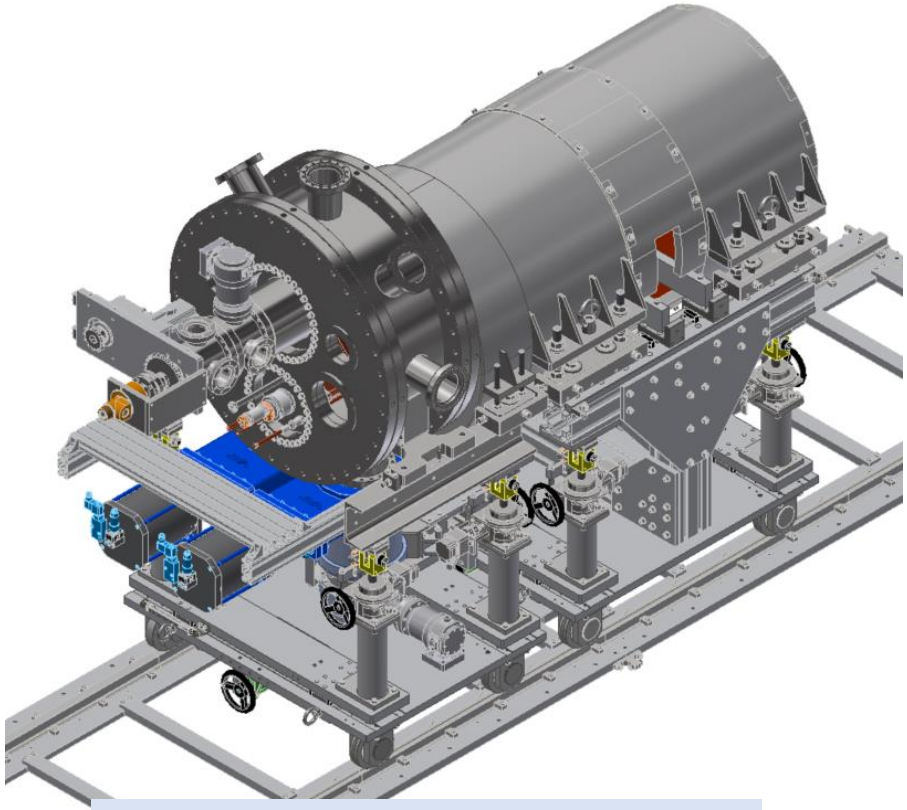
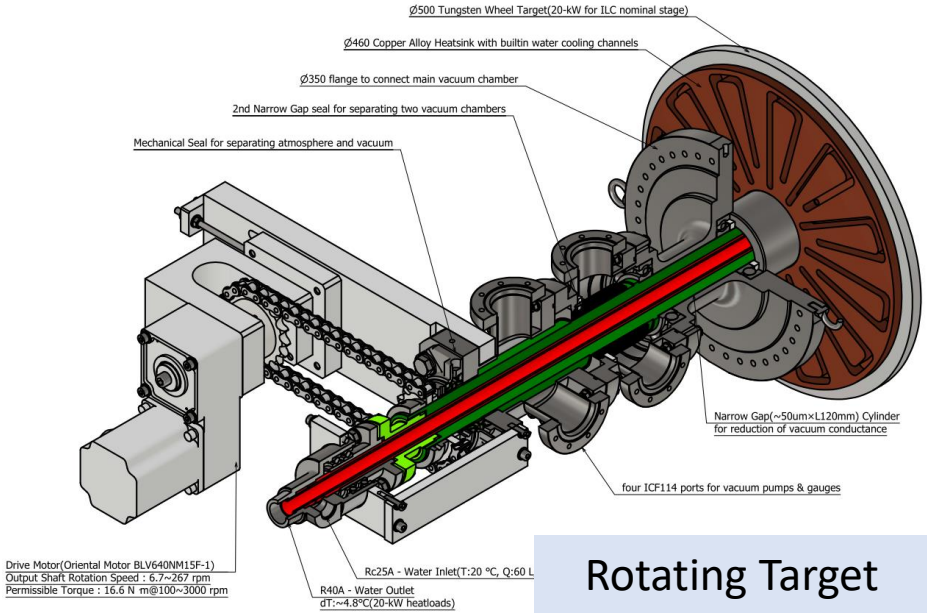
E-driven Target Status and Plans

○Yu Morikawa(KEK)



Mockup for ILC positron source



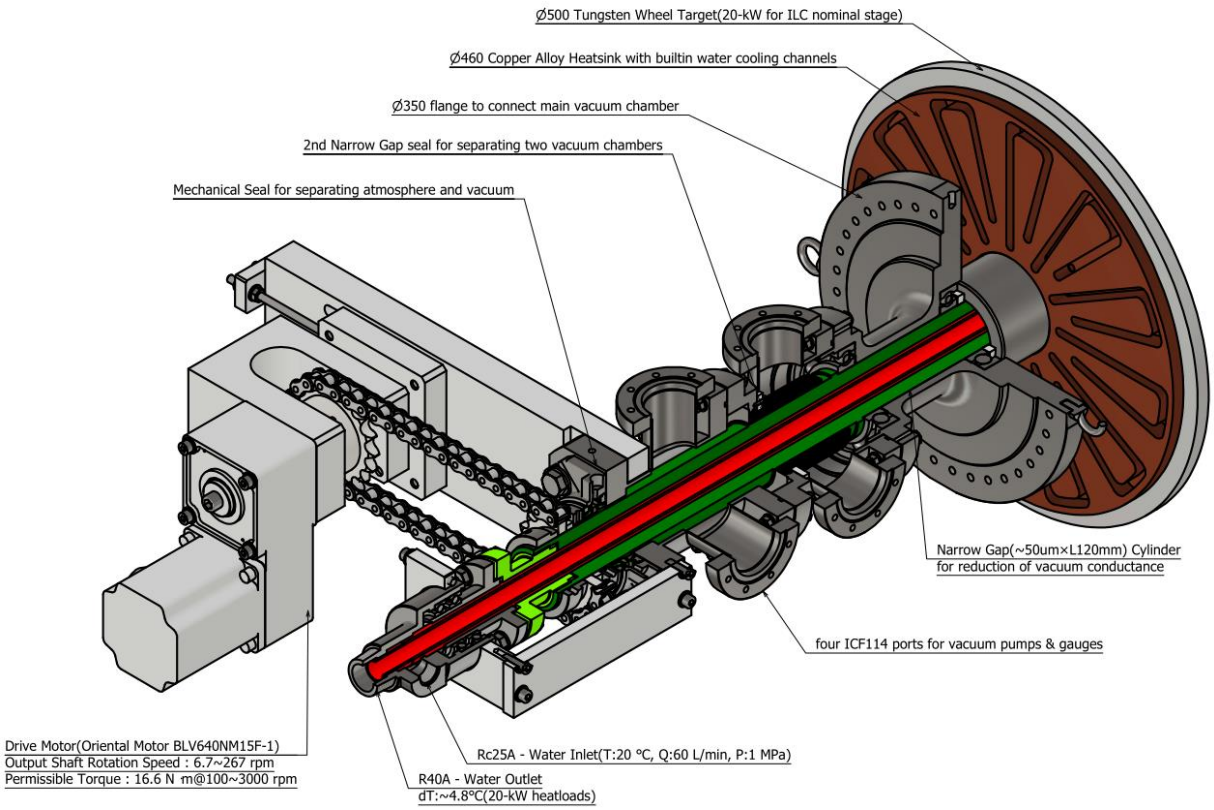
Rotating Target

A) Mockup of rotating target
B) Thermal & Structural analysis
C) Target Material : W/Cu junction,
Advanced tungsten.

e^- e^+

Mechanical Design of Rotating Target

¾ cut cross section



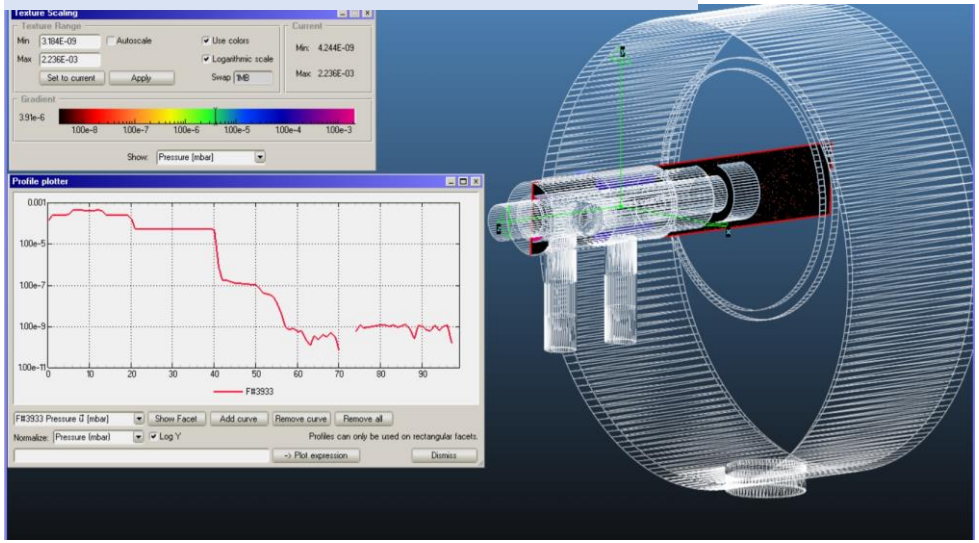
【Features of Rotating Target】

- ✓ ϕ500mm tungsten disk
- ✓ ϕ460mm copper alloy heat sink
- ✓ Rotation Speed : 220 rpm
- ✓ Water cooling (60L/min)
- ✓ ϕ70mm shaft with embedded water channel
- ✓ Required vacuum ~1e-6Pa
- ✓ Differential pumping
  - 2 additional chamber
  - Narrow Gap, Mechanical Seal

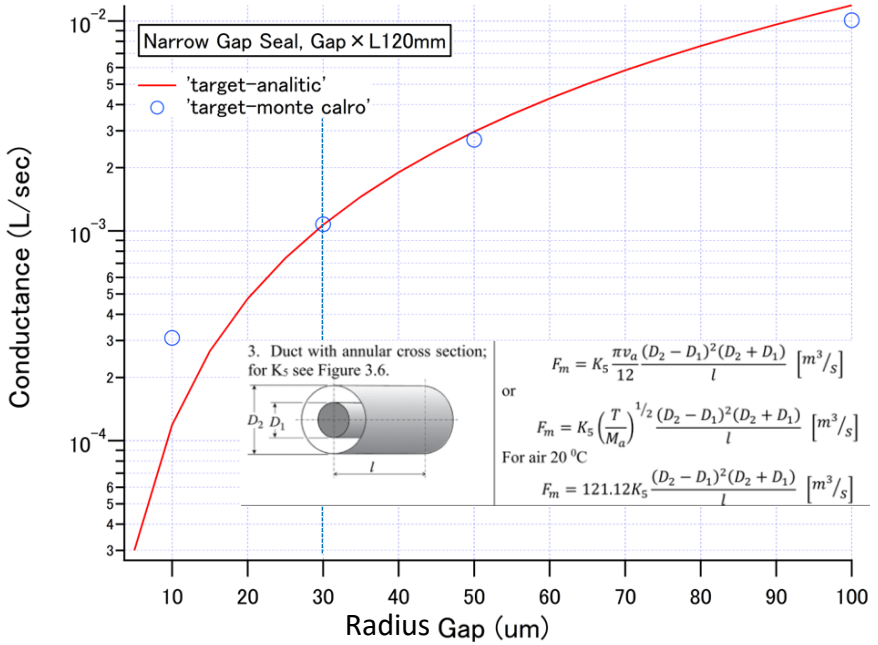
e^- e^+

Mockup test in 2023

Vacuum Simulation by Molflow



Vacuum Conductance -Narrow Gap Seal



【1st year plan】

- ✓ Build the target mockup without Tungsten disk, FC, 1st ACC
- ✓ Rotation & Vacuum test

【Key points 】

(Mechanic) Precision Machining & Assembly, Vacuum compatible component

(Vacuum) Vacuum performance of narrow gap seal, Mechanical Seal

e^- e^+

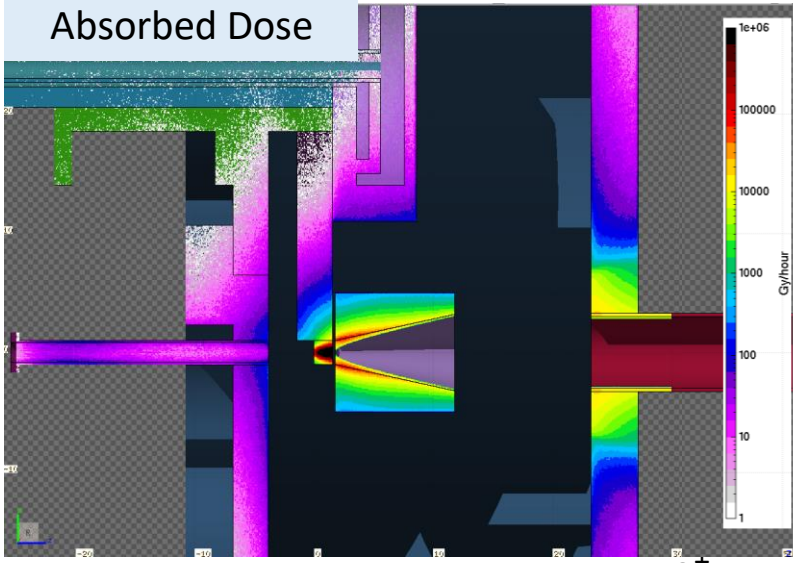
A) Mockup of rotating target
B) Thermal & Structural analysis
C) Target Material : W/Cu junction, Advanced tungsten.

Thermal & Structural analysis

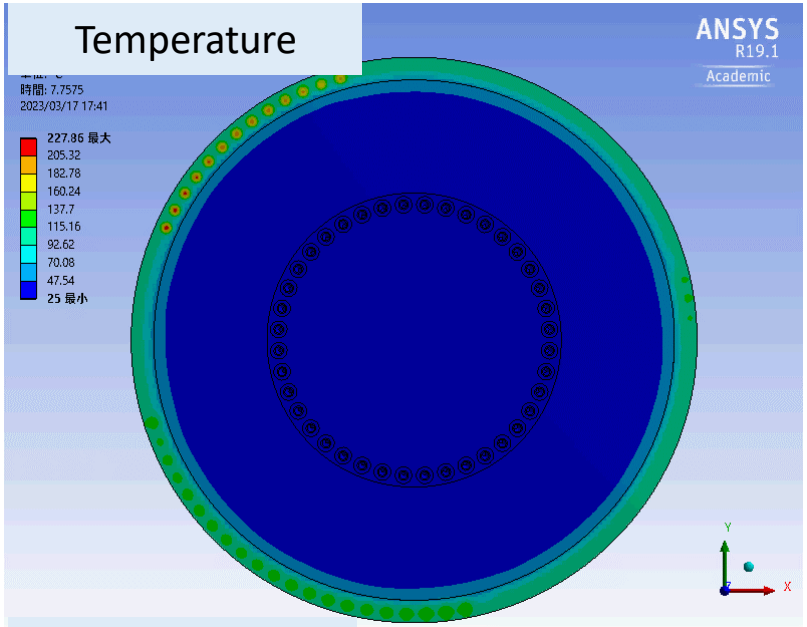
Preliminary Results

	ILC e-driven
Primary electron energy(e^-) [GeV]	3
e^- Beam power [kW]	74
e^- Beam size on target [σ - mm]	2
Target material	W (or W alloy)
Target thickness	$4.5X_0$-(15.7mm)
Power deposition on target [kW]	18.8
PEDD*** [J/g]	33.6
Max temperature of Cu alloy [°C]	~160
Max temperature of W [°C]	~420
Max equivalent stress at W/Cu junction [MPa]	~200
Max equivalent stress at W junction [MPa]	~250

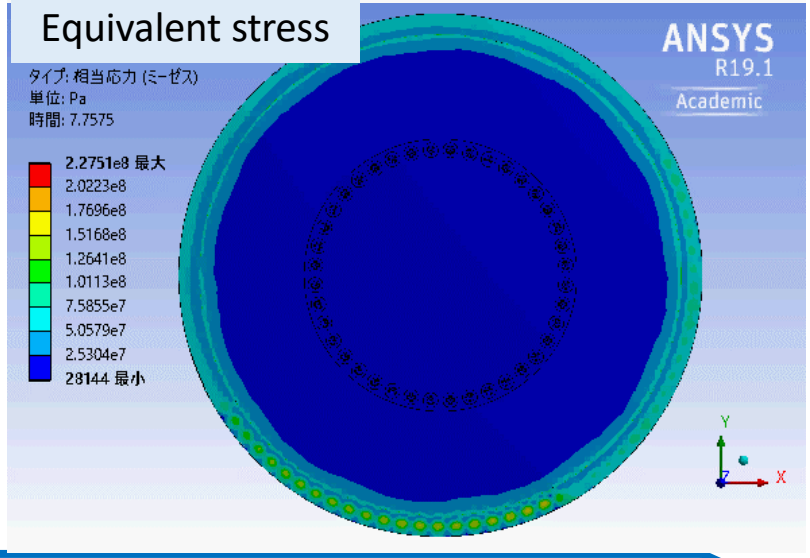
Absorbed Dose



Temperature



Equivalent stress



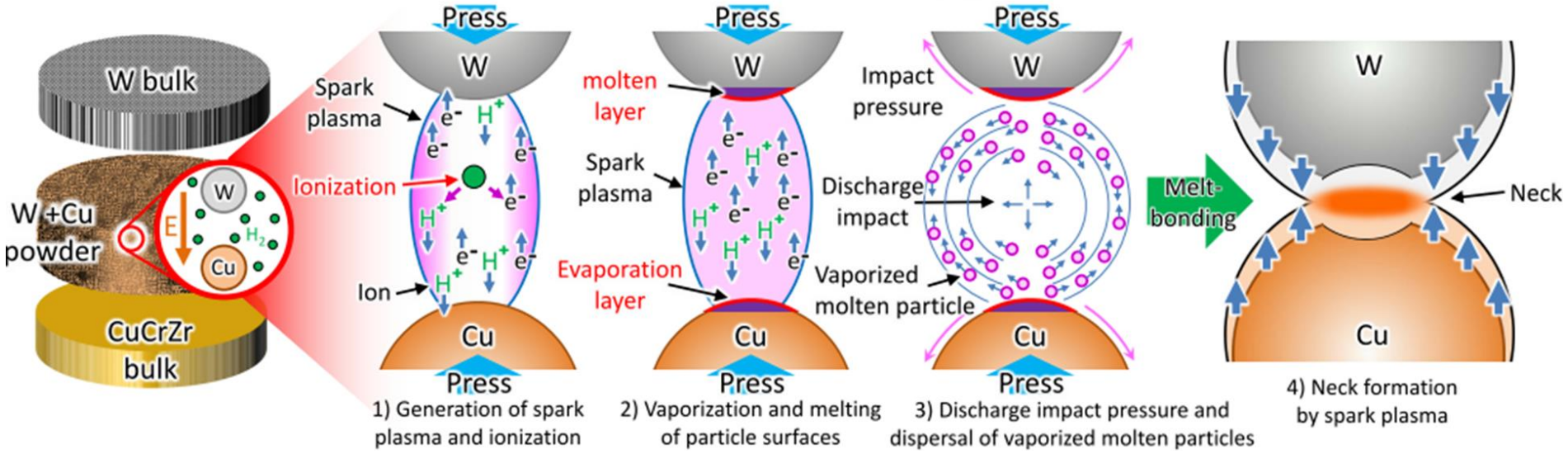
e^- e^+

A) Mockup of rotating target
B) Thermal & Structural analysis
C) Target Material : W/Cu junction, Advanced tungsten.

W/Cu Junction

Junction by Spark Plasma Sintering(SPS)*1

collaboration research with National Institute for Fusion Science(NIFS, Japan)



【SPS advantages 】

・Junction process can be performed at relatively low temp of bulk material.

・Interlayer thickness and composition can be adjusted to meet design requirements.

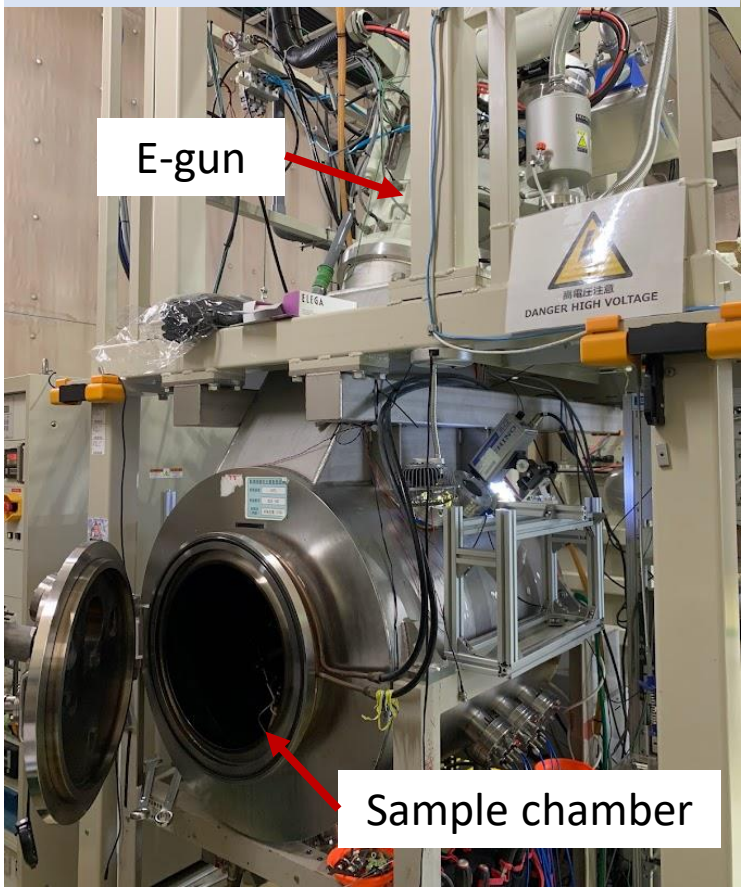
【1st year plan】

✓ ϕ40mm & ϕ100 test piece, thermal & mechanical test by using ϕ100 test piece

*1. Investigation of Joining Quality in Tungsten and Copper Alloy Joints using Spark Plasma Sintering for Plasma Facing Materials, MURASE Takanori, et al. SOFT 2022.

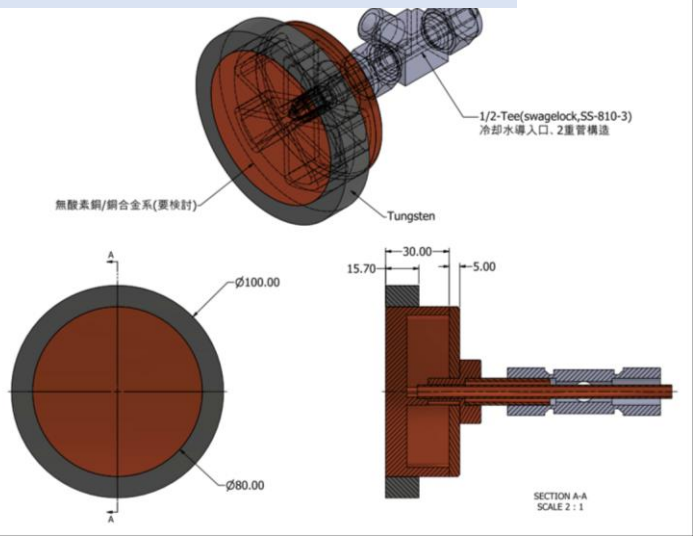
Thermal Test of ϕ100mm target mockup

Thermal Test Facility - ACT2@ NIFS



specifications		
parameters	value	unit
max. output power	300 (100)	kW
acceleration voltage	40	kV DC
max. current	7.5	A
max. scanning area	300 x 300	mm
spot size of e-beam	～10	mm

ϕ100mm-target mockup



✓ Thermal test by electron beam - max300kW (Cooling capacity, thermal resistance at junction)

e^- e^+

Actions in 2023

- ✓ Build target mockup and rotation & vacuum test
- ✓ Test piece of W/Cu joint by SPS
- ✓ Thermal test of ϕ100 target mockup by electron beam
- ✓ Investigation about advanced tungsten