High Intensity heavy-ion Accelerator Facility

Design of the SRing Electron Target

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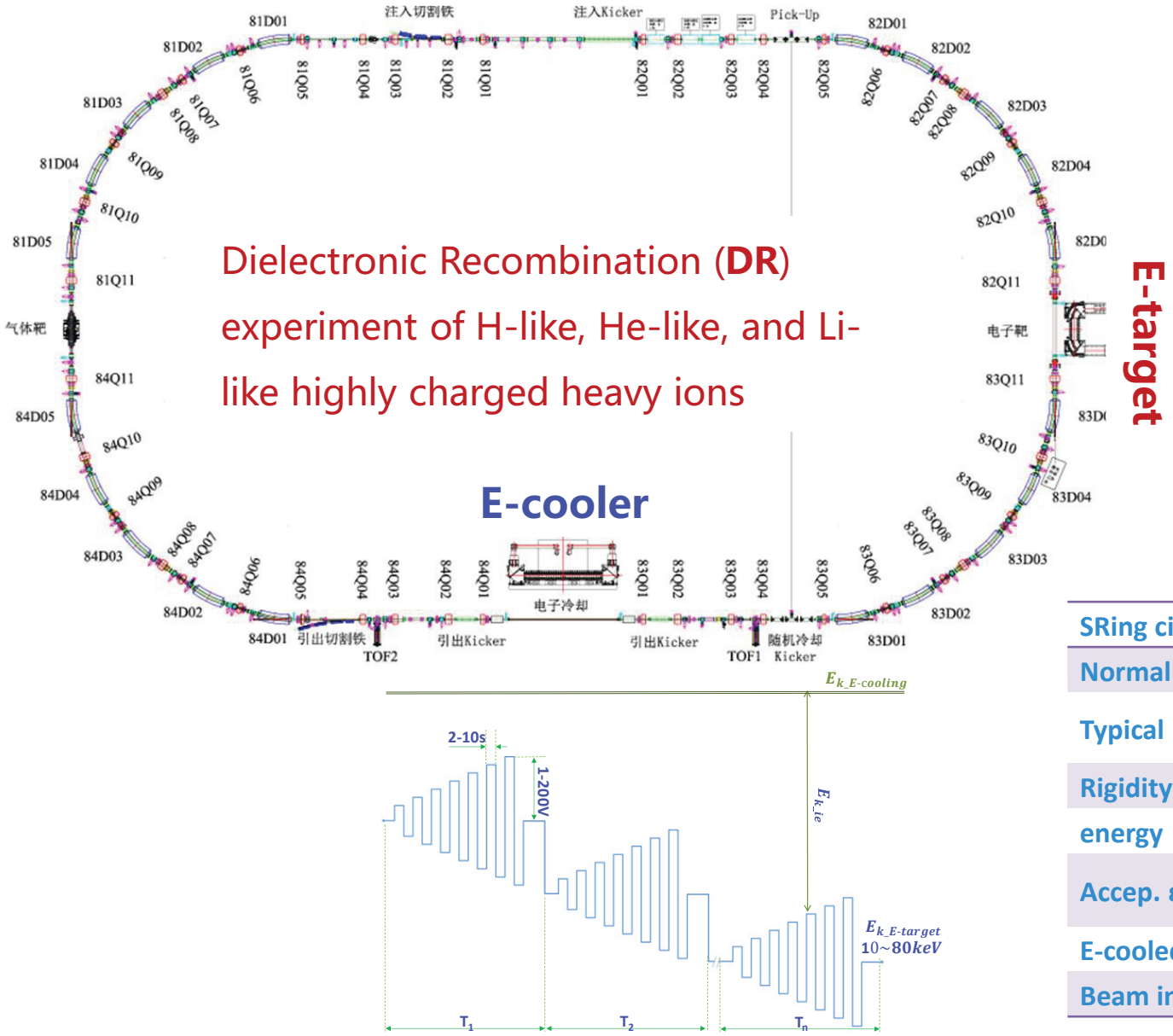
Introduction

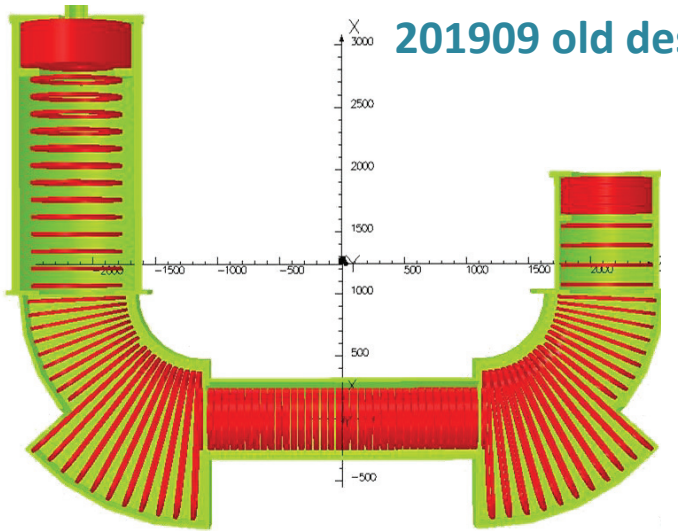


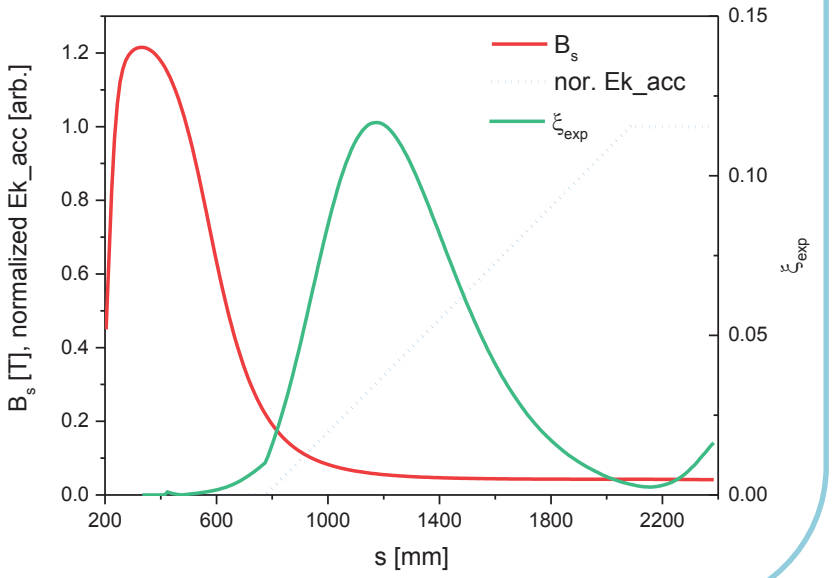
Electron energy	**10-80keV**
E-density for DR exp.	2×10^6 cm^{-3}
kTe_trans for DR exp.	**5meV**
kTe_long for DR exp.	**0.1meV**
E-cooled ion beam size in DR exp.	4.7mm/3.7mm
Electron current	200mA
Cathode diameter	10mm
Mag. field at cathode/interaction	1.2 T/0.04T
Length of interaction section	2.24 m
Aperture througth e-target	**Φ270mm**
Vacuum pressure	1×10^{-9}Pa
Total length of e-target	5.5m
E-target orientation	**horizontal**

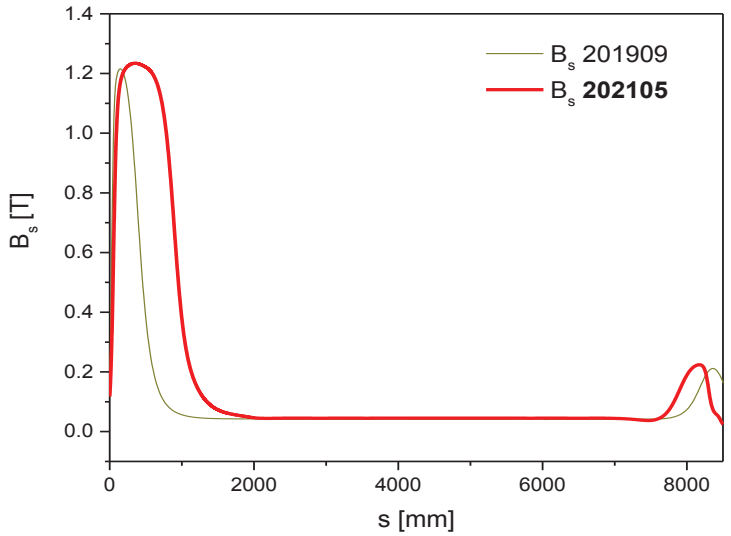
SRing circum.	277.3m	
Normal optics	Nor-1 mode	Nor-2 mode
Typical ions	RIBs: $^{104}Sn^{50+}$, $^{132}Sn^{50+}$	Stable (Li-like, H-like, He-like): $^{197}Au^{76\text{-}78+}$, $^{238}U^{89\text{-}92+}$
Rigidity	8.6-13.2Tm	3.5-15Tm
energy	621-837MeV/u	85-835MeV/u ($^{238}U^{92+}$)
Accep. $\varepsilon_h/\varepsilon_v,\Delta p/p$	30/30π mm·mrad, ±1.5% 120/30π mm·mrad, ±1.1%	120/30π mm·mrad, ±1.1%
E-cooled $\varepsilon_h/\varepsilon_v,\Delta p/p$	0.1/0.1π mm·mrad, ±1×10^{-5}	**0.2/0.2π** mm·mrad, **±1×10^{-4}**
Beam intensity	1×10^8 ppp	10^4 -10^8 ppp

Magnetic system

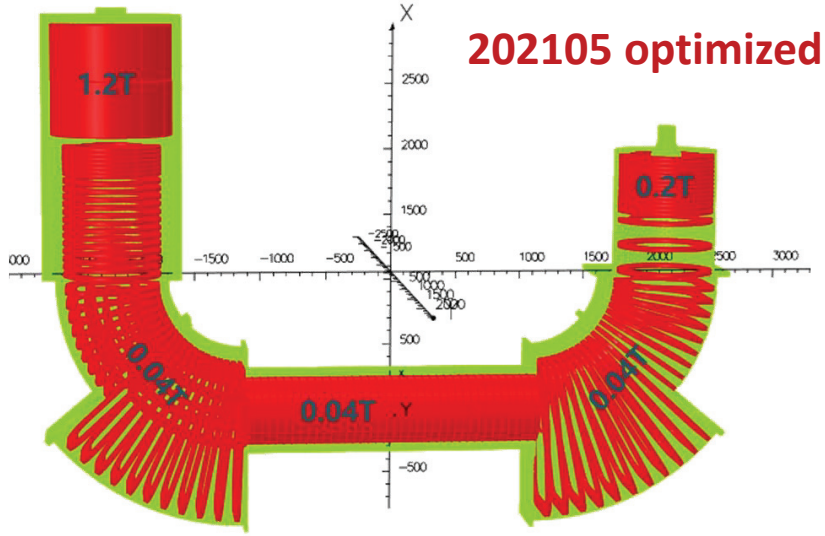
201909 old design





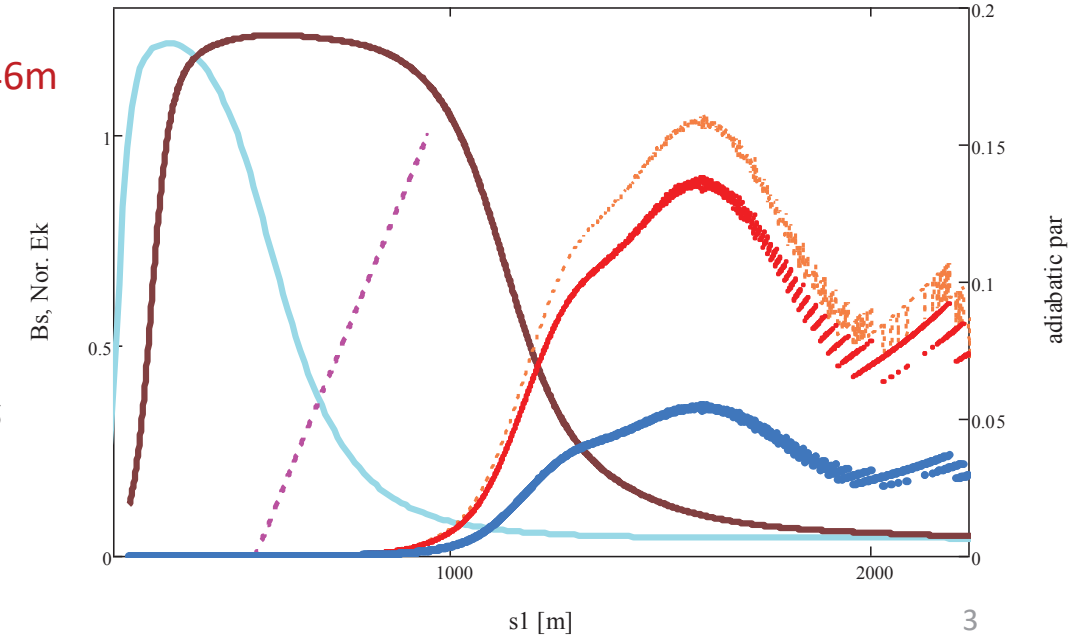


202105 optimized



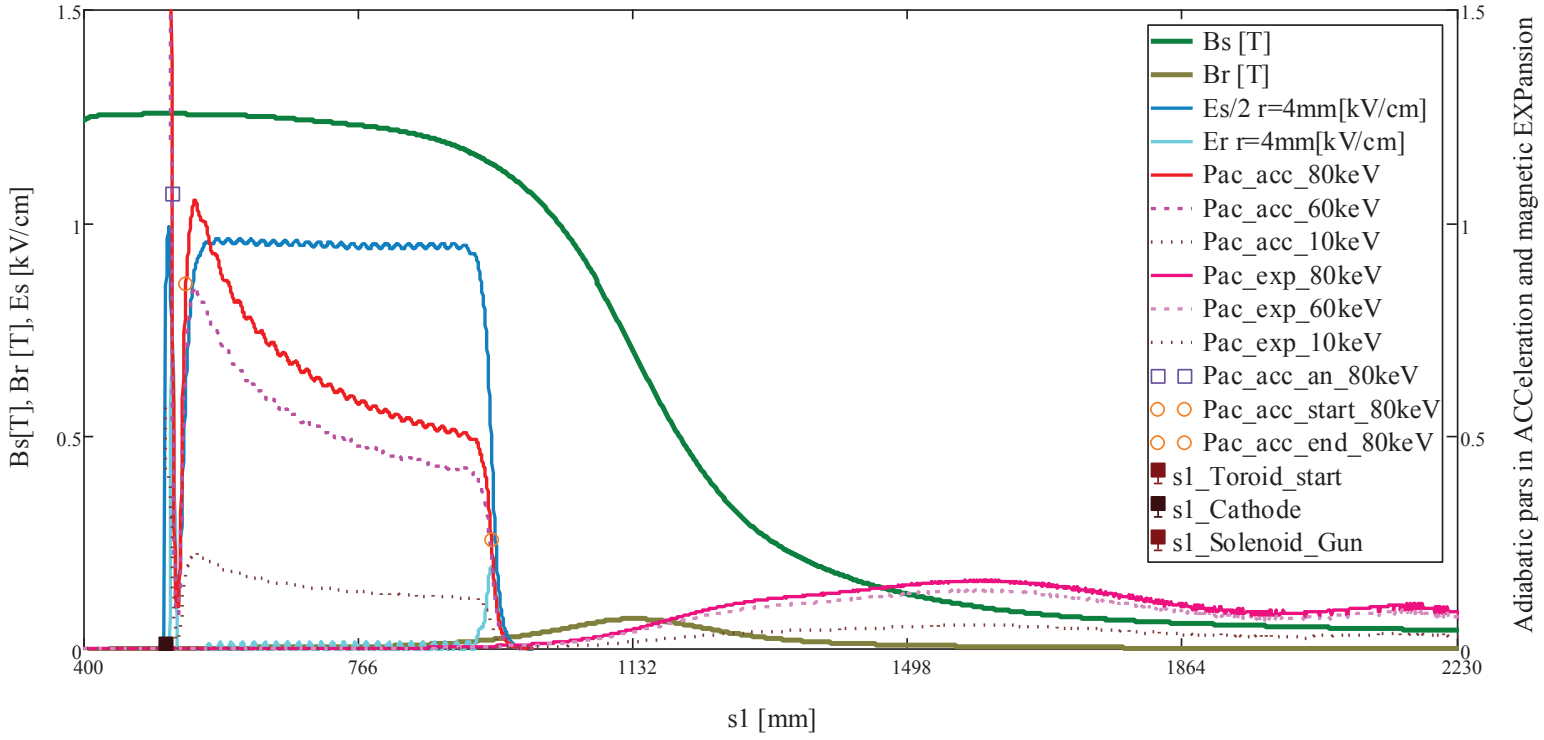
202105 optimized:

- Acc. Length shorten: 0.46m
- Acc. at 1.2T mag. field
- Lower temperatures
- More reliable

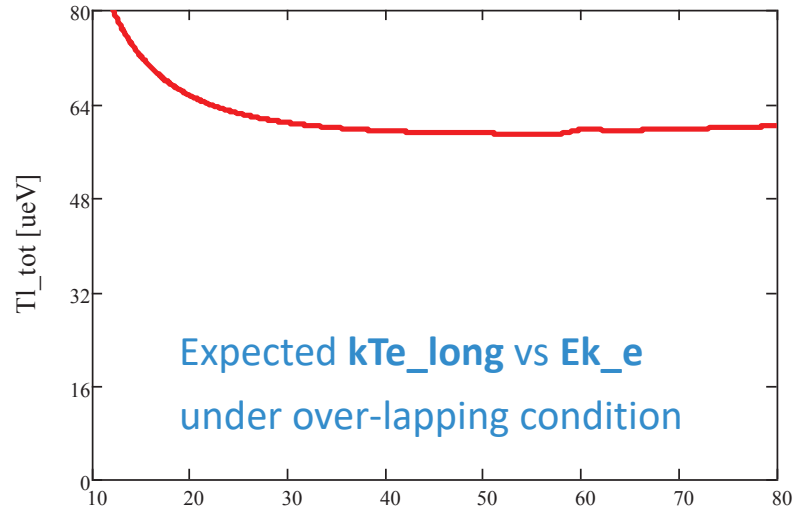


Temperature, Adiabatic ACCeleration and EXPansion

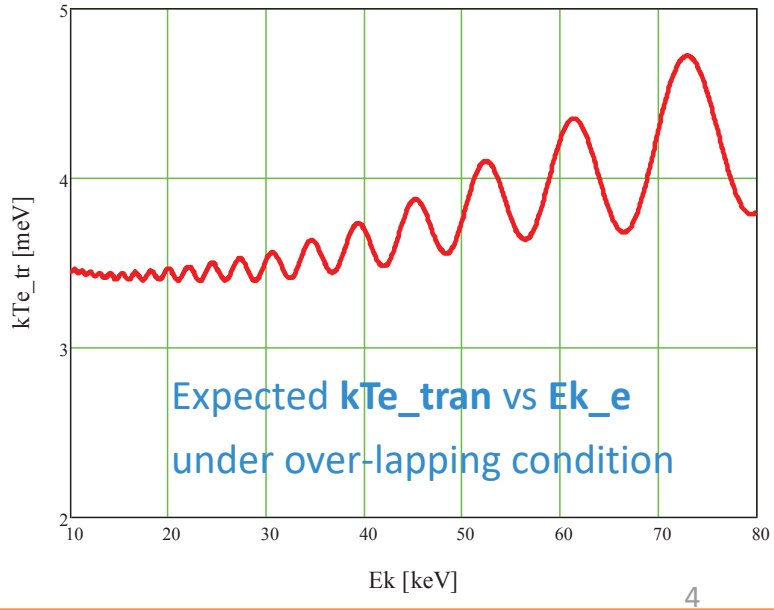
Adiabatic parameters



Electrons are **accelerated** with the **adiabatic parameters 1.04/0.85/0.21** in longitudinal, and **expanded** with the **parameters 0.16/0.14/0.05** in transverse at three electron energy of 80keV/60keV/10keV respectively. They met the adiabatic conditions.

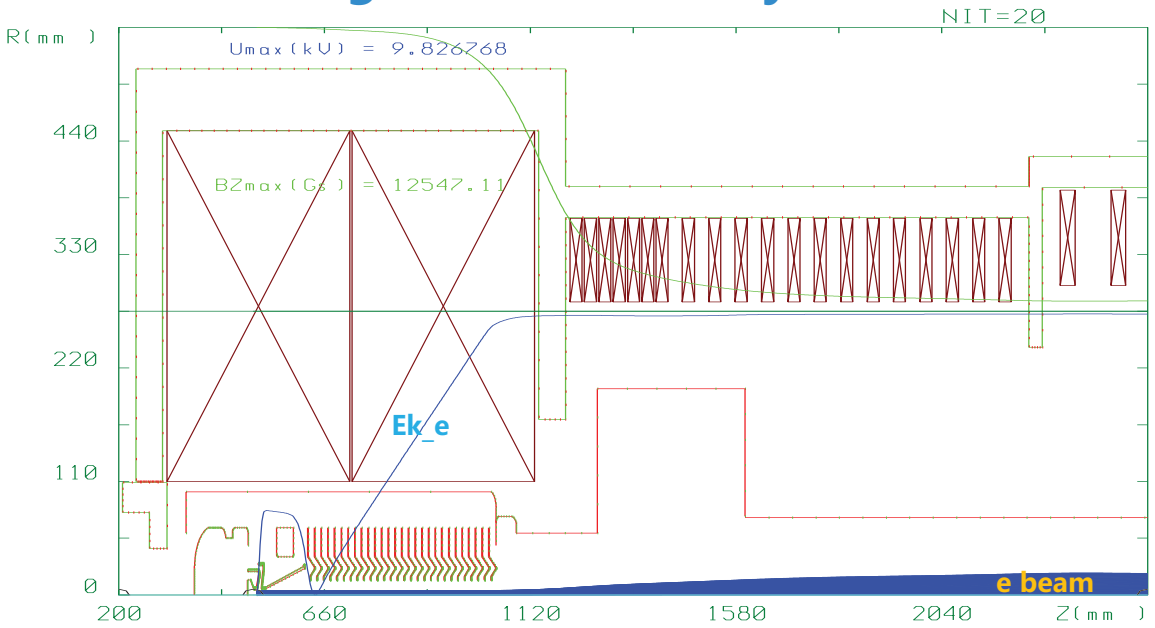


Temperatures

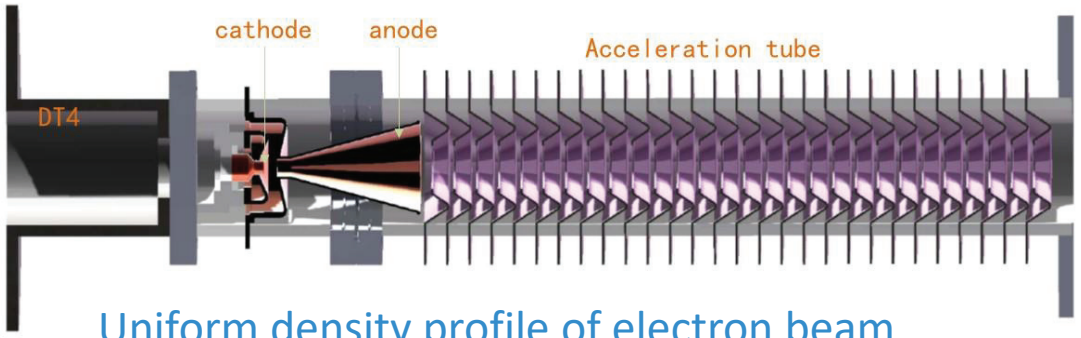


Gun section

New e-gun calculation by USAM



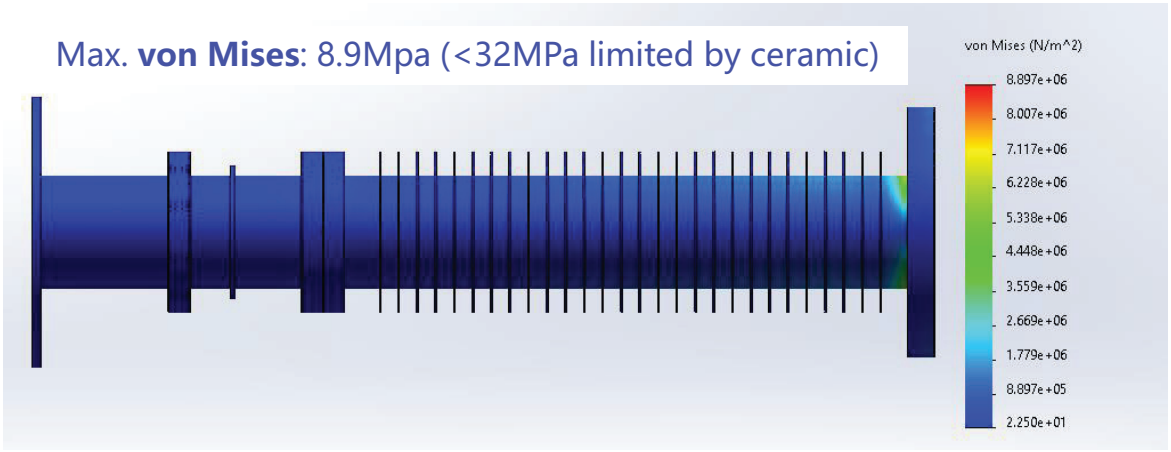
New design of e-gun and acceleration



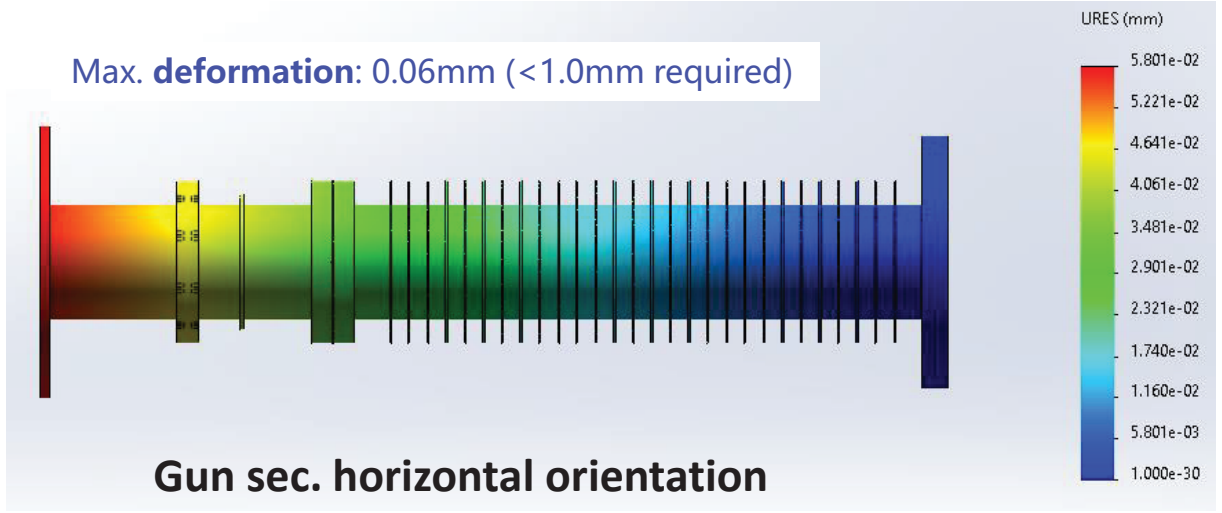
Uniform density profile of electron beam

Stress and deformation

Max. **von Mises**: 8.9Mpa (<32MPa limited by ceramic)



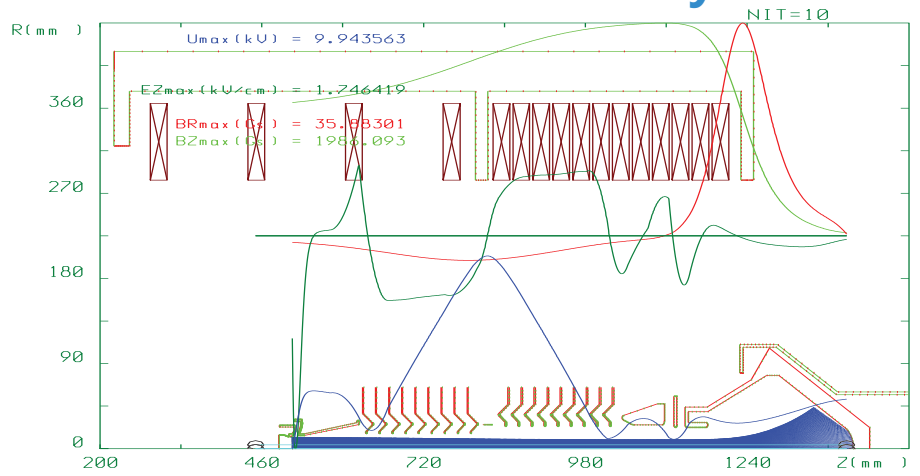
Max. **deformation**: 0.06mm (<1.0mm required)

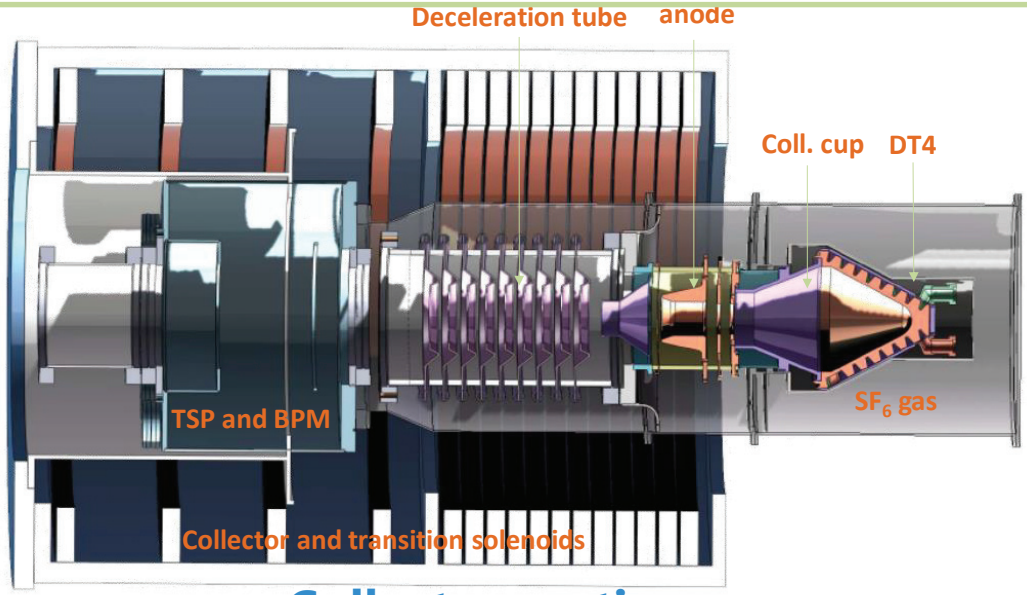


Gun sec. horizontal orientation

Collector section

Collector sec. calculation by USAM

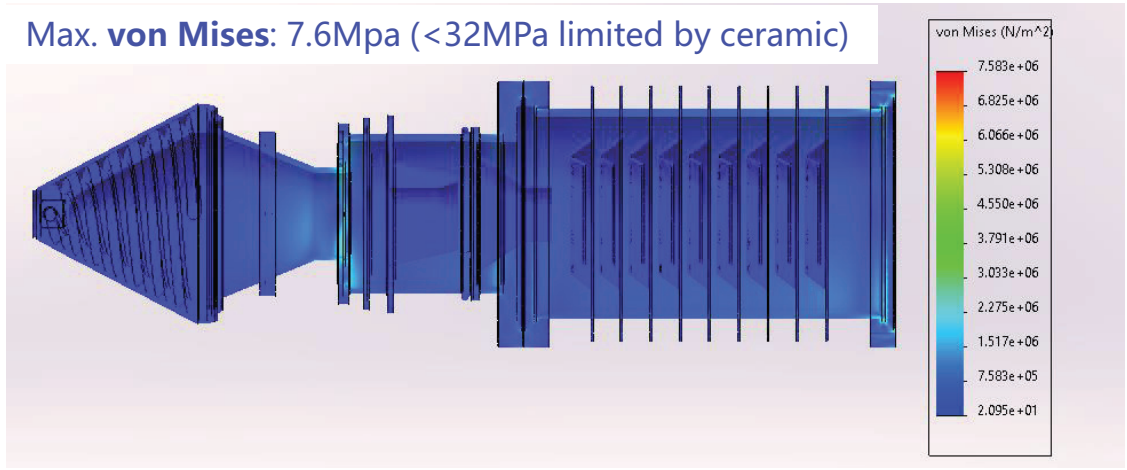




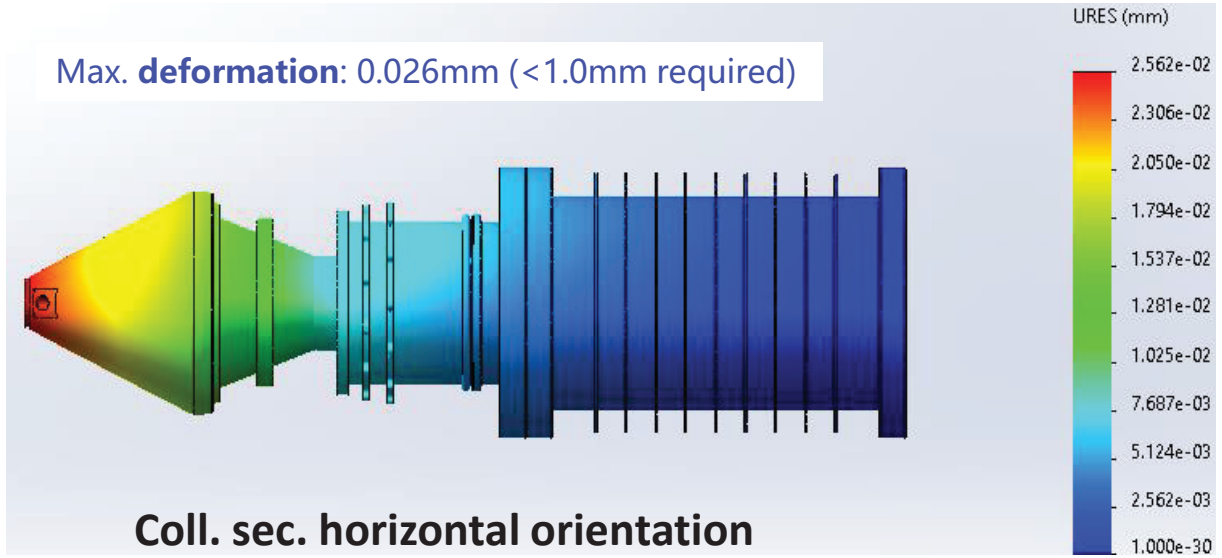
Collector section

Stress and deformation

Max. **von Mises**: 7.6Mpa (<32MPa limited by ceramic)



Max. **deformation**: 0.026mm (<1.0mm required)



Coll. sec. horizontal orientation

Summary and timeline

- Physical design of the SRing 80keV e-target are optimized mainly at gun and collection sections. Engineering design optimization have also be made for reliability considering horizontal orientation.
- Many physical design and technologies have inherited CSR e-coolers benefit from BINP-IMP cooperation and refer to similar devices.
- Manufacture and Ordering have been started after the prototype test and verification.
- Manufacture of all components will end in the first half of 2023. Assemble and commissioning of the e-target will start in the second half of 2023.