presented
- Bmad simulations have been started

Plans:

- Adding field maps into PPS-Sim
- Finding of optimal electrical field phase
- Beam tracking up to DR in PPS-Sim + Bmad