中国科学技术大学

University of Science and Technology of China

STCF

The positron source of STCF in China

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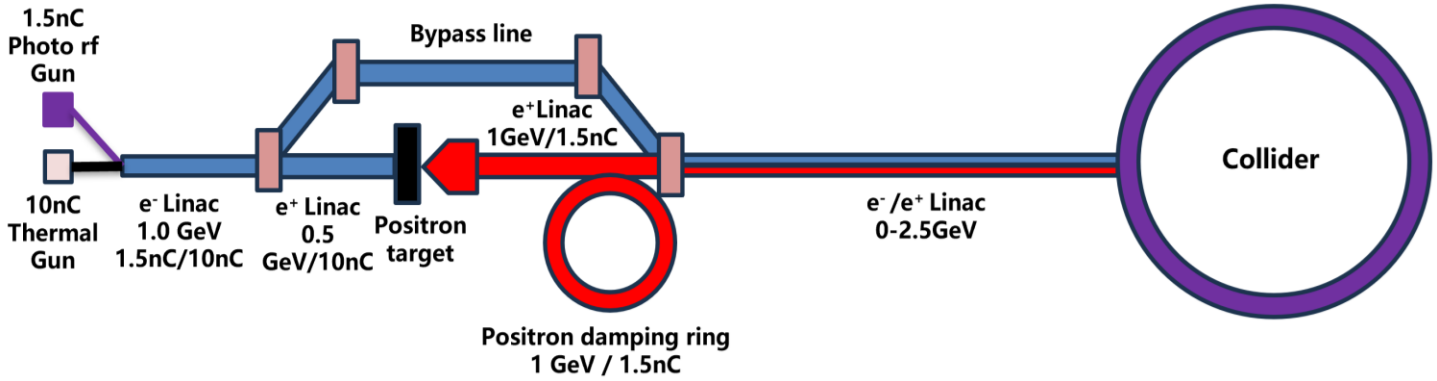
Contents

The Super Tau-Charm Facility in China

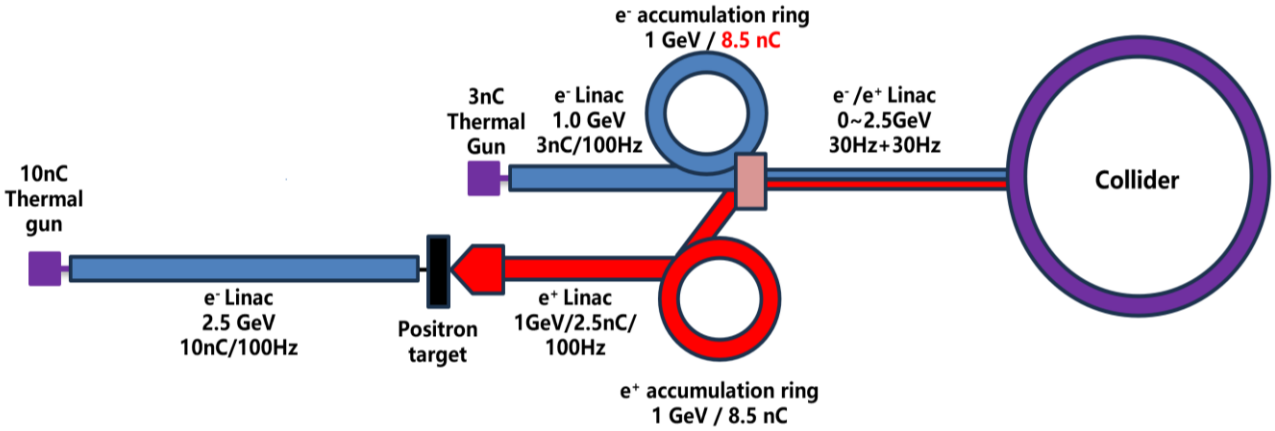
Parameter	Value
Perimeter/m	600~800
Optimized beam energy/GeV	2
Energy/GeV	1-3.5
Current/A	1.5
Emittance$(\varepsilon_x/\varepsilon_y)$/nm·rad	5/0.05
$\beta(\beta_x^*/\beta_y^*)$/mm	90/0.9
Crossing Angle 2θ/mrad	60
Frequency shift ξy	0.06
Hourglass	0.8
Luminosity/$\times 10^{35}$cm^{-2}s^{-1}	≥0.5

The off-axis injection of STCF



Parameter	Off-axis injection
Bunch charge(e/e⁺)	1.5nC/50 Hz
Beam energy(e/e⁺)	1-3.5GeV
Emittance(@2GeV)	≤6 nm·rad
e beam for e⁺(energy)	1.5GeV
e beam for e⁺(charge)	10 nC/50 Hz

The Swap-out injection of STCF



Parameter	Swap-out injection
Bunch charge(e/e⁺)	8.5nC/30 Hz
Beam energy(e/e⁺)	1-3.5GeV
Emittance(@2GeV)	≤30 nm·rad
e beam for e⁺(energy)	2.5GeV
e beam for e⁺(charge)	10 nC/100 Hz

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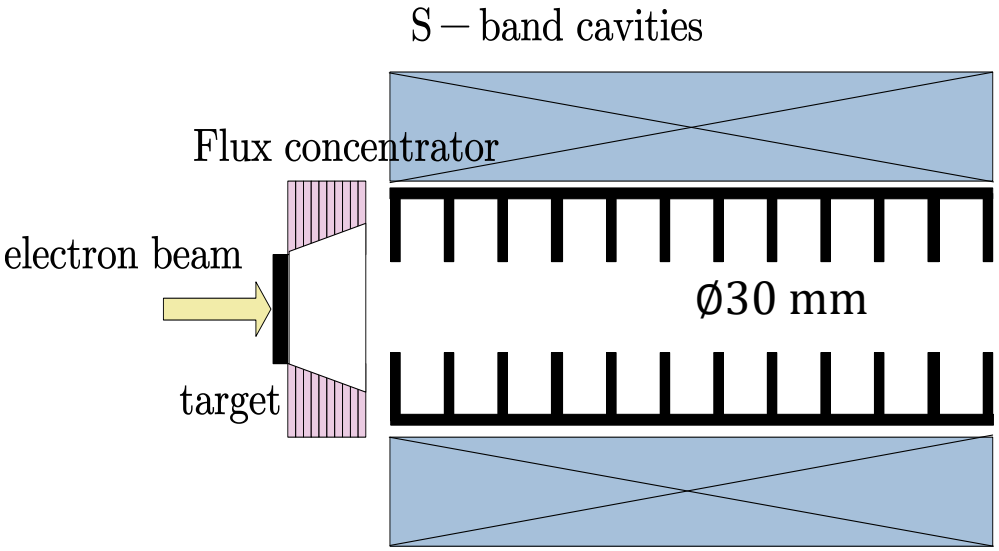
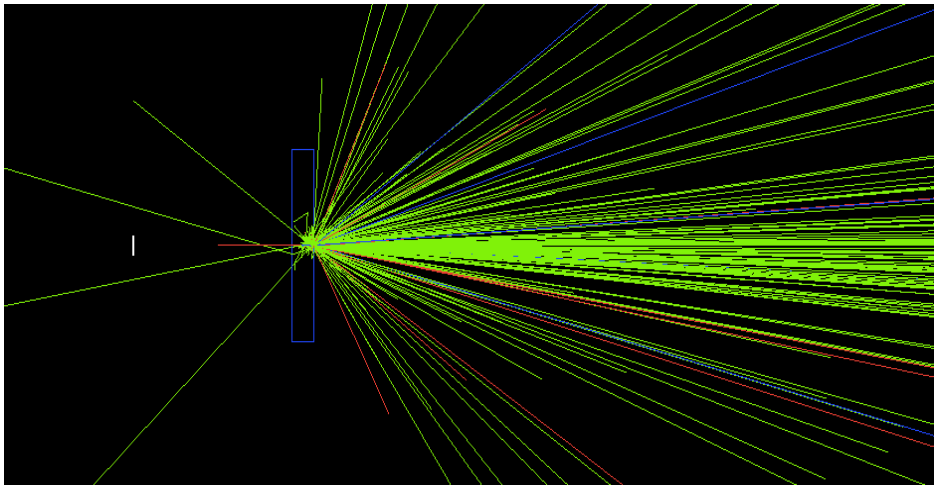
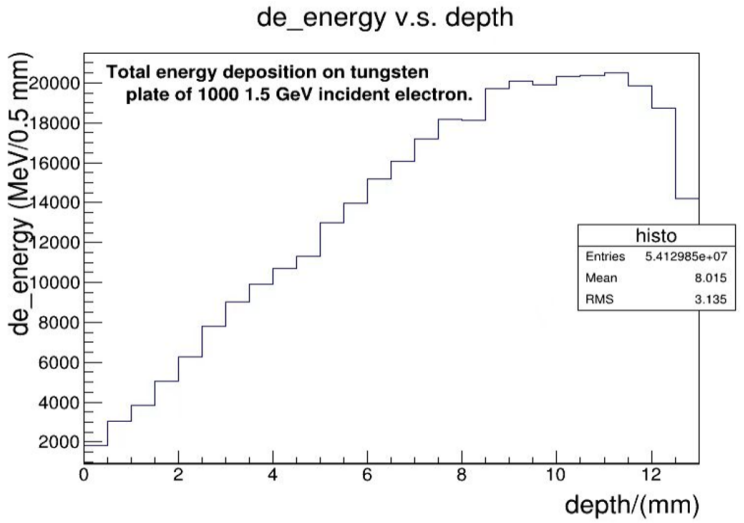
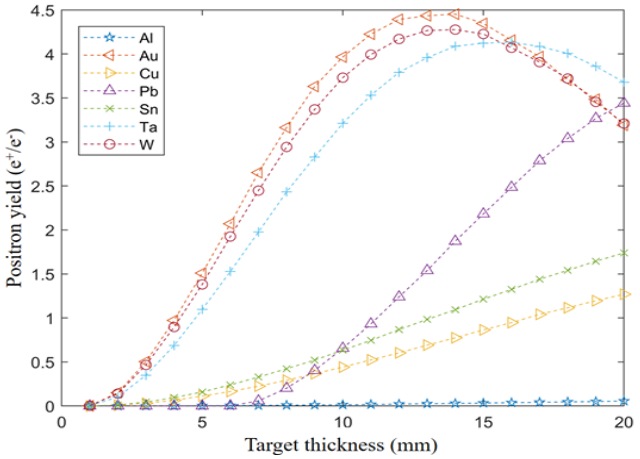
The positron production system



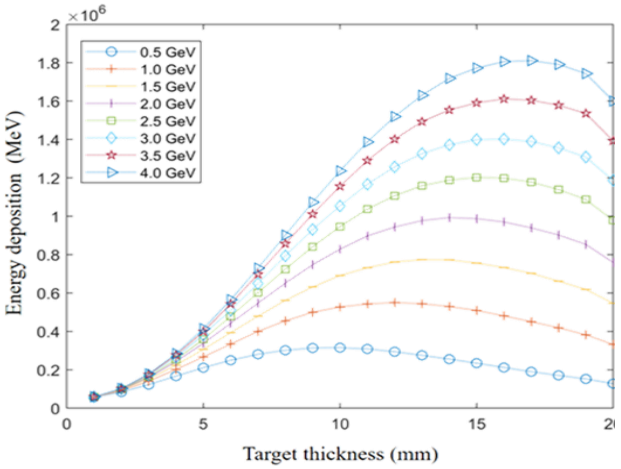
Parameter	Value
Electron bunch	10 nC
Electron energy	2.5 GeV
Rep. rate	100 Hz
Beam diameter	0.8 mm
Magnetic field	5↘0.4
Target thickness	13 mm
Target material	Tungsten
e^+ yield	0.25



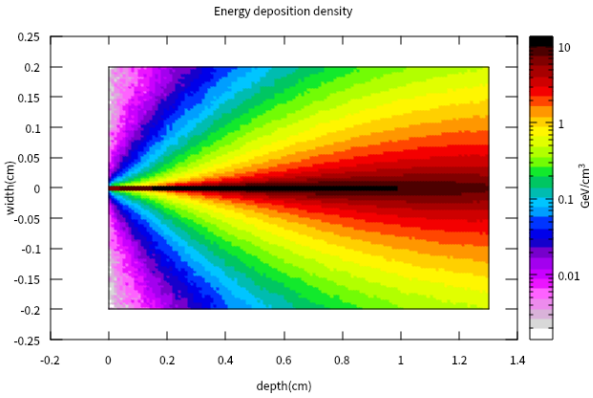




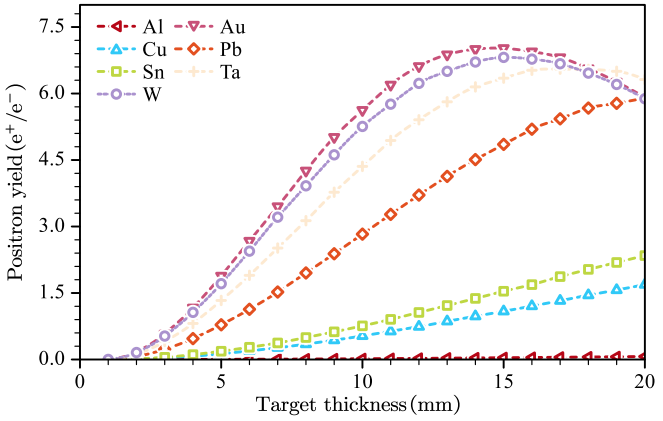
Positron yield of different target materials under 1.5 GeV electron bombardment



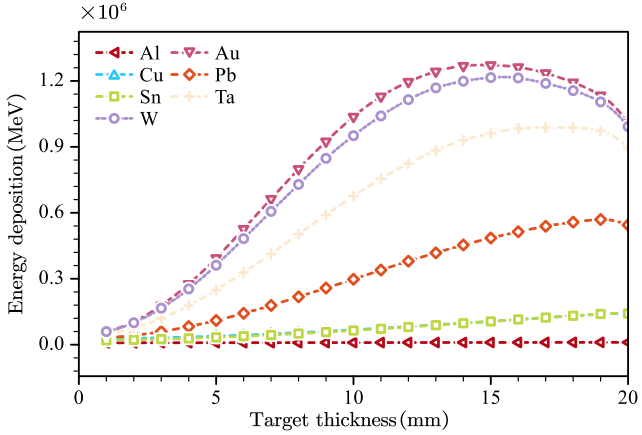
Thermal deposition of different target materials under 1.5 GeV electron bombardment



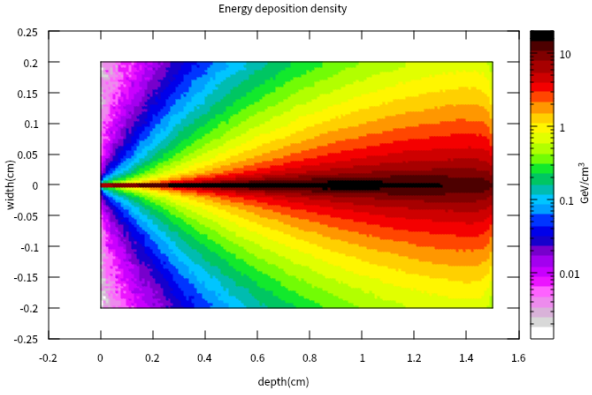
Energy deposition simulation of a 1.5 GeV electron beam in a 13 mm thick tungsten



Positron yield of different target materials under 2.5 GeV electron bombardment

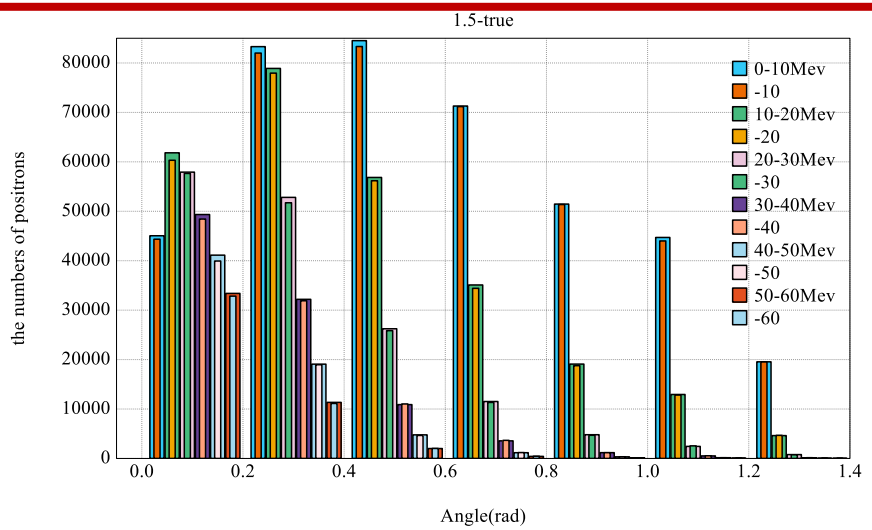


Thermal deposition of different target materials under 2.5 GeV electron bombardment

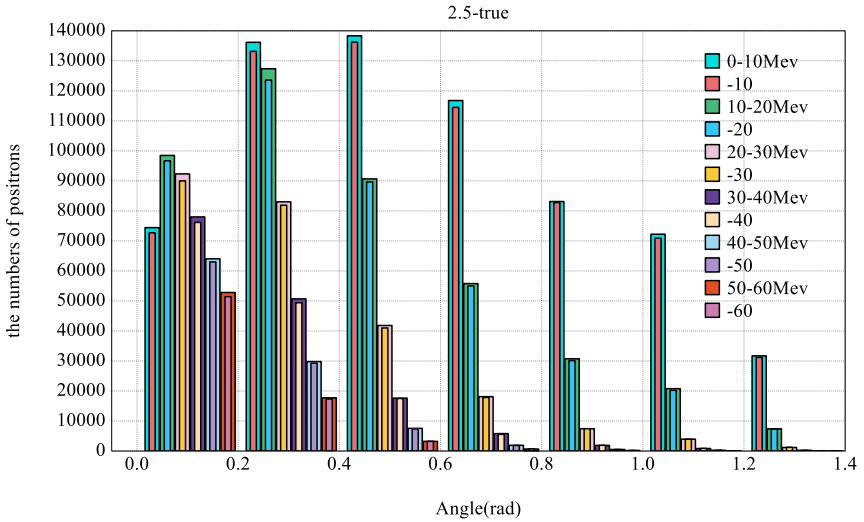


Energy deposition simulation of a 2.5 GeV electron beam in a 15 mm thick tungsten

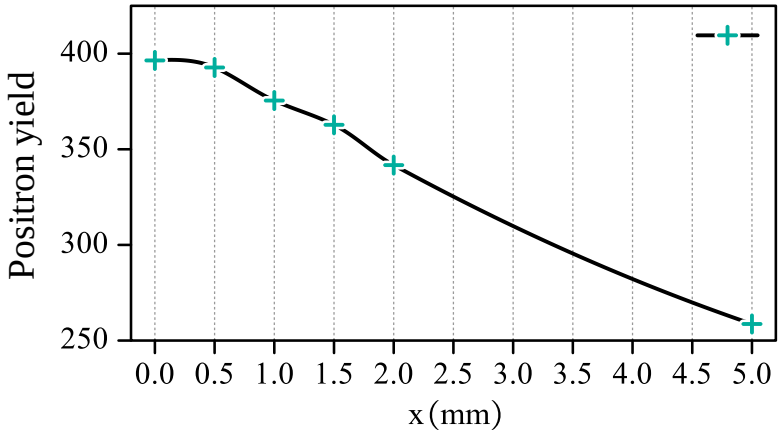
Positron pre-accelerating section



Positron energy and angle distribution generated by 1.5Gev electron beam targeting



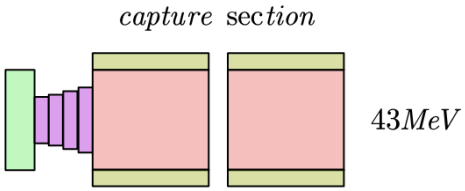
Positron energy and angle distribution generated by 2.5Gev electron beam targeting



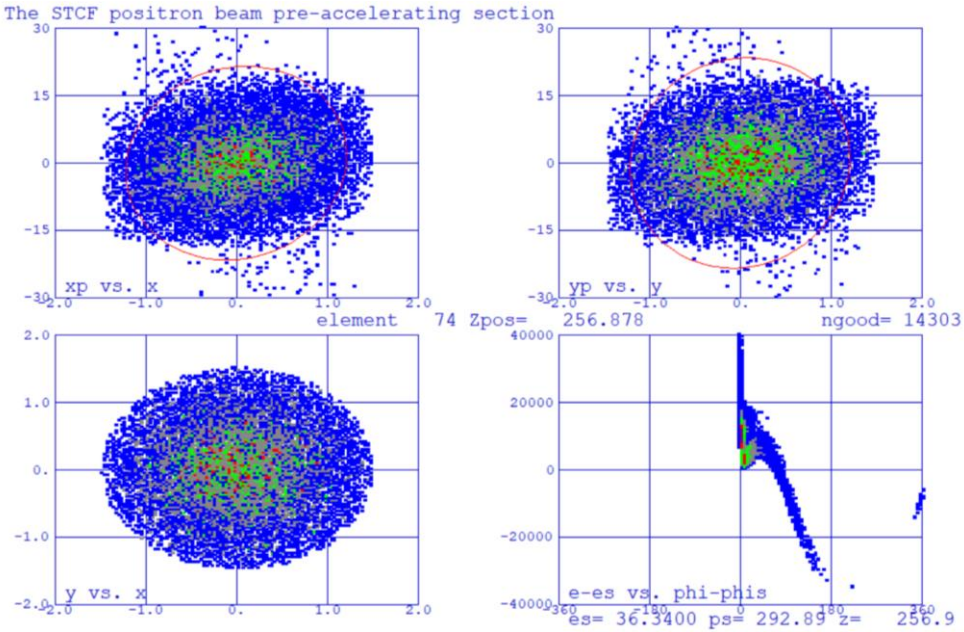
The effect of electron beam target displacement on positron yield

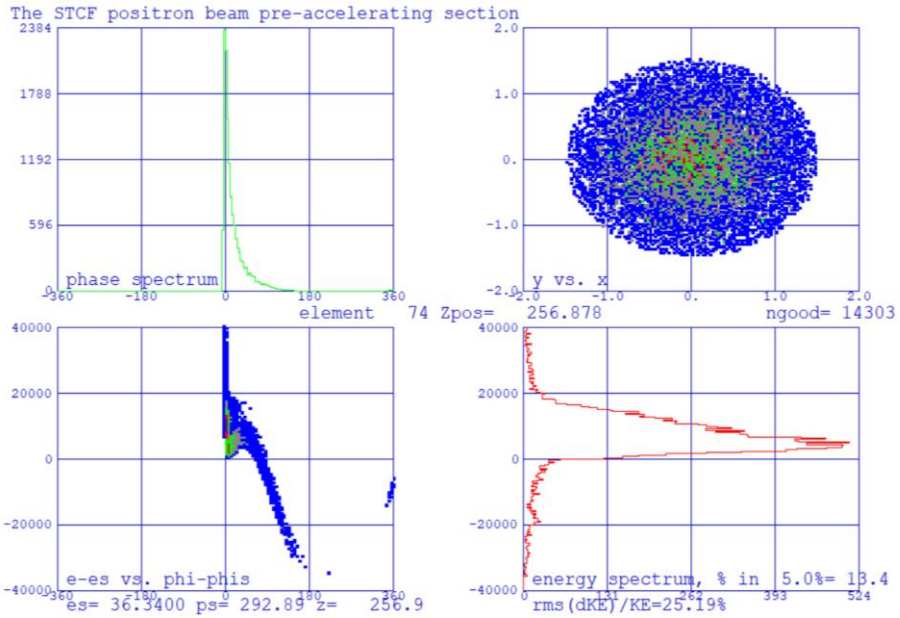
1. **The energy dissipation of the target electron beam has a relatively small impact on the electron yield and energy angle distribution**
2. **2. Eccentricity of electron beam targeting needs to be within 0.3mm**

Positron pre-accelerating section

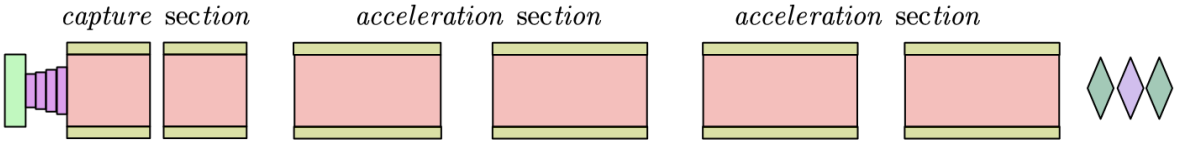


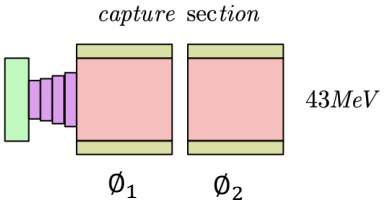
Capture efficiency	rms, ϵ_x $cm \cdot mrad$	rms, ϵ_y $cm \cdot mrad$	$\frac{rms(\Delta kE)}{kE}$	$rms(\Delta\varphi)$	$< kE >$ Mev
17.9%	393.40	394.07	0.25	****	43.7462





Positron pre-accelerating section





Capture efficiency	rms, ϵ_x $cm \cdot mrad$	rms, ϵ_y $cm \cdot mrad$	$\frac{rms(\Delta kE)}{kE}$	$rms(\Delta\varphi)$	$< kE >$ Mev
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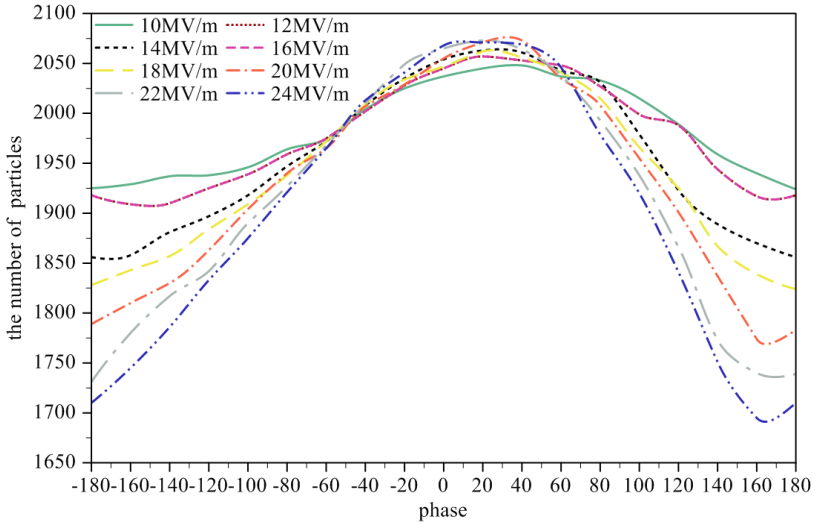
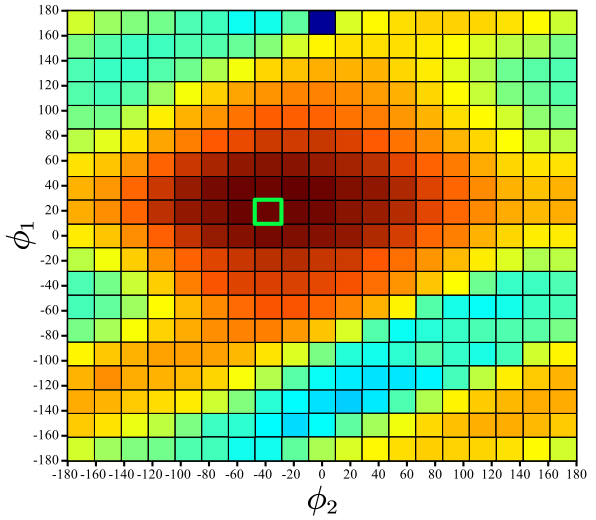
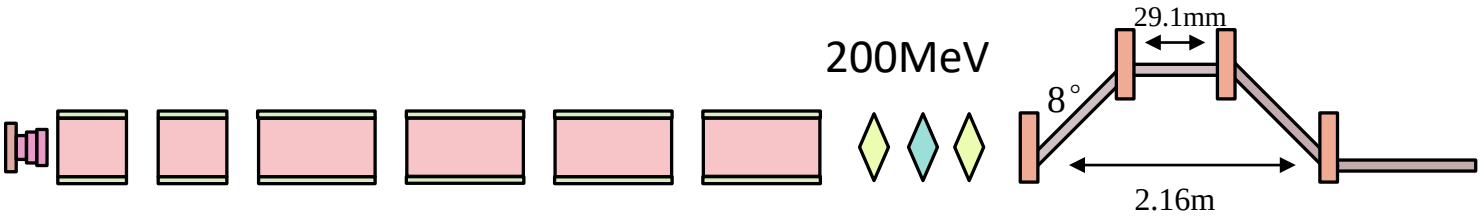
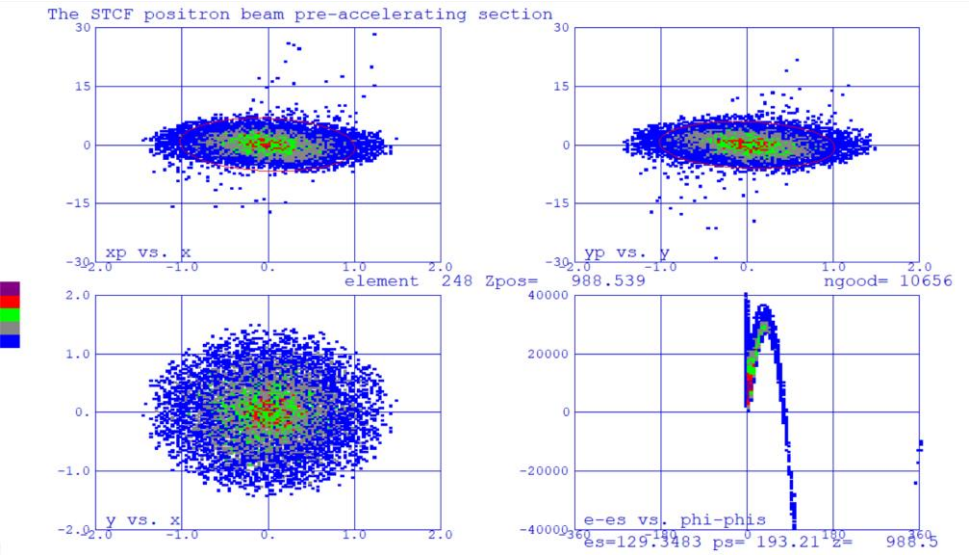


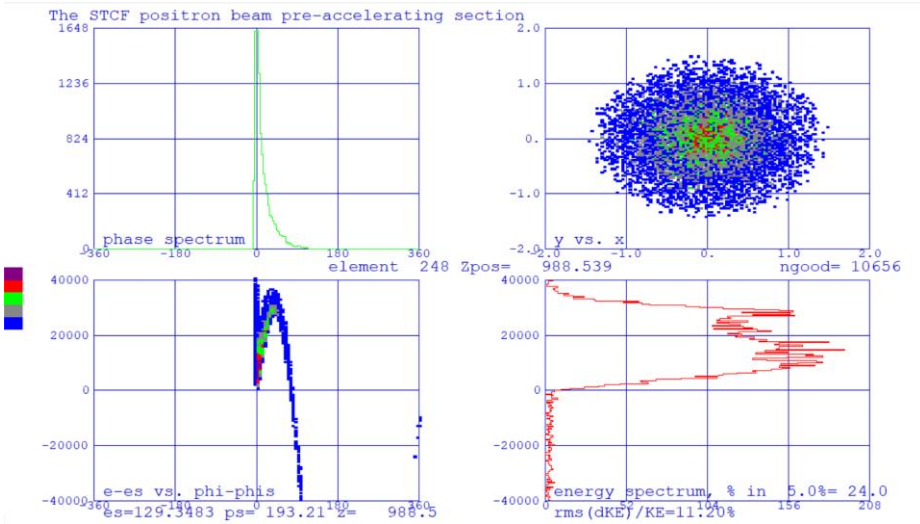


Positron pre-accelerating section



Design of Chiane

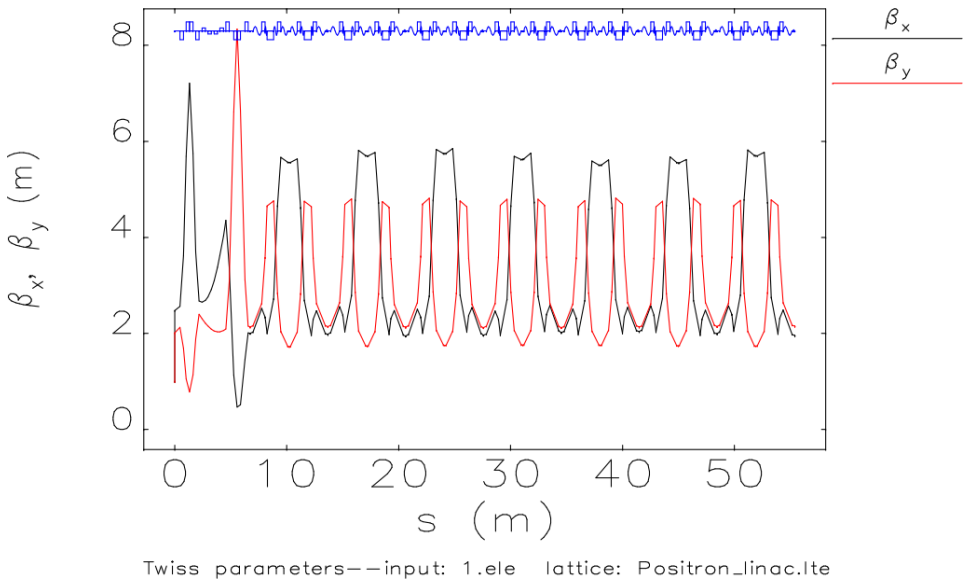


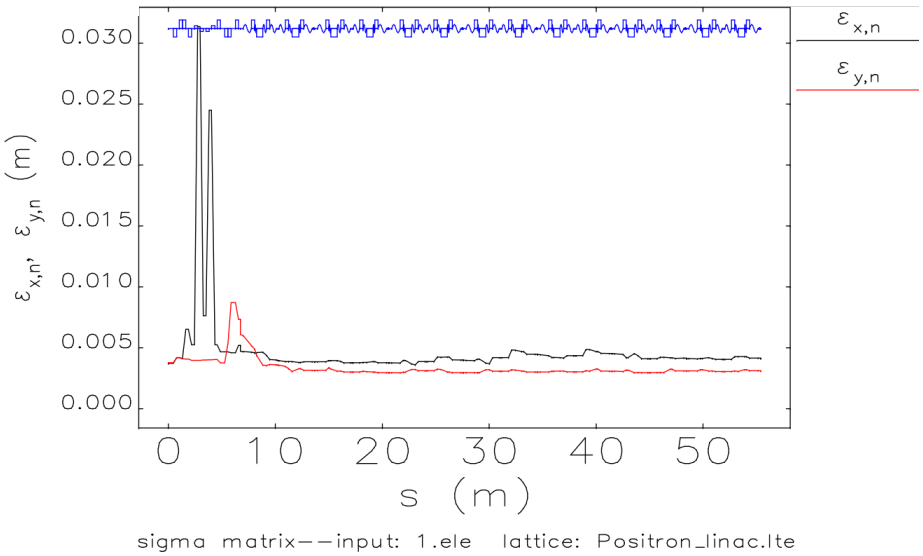


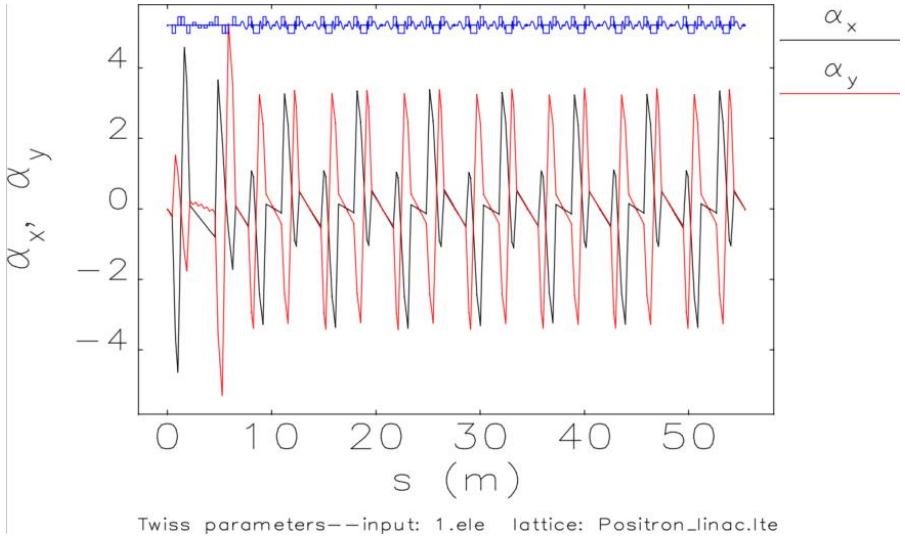
Design of 200MeV Positron Pre-Acceleration section Chiane

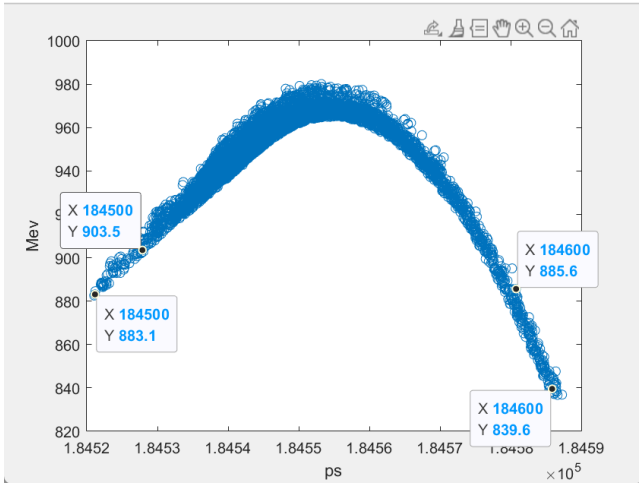
capture effiency	$\varepsilon_x\,(\mathrm{mm}\cdot\mathrm{mrad})$	$\varepsilon_y\,(\mathrm{mm}\cdot\mathrm{mrad})$	$\frac{\Delta kE}{kE}$
13.33%	3560	3573	11.20%

Design of 1 GeV positron beam-line









Beam distribution of 1 GeV positron beam

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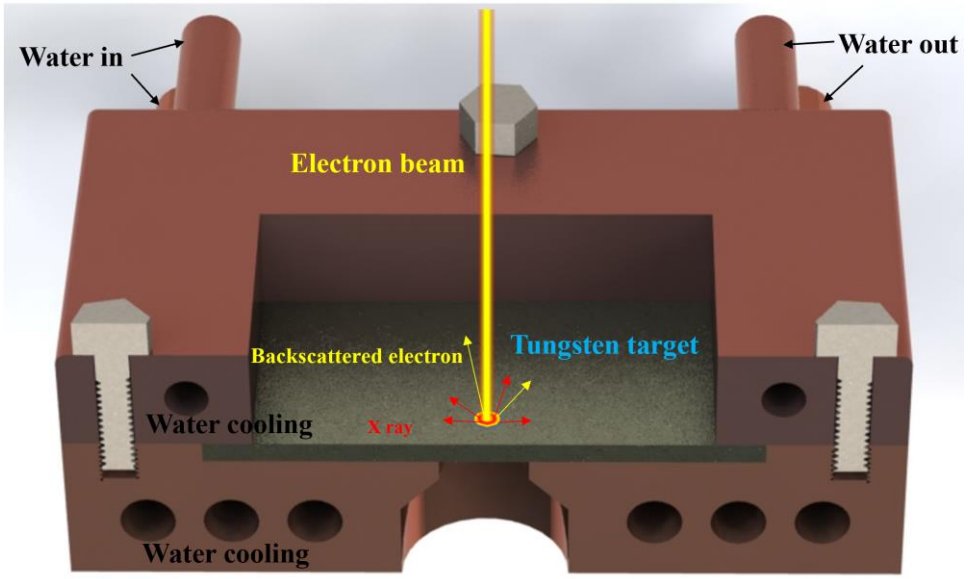
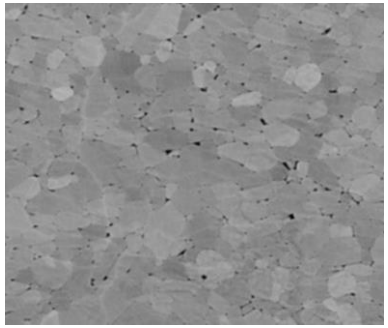
Recrystallization of tungsten target



Melting point of tungsten 3410℃.

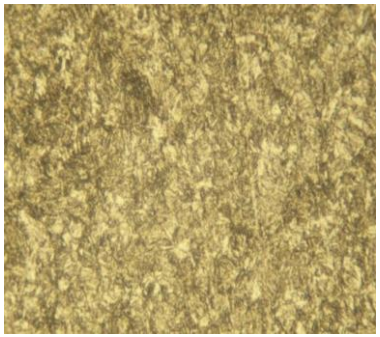
Recrystallization of tungsten 900 ℃

900 ℃

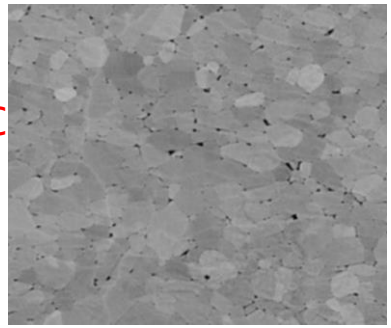


Single crystal tungsten

Polycrystalline tungsten



900 ℃

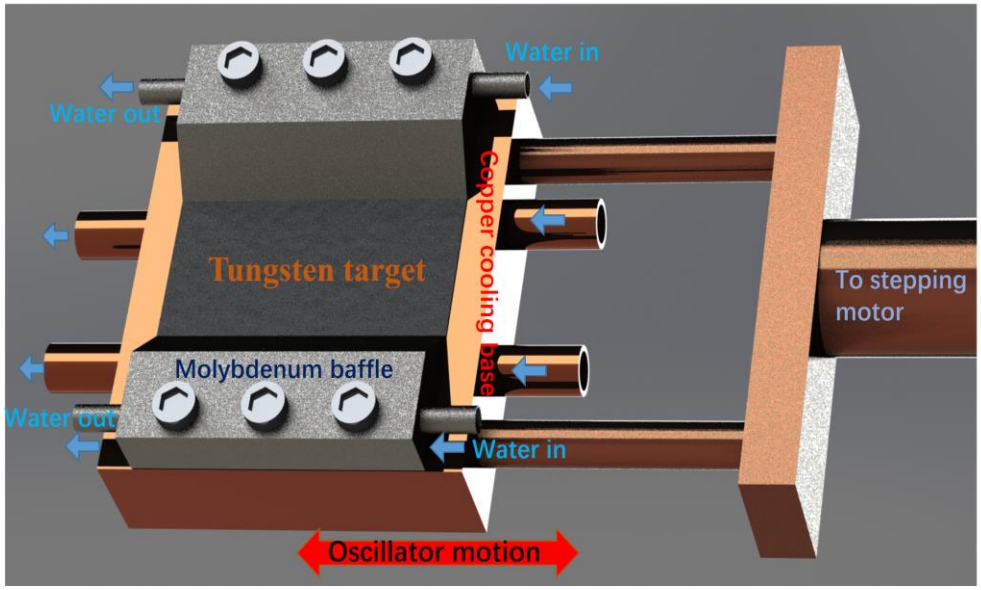


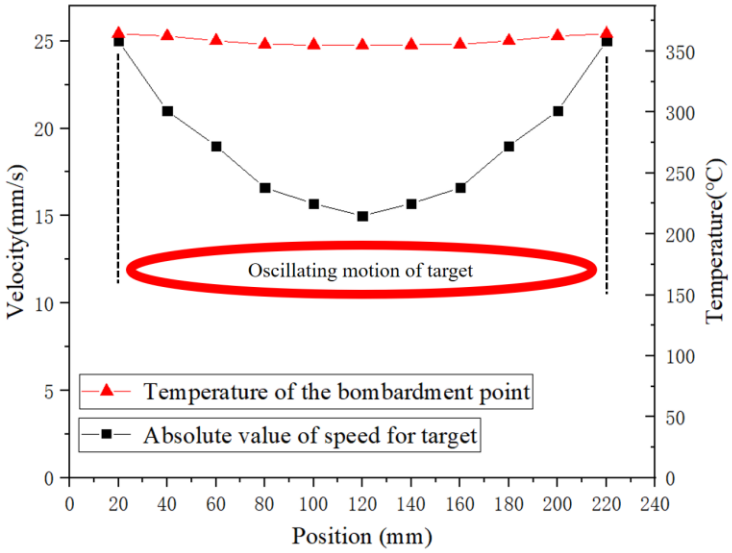
Amorphous tungsten

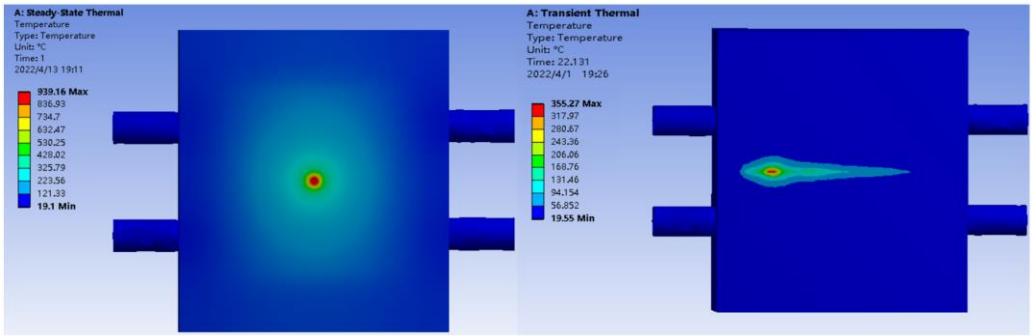
Polycrystalline tungsten

Recrystallization of tungsten target

Design of oscillating moving targets







2.5 GeV/100Hz/10nC

Thanks for your attention !