# Construction and Timing System of the EPOS Beam System

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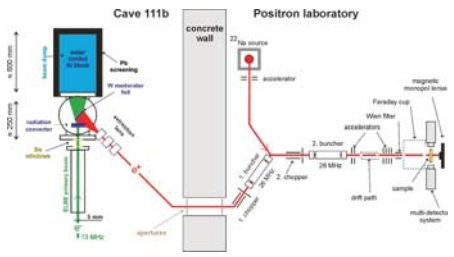
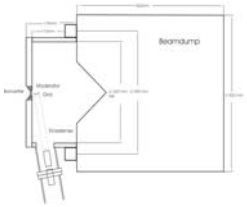
## Introduction

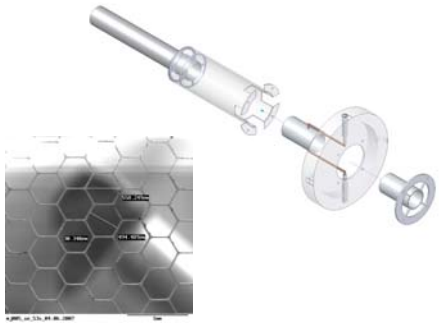



The Forschungszentrum Dresden-Rossendorf provides an intense pulsed 40 MeV electron beam with high brilliance and low emittance (ELBE). The EPOS System (ELBE Positron Source) generates by pair production on a tungsten converter and a tungsten moderator an intense pulsed beam of mono-energetic positrons. To transport the positrons to the laboratory (12 meters) we constructed a magnetic beam guidance system with a longitudinal magnetic field of 75 G. In the laboratory outside the cave, the positron beam (77 ns repetition time) is chopped and bunched. It is necessary, because the very sharp bunch structure of the electron pulses is broadened for the positron beam on the strength of beam transport and moderation. An overview of the EPOS system is shown in the illustration above.

The overview screen shows the beamdump and the converter chamber.
In the converter electrons with an energy of 40 MeV create positrons by pair production from Bremsstrahlung. The high-energy positrons will be moderated in the tungsten moderator foil.

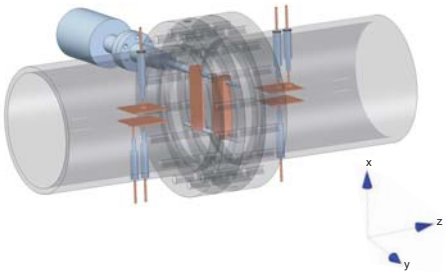



## Design of Electron Lens



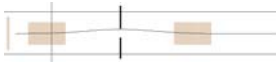
At the beginning of the positron lens a mesh grid with an open area of 89 per cent is fixated. The first tube has a length of 170 mm, the others 50 mm. The distance of the tubes is 10 mm. The moderator has a potential of 2000 V. The mesh grid of the first and third part of the Einzellense have earth potential. Thus, the positrons obtains the transport energy. On the second electrode 675 V are applied. So the focal length is 1.1 meter. On this point, the magnetic field is beginning. Because the converter chamber and the tubes material is aluminium, the whole construction is build of a flange of stainless steel, so electrical feedthroughs can be used. The flange between two flanges made of aluminium. The first electrode, which comes into reach of electron beam, is made of a thin foil.

## Configuration of the Chopper



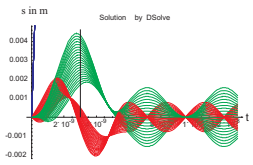

In z-direction, a magnetic field of 75 G is applied. If between two plates an electric field is applied in x-direction, the positrons obtain a transversal energy in that direction. Therefore, the radius of gyration is larger and the positrons can not pass the plates of the chopper. The pairs of plates with an antipodal electric field are spaced at intervals of one length of gyration (126 mm), so that the transversal energy is compensated when the positrons drop out of the chopper.

## Deflection of Positrons

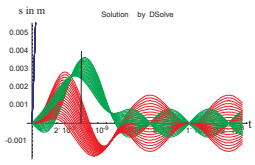


voltage is below 100 V

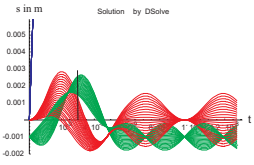
voltage is above 100 V



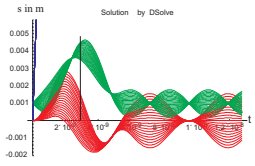

transversal energie x-direction -3 eV to 3 eV




transversal Energie y-direction -3 eV to 3 eV




transversal energie y-direction -3 eV to 3 eV
y0 = -1 mm



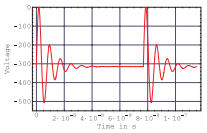

transversal energie y-direction -3 eV to 3 eV
y0 = 1 mm

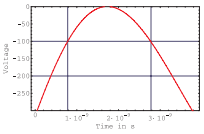
The green line shows the deflection in y direction , the black line the position of the chopper plates.

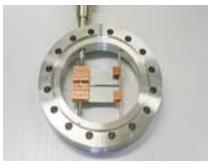
In a range of 2 ns the chopper will open the way for the positrons because the voltage is lower then 100 V. In the other time (previous picture), the positrons will be more deflected and they annihilate on the chopper plates (aperture of the chopper plates 3 mm). The repetition time of the signal is 77 ns.

## Signal of the Chopper

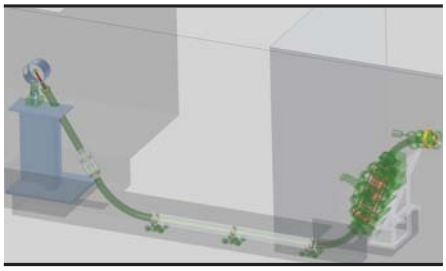
In order to create the field, we try to use a damped oscillation with a frequency of 130 MHz, superposed with a direct voltage .



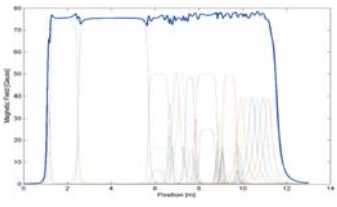



## Construction and magnetic guidance field



These two pictures show the construction of the beam guidance through the concrete channel and the simulation of the magnetic guidance field. The deviation is lower then 6 G and the gradient is below 0.11 G per mm.



## References

[1] W. Bauer-Kugelmann, “Technische Weiterentwicklungen am gepulsten Positronenstrahlsystem PLEPS”, Universität der Bundeswehr, München 2000

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