STUDIES ON THE INTENSE POSITRON SOURCE

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Introduction

In e-e+ colliders, positron source is a very important part. In this report I will describe the work on the simulations of the different positron sources by using specialized software. The goal of this internship was to create a simulation to compare different methods of producing positrons.

Conventional source

The first step of my work is simulation of the conventional source. Conventional source is just a target (made of tungsten) which fired by electrons and from which positrons are emitted (see Fig. 1).

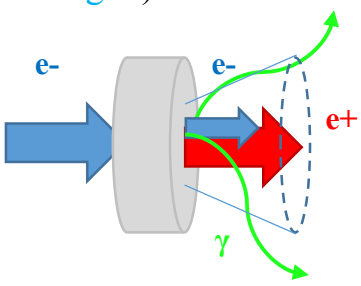

Fig. 1 - Principal scheme of the simulation

For reducing transverse momentum of the outcome positron beam we use AMD.

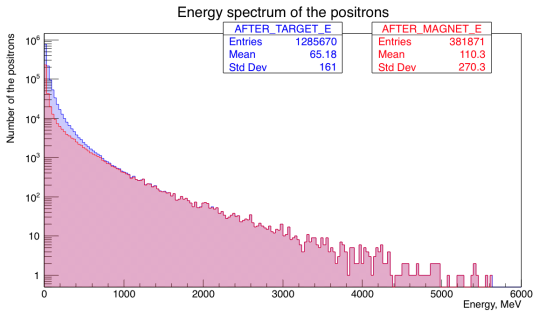

Fig. 2 – Energy spectrum of the positrons

In this plots blue one is positrons after target and red is after AMD.
(Fig. 2, Fig. 3)

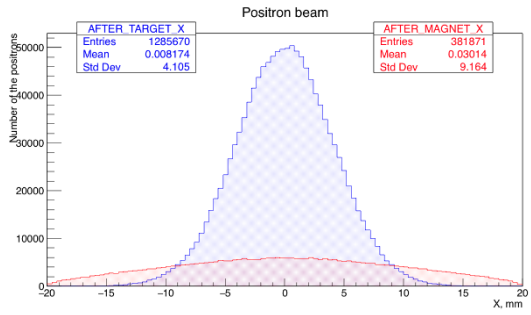

Fig. 3 - Outcome positron beam

Hybrid source:

In intense positron source, energy deposition is a one of the main problem.

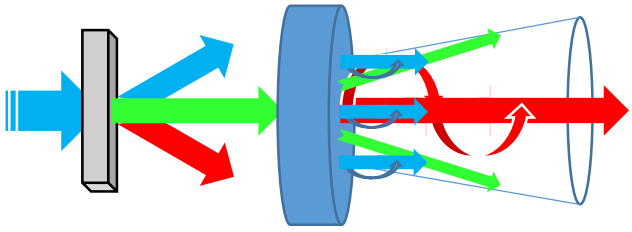

Fig. 4 – Principal scheme of the hybrid source simulation

The ionization process deposit a big part of energy of the particles in the target. In my work, simulated an hybrid source. For comparison, a lot of positron beam parameters in different system configurations have been used.

- ***FOTPP***

The next step of my work plan is work on the program FOTPP as a one of the main part of simulation of the hybrid source.

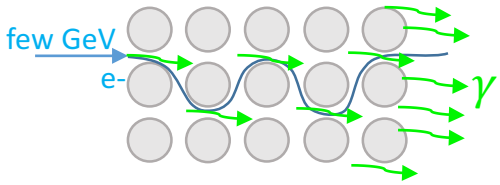

Fig. 5 - generating photons principle

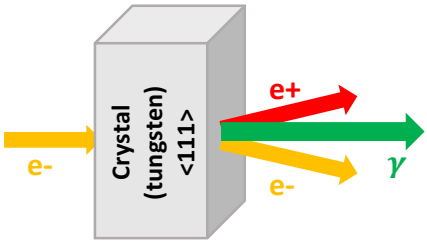

Fig. 6 – first part of the hybrid source simulation (FOTPP)

That's during this internship I learn and try to understand the basics of FOTPP (FOT and also G4FOT), study the photon generation in the crystal and benchmark of the obtained results. FOT is a program for channeling effect simulation using the Baier-Katkov formula for synchrotron radiation in non-uniform field. FOTPP is FOT, but rewritten using C++.

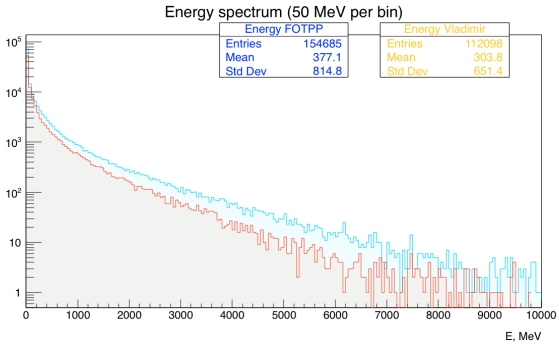

Fig. 7 – evaluation of the FOTPP results (γ energy spectrum for initial 10 GeV e-)

➢ *Compact converter*

A hybrid target scheme (see Fig. 4) is composed of a crystal target and an amorphous converter. Our simulation was done for 10 GeV e- beam passed through the crystal. At the entrance to the converter we have 24.6 photons per initial electron.

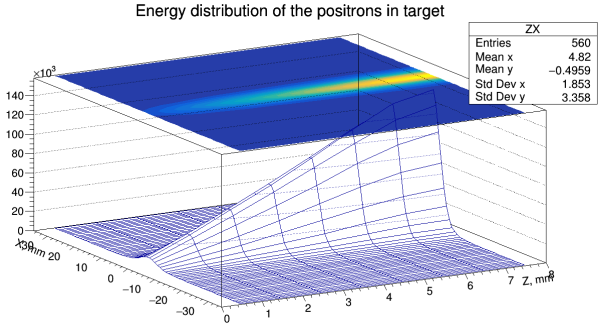

Fig. 8 – deposited energy in a convertor (XZ projection)

The main parameter what was checked is the deposited energy (see Fig. 8) and a PEDD (Peak Energy Deposited Density).

➢ *Granular converter*

The principal scheme of the simulation is not changed for simulation with granular converter (see Fig. 4).

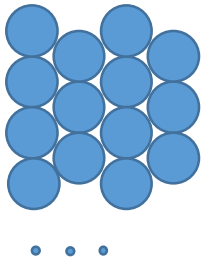

Fig. 9 – granular target structure

We changed just the converter (the target is composed of lots of small spheres, see Fig. 9). With this configuration at the entrance of the converter we have 24.3 photons per initial electron.

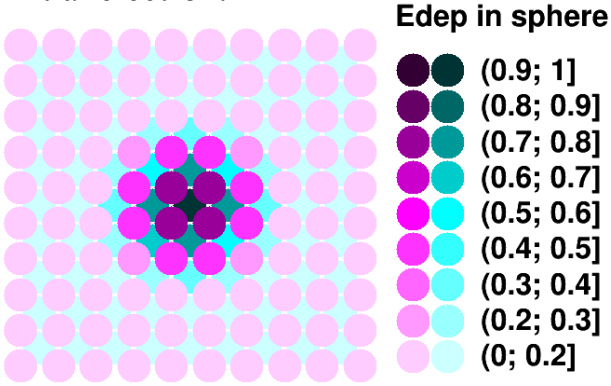

Fig. 10 – deposited energy in last two layer of the target (cyan spheres are a last layer spheres)

As we can see, the maximum of the deposited energy is in the last central sphere as we expected.

Conclusions

During this internship, my work consisting in:

- Simulation of a conventional target similar to that proposal by T. Omori for ILC.
- Use of FOTPP (simulation of crystal effects) – many results correspond to the expected but, in the future verification of some parameters are needed.
- Simulation of the hybrid target - good agreement with the simulation of C. Xu.