PPS-Sim

Update & Future developments

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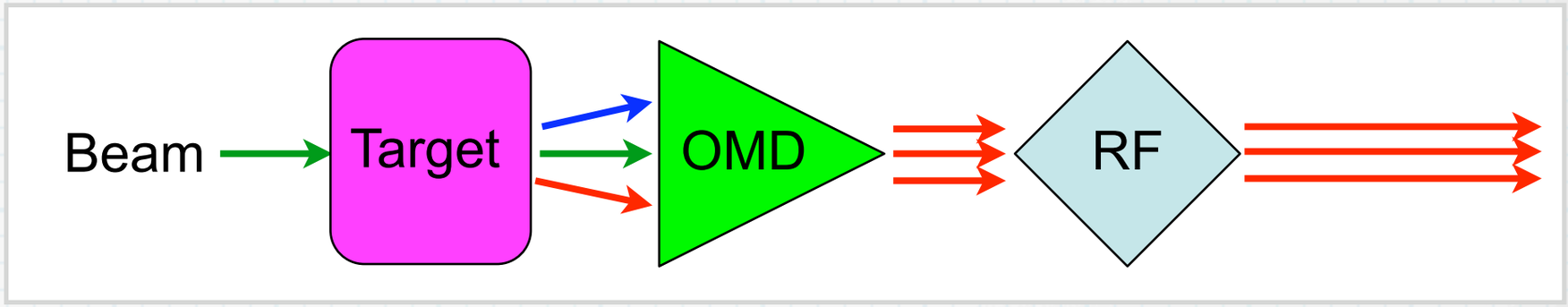
Outline

* Brief introduction to PPS-Sim
  - Features
  - Usage
* Update
  - external input spectrum
  - PEDD determination
* Outlook/Summary

PPS-Sim

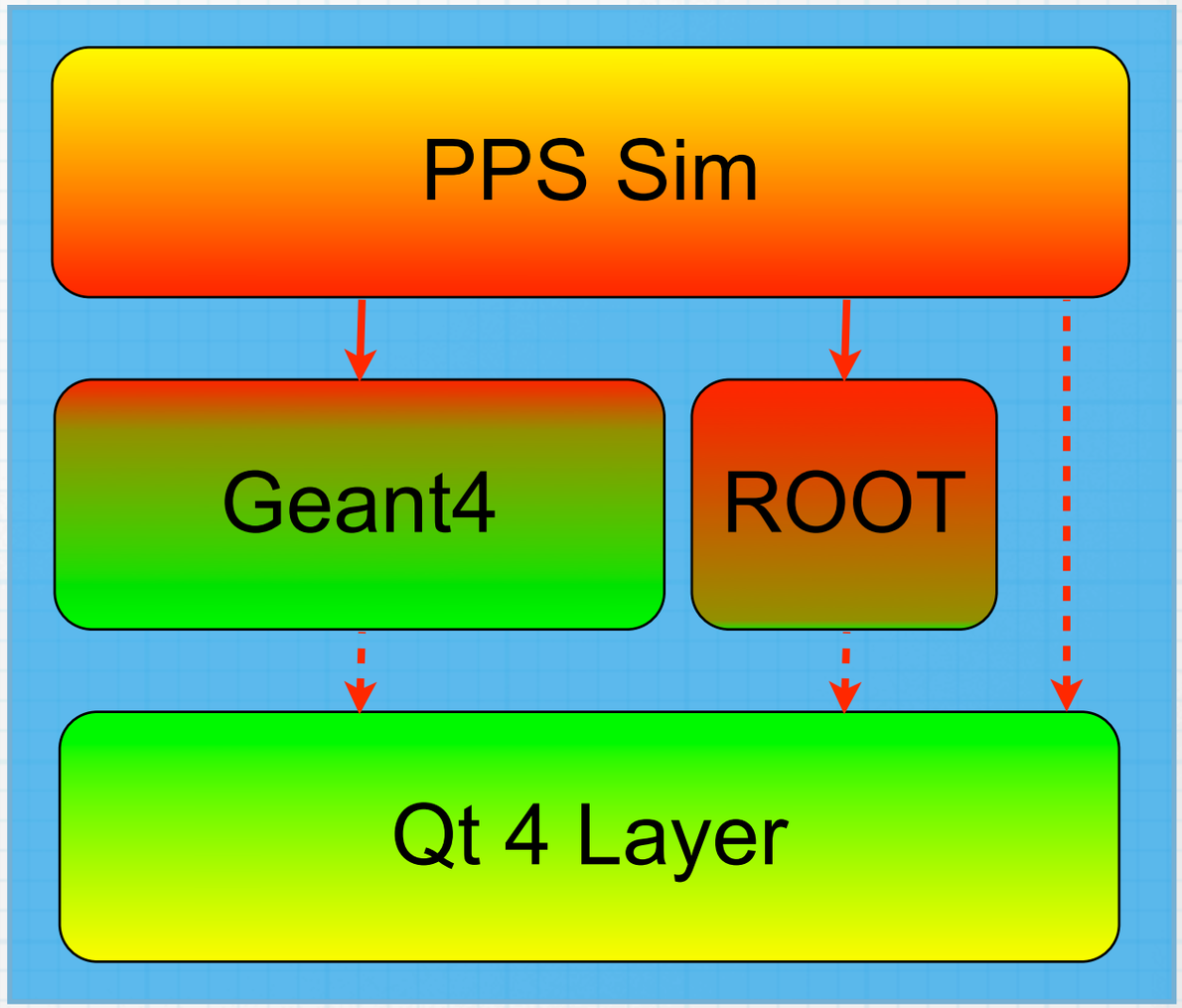


* Polarised Positron Source Simulation

- Primary beam
  - Photons from Undulator
  - Electrons (conventional source)
  - Input file (Compton photons, Crystal target)
- Target
  - Ti wheel, Liquid Lead
- Positron Capture Optics (OMD)
  - AMD, QWT, Li-Lens
  - Solenoid B-field, RF E-field

PPS-Sim

* Based on
  - Geant4
    - incl. polarised processes
    - spin tracking
  - ROOT
    - online analysis
    - persistency
    - input spectrum
  - QT4
    - GUI
    - Visualisation (OpenGL)



PPS-Sim

* Features:
  - calculates positron yield & polarisation (incl. DR acceptance)
  - provides beam properties (width, emittance, energy, ...)
  - lists total energy deposition in components
  - new gives PEDD in target, LiLens or Windows
* User interface:
  - Geant4 macro files
  - Qt GUI
  - Output/Analysis: ROOT or PyROOT

pps-sim Run Gun Visualization Tests Analysis Help

47°C 2982rpm (98%) 1:58 PM

Open Viewer
Set style solid
Set style wireframe
Add CutawayPlane
Remove CutawayPlanes
Accumulate events
No accumulate
Disable Visualization
Enable Visualization

Menu
free configurable

```
#  Ctrl + pick a volume
#  Shift + pick a volum
# - in viewing mode (c
#  Left-button + point
#  Ctrl+Left-button +
#  Ctrl+Shift+Left-but
#  Middle-button + pointer move : pane.
#
#################################################
##############
/vis/viewer/update
/vis/viewer/set/style solid
/vis/viewer/refresh
/vis/viewer/addCutawayPlane 0 0 0 m -1 0 0
/vis/viewer/refresh
/gui/showPreferences
```

clear

session

Geant4 Prompt

Terminal — pps-sim — 91×19

```
s28dyn091:PPS-Sim dreas$ pps-sim
**************************************************************
 PPS-Sim   : Polarised Positron Surce Simulation in Geant4
 Version   : 0.1 (8-April-2009)
 Authors   : S. Riemann, A. Schaelicke, A. Ushakov
**************************************************************
```

Help on commands

Search :

Geant4
Online Help

Command | Match

- /vis/viewer/
  - /vis/viewer/set/
  - /vis/viewer/addCuta...
  - /vis/viewer/changeC...
  - /vis/viewer/clear
  - /vis/viewer/clearCut...
  - /vis/viewer/clearTra...
  - /vis/vi...

/addCutawayPlane

Guidance :
Add cutaway plane to current viewer.

Parameter : x
Coordinate of point on the plane.
Parameter type : d
Omittable : True

viewer-0 (OpenGLImmediateQt)

visualisation

Preferences

Beam | Target | OMD | RF | Analysis

use Undulator
Electron beam energy 150 GeV
Undulator Peridod 11.5 mm
Undulator Kvalue 0.92
Beam particle gamma
Beam energy
use Collimator
Collimator Radius 2.3 mm

OK
Cancel
Save
Open

Parameter settings

G4UI Session

```
 N_e+ after target: 662
Mean e+ polarization (after target) : 0.46943857 +- 0.012203364
N_e+ (in DR acceptance): 212
Mean e+ polarization (in DR acc.) : 0.5096635 +- 0.055309366
iAngle : 345
--------------------Energy Deposition----------------------
 mean Energy in Target : 1.1286344 MeV +- 22.102176 keV
mean Energy in AMD : 467.1731 keV +- 15.941289 keV
mean Energy in RF : 200.89736 keV +- 13.147376 keV
mean Energy in Sol : 20.585068 keV +- 3.7232789 keV
--------------------Run Summary----------------------------

 The run consists of 20000 gamma of 14.992 MeV through 1.48
(density: 4.4925
```

session

Geant4 output
(e.g. energy deposition)

About PPS Sim

PPS Sim G4

Polarised Positron Source Simulation in Geant4

Version 0.1

Authors: S. Riemann, A. Schälicke, A. Ushakov
DESY, Zeuthen, Germany

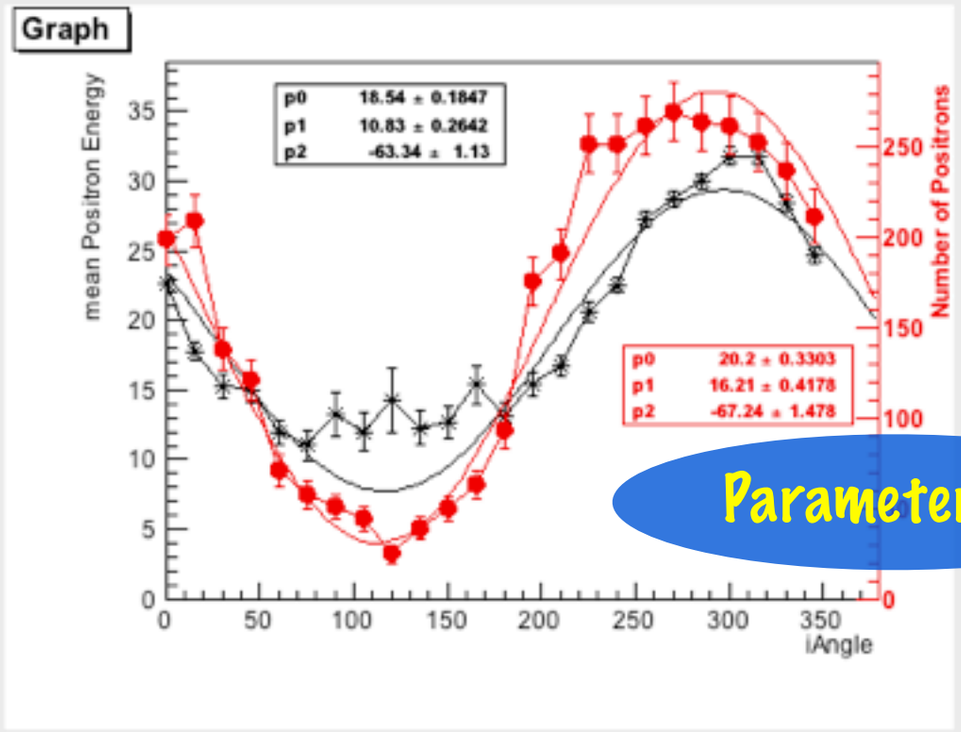
Ok

Terminal — pps-sim — 91×19

```
59.1522 percent of e+ are out of transv. and long. DR  acceptance
tag=iAngle#
value=345#
212 : 24.6416 +- 0.551981
 FCN=161.707 FROM MIGRAD    STATUS=CONVERGED      81 CALLS          82 TOTAL
                     EDM=7.45058e-12    STRATEGY= 1      ERROR MATRIX ACCURATE
  EXT PARAMETER                                   STEP         FIRST
  NO.   NAME      VALUE            ERROR          SIZE      DERIVATIVE
   1  p0           1.85434e+01   1.84651e-01   6.05036e-05  -1.33478e-04
   2  p1           1.08273e+01   2.64165e-01   9.00113e-05  -2.56887e-04
   3  p2          -6.33418e+01   1.13032e+00   7.02783e-03  -1.96041e-07
 FCN=51.5481 FROM MIGRAD    STATUS=CONVERGED      75 CALLS          76 TOTAL
                     EDM=4.22859e-11    STRATEGY= 1      ERROR MATRIX ACCURATE
                                                   STEP         FIRST
                  VALUE            ERROR          SIZE      DERIVATIVE
                   2.01998e+01   3.30255e-01   5.89556e-05   3.55539e-05
                   1.62106e+01   4.17770e-01   7.17402e-05  -1.86939e-04
                  -6.72356e+01   1.47810e+00   5.22130e-03  -5.60456e-06
```

ROOT output
(e.g. fit results)

Parameter Scan



OK

Save

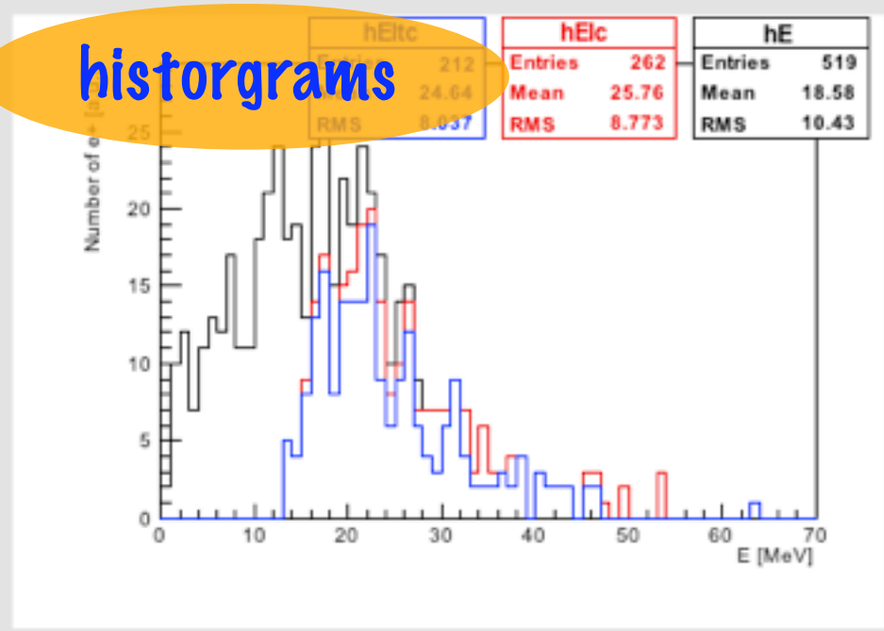
Parameter scan

Analysis

hXY | hXd... | hXphsp | hYphsp | Ebeam | hZ | hE | hEm...

OK

Save

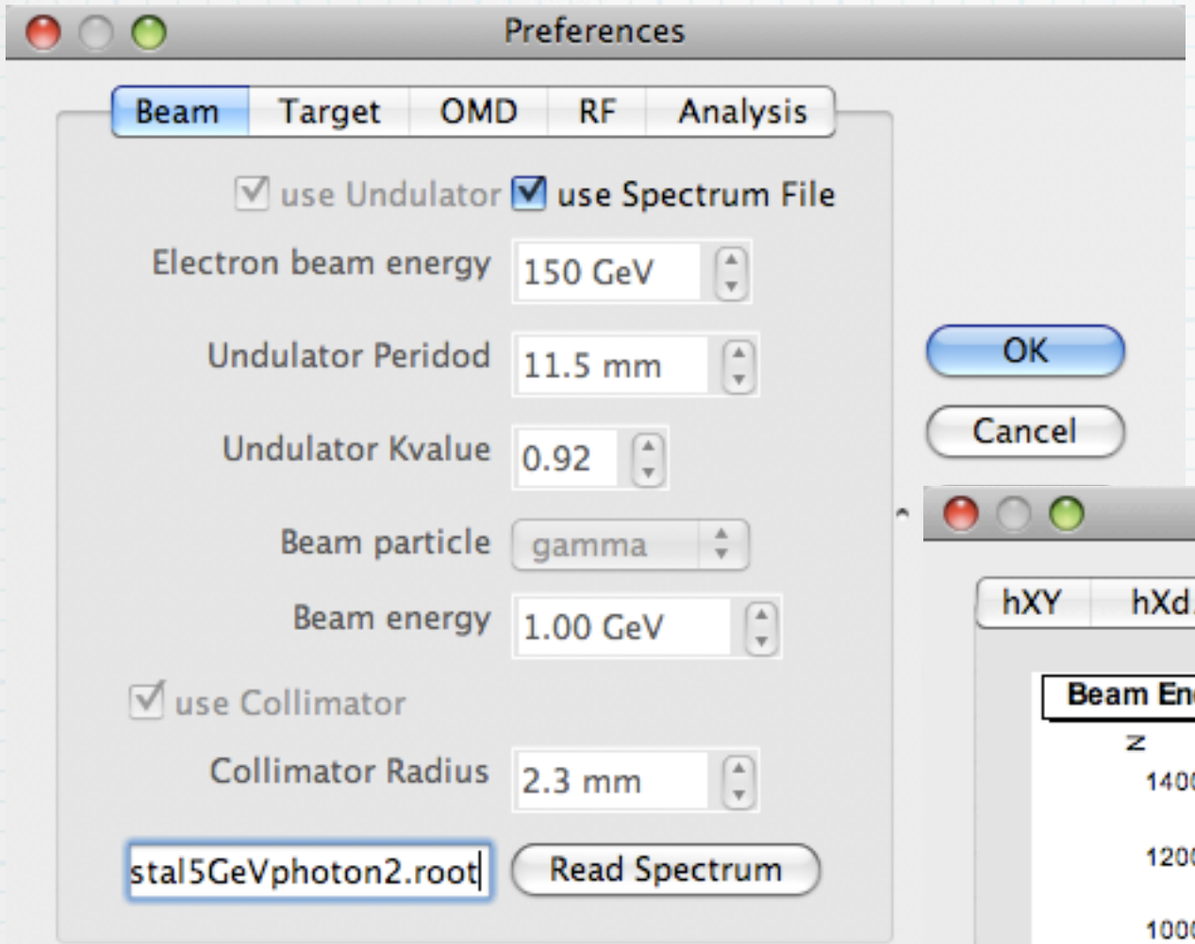


historgrams

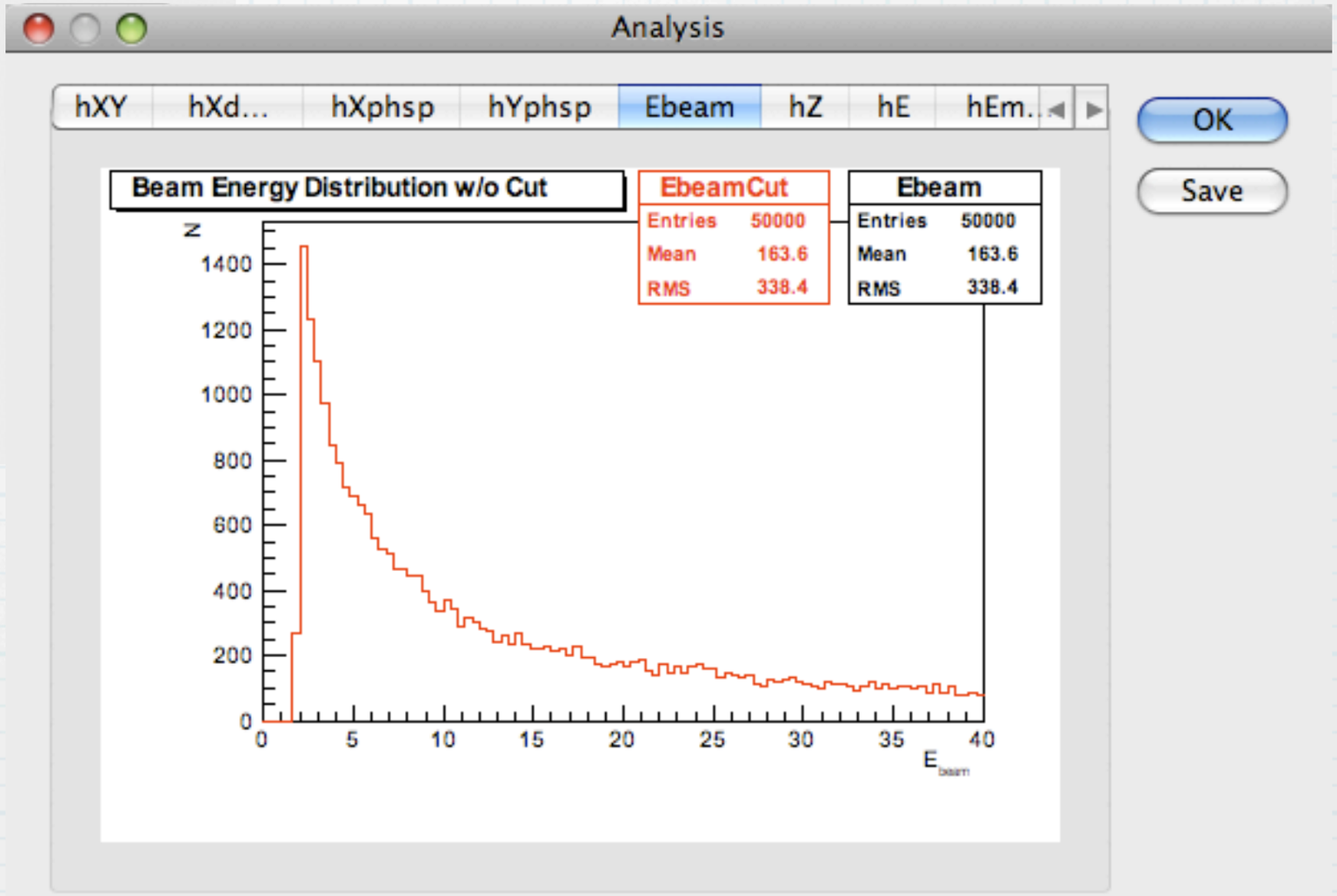
PPS-Sim: input spectrum

* Internal
  - undulator radiation
    - point source few 100 meter upstream
    - analytic angle & energy spectrum
  - monocromatic particle (e.g. electron) beam
* External
  - Compton spectrum (Eugene Bulyak)
  - Coherent Bremsstrahlung (Strakhovenko/Dadoun)

Coherent Bremsstrahlung



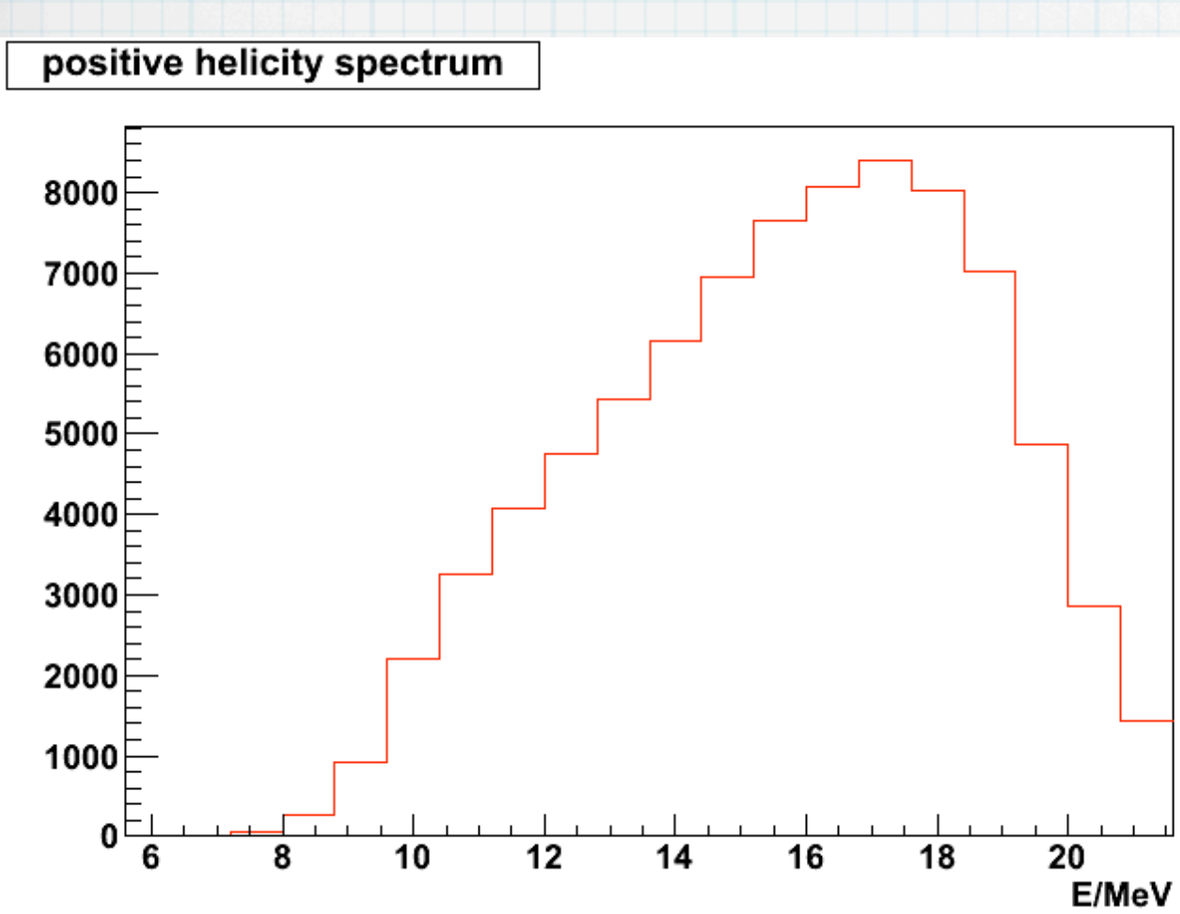
* ROOT input file
  - Data provided by Strakhovenko/Dadoun

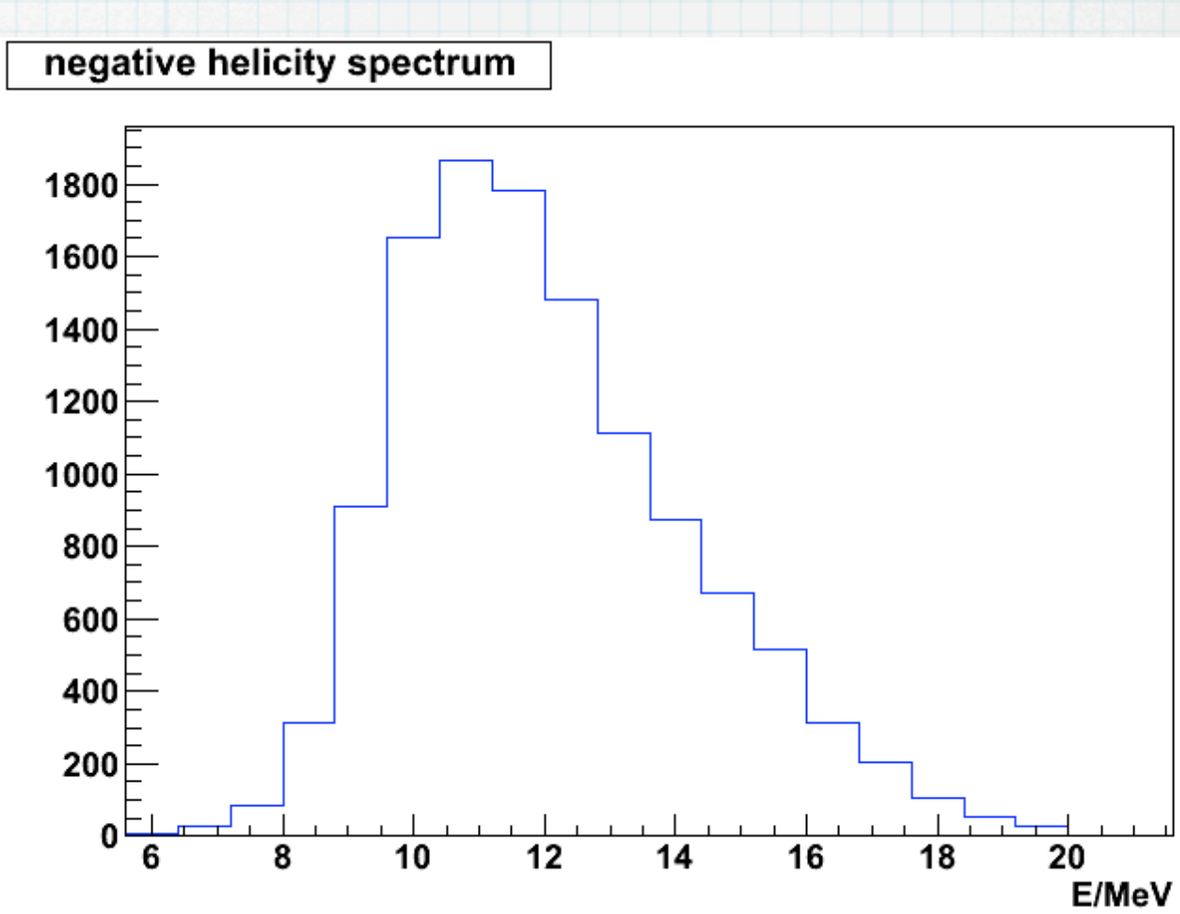


- one file per **particle type**
- general file structure **ntuple** (pos, mom, pol)
- γ, e^-, e^+ can be simulated simultaneously

Compton spectrum (Eugene)

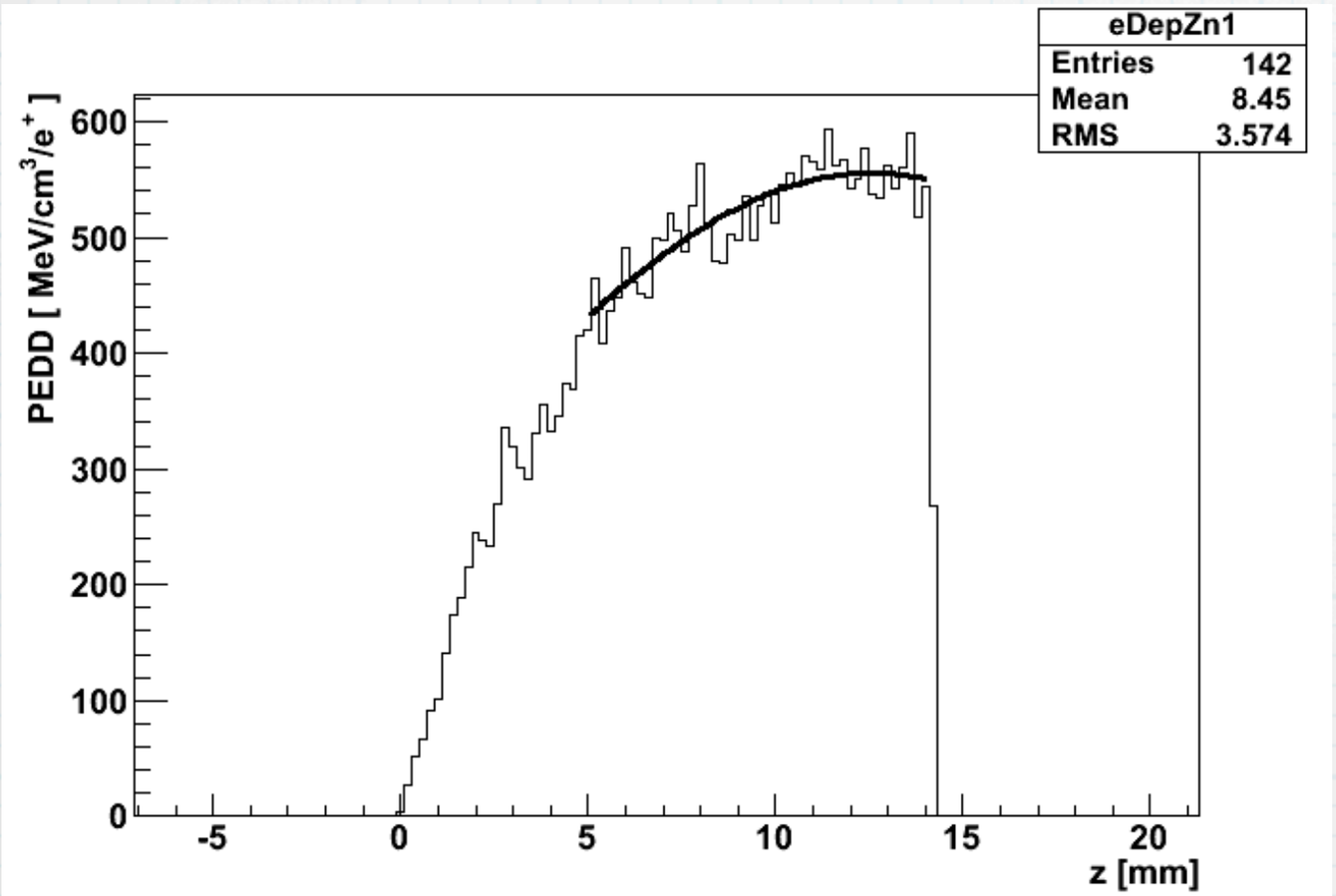
- independent histogram for each polarisation state
- collimator included in input data

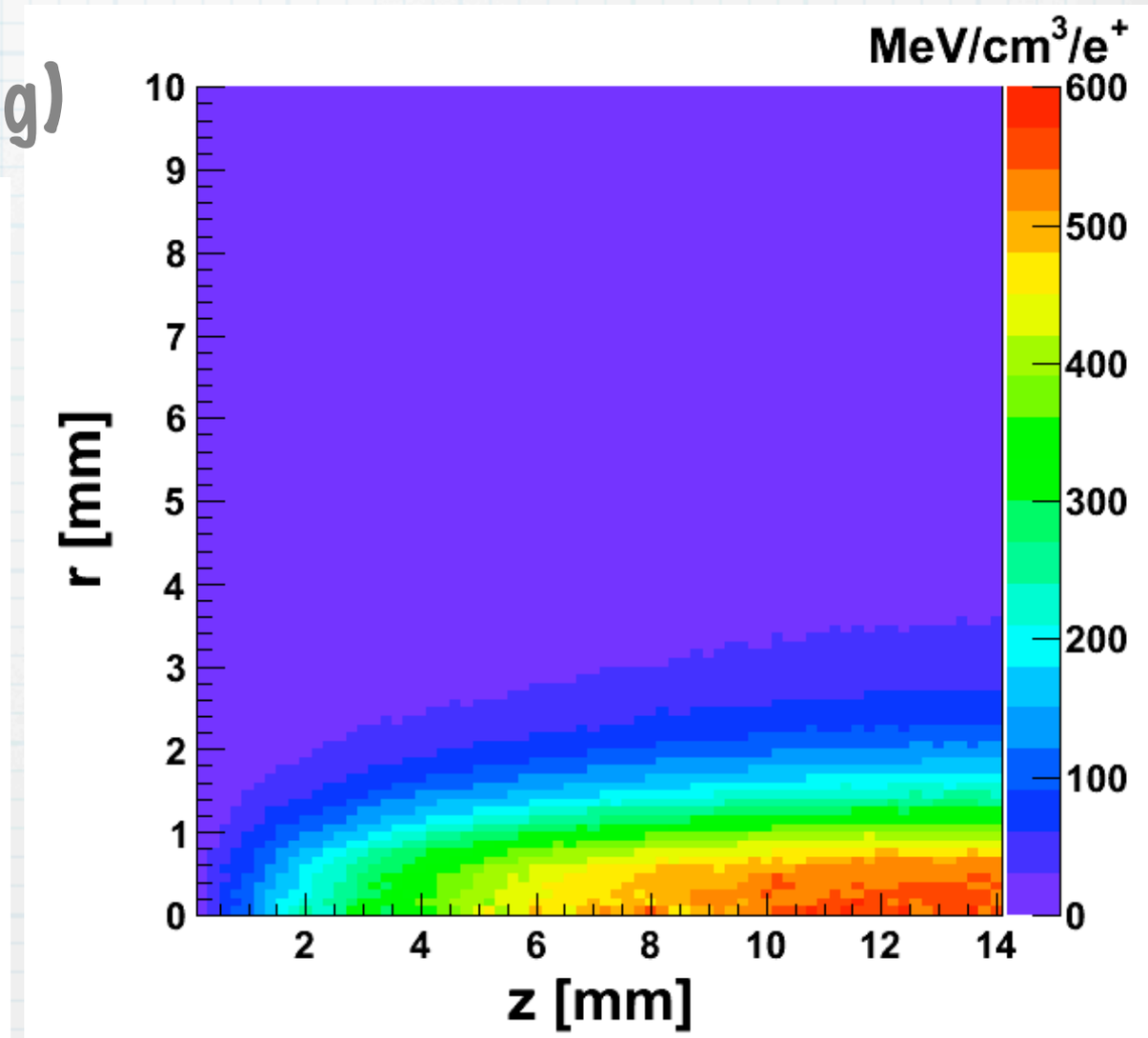




PEDD calculations

* peak energy deposition density
  - in target
  - no magnetic field (bug in Geant4)
  - determined using fits
    (robust, independent of binning)





Outlook/Summary

* PPS Sim Status
  - calculation of positron source properties
  - based on Geant4, Qt, and ROOT
  - source code available from pps-sim.desy.de
  - new version expected after workshop
* Outlook
  - enable alternative physics setting
  - extend simulation up to 125 MeV point
  - optimise and simplify RF phase determination
  - ....