

Development of high-temperature superconducting REBCO coils for ECR ion sources

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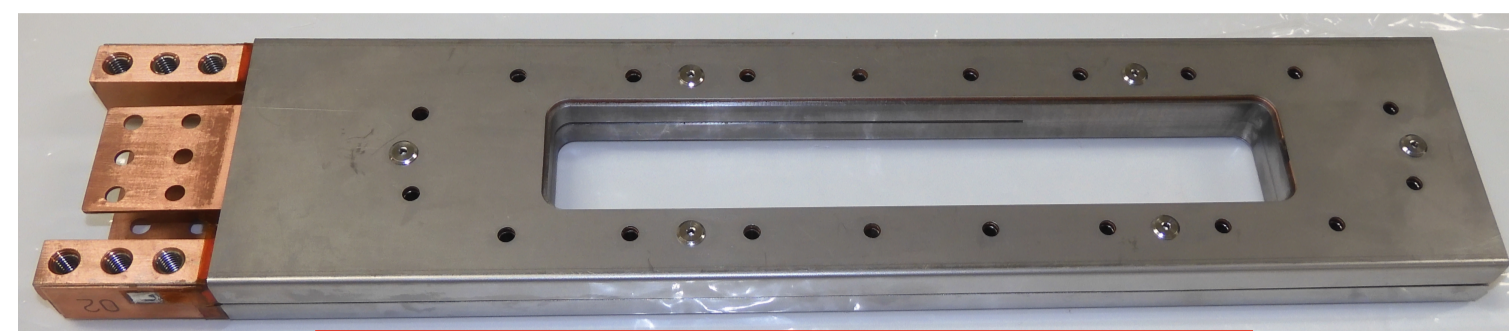
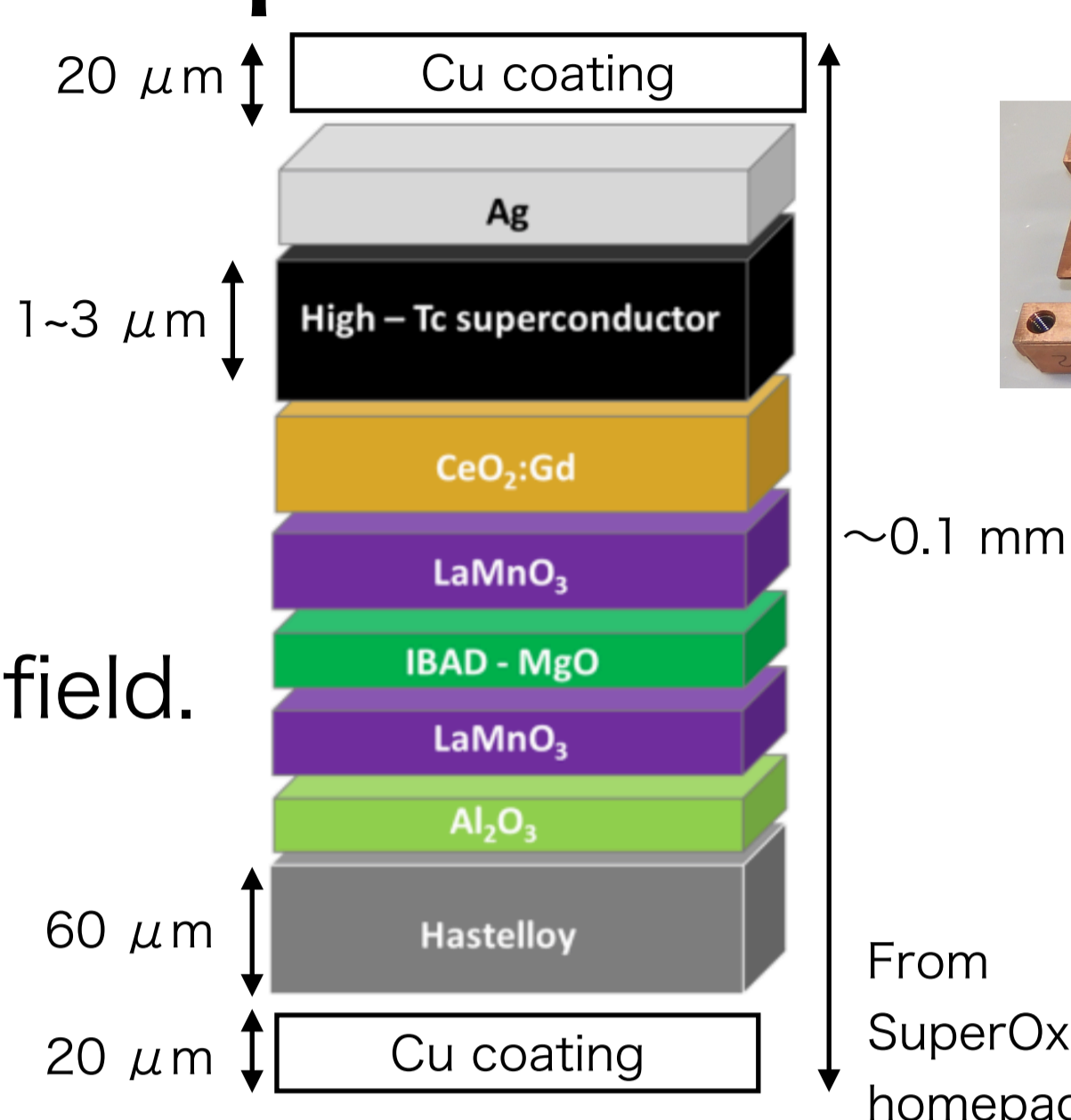
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REBCO coils for ECR ion sources

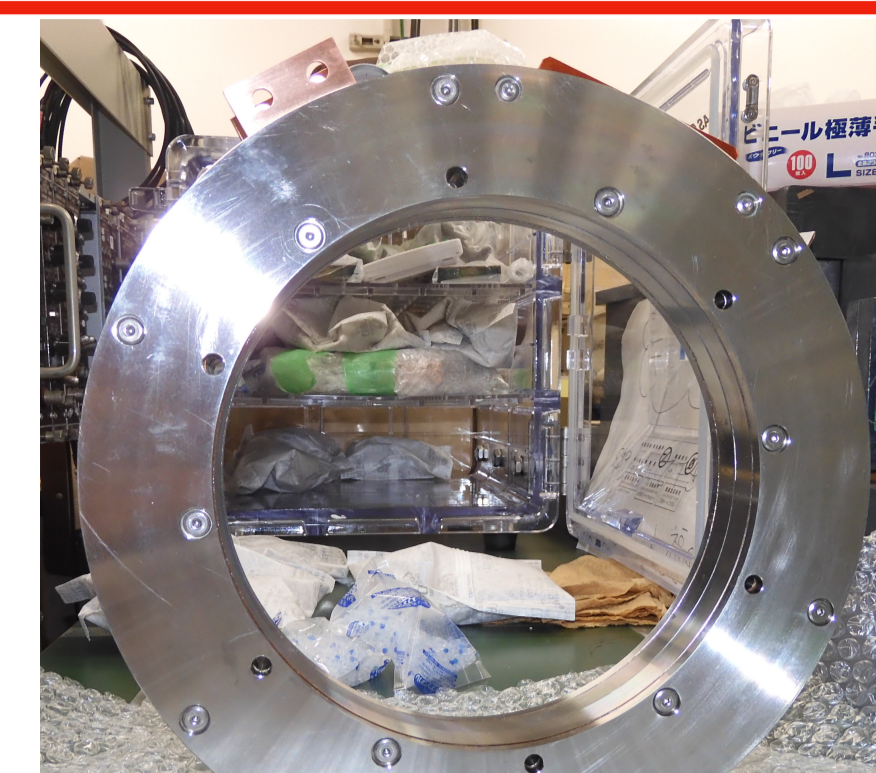
Second Generation High Temperature Superconductor (HTS) Tapes

Product of SuperOx Japan

- REBa₂Cu₃O_{7-x} (REBCO, RE=rare earth), rare earth barium copper oxide.
- T_c > 90K
- High Current density in high transverse magnetic field.
- J_c > 10,000 $\frac{A}{mm^2}$ under 20T transverse B-field, 30K



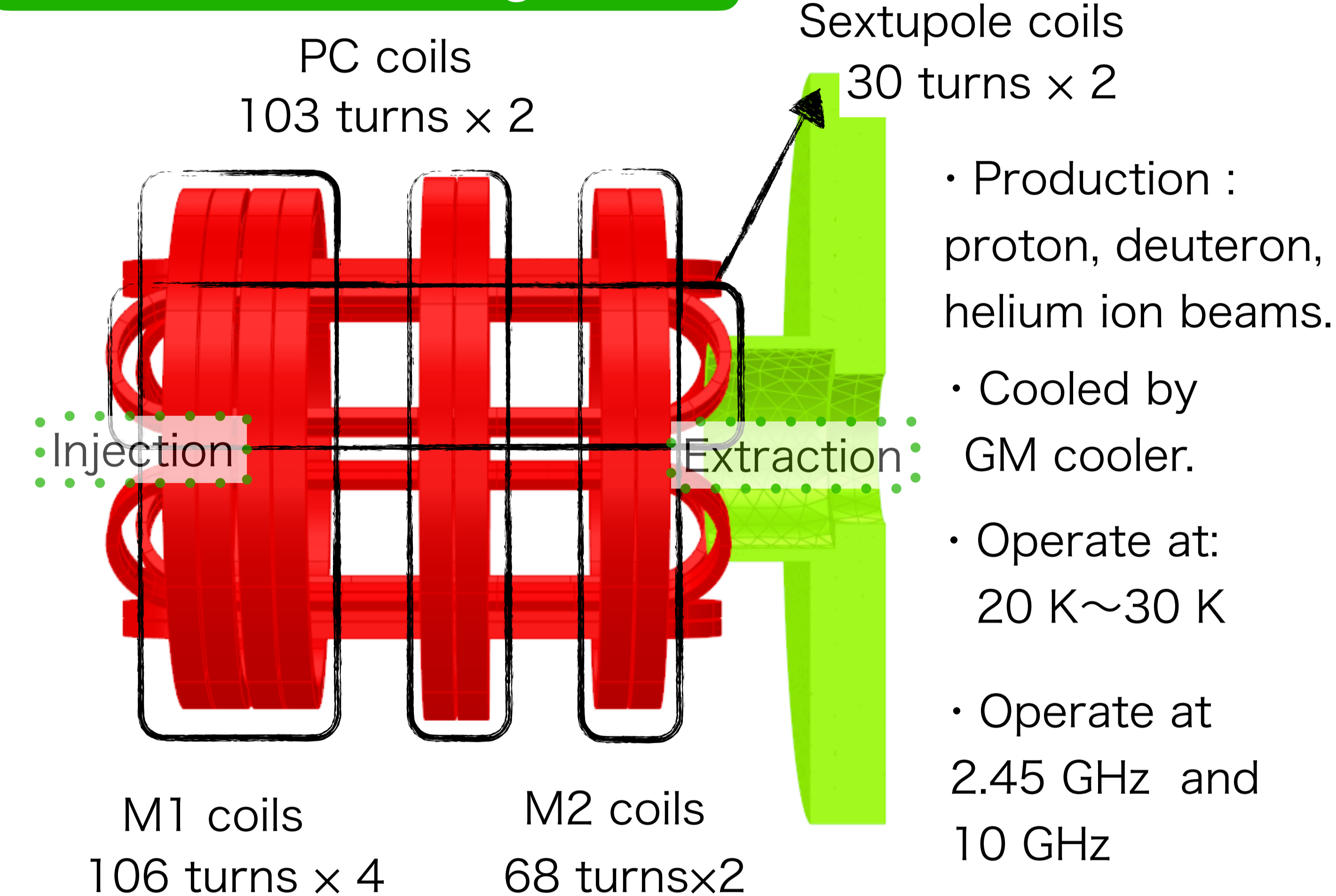
Sextupole coils



Solenoid coils

- Width : 6 mm
- Bending radius : 25 mm
- I_c > 250 A at 30 K
- No Insulation windings.
- Width : 12 mm
- Internal diameter ~190 mm
- I_c > 500 A at 30 K
- Metal Insulation windings.

REBCO coils configuration



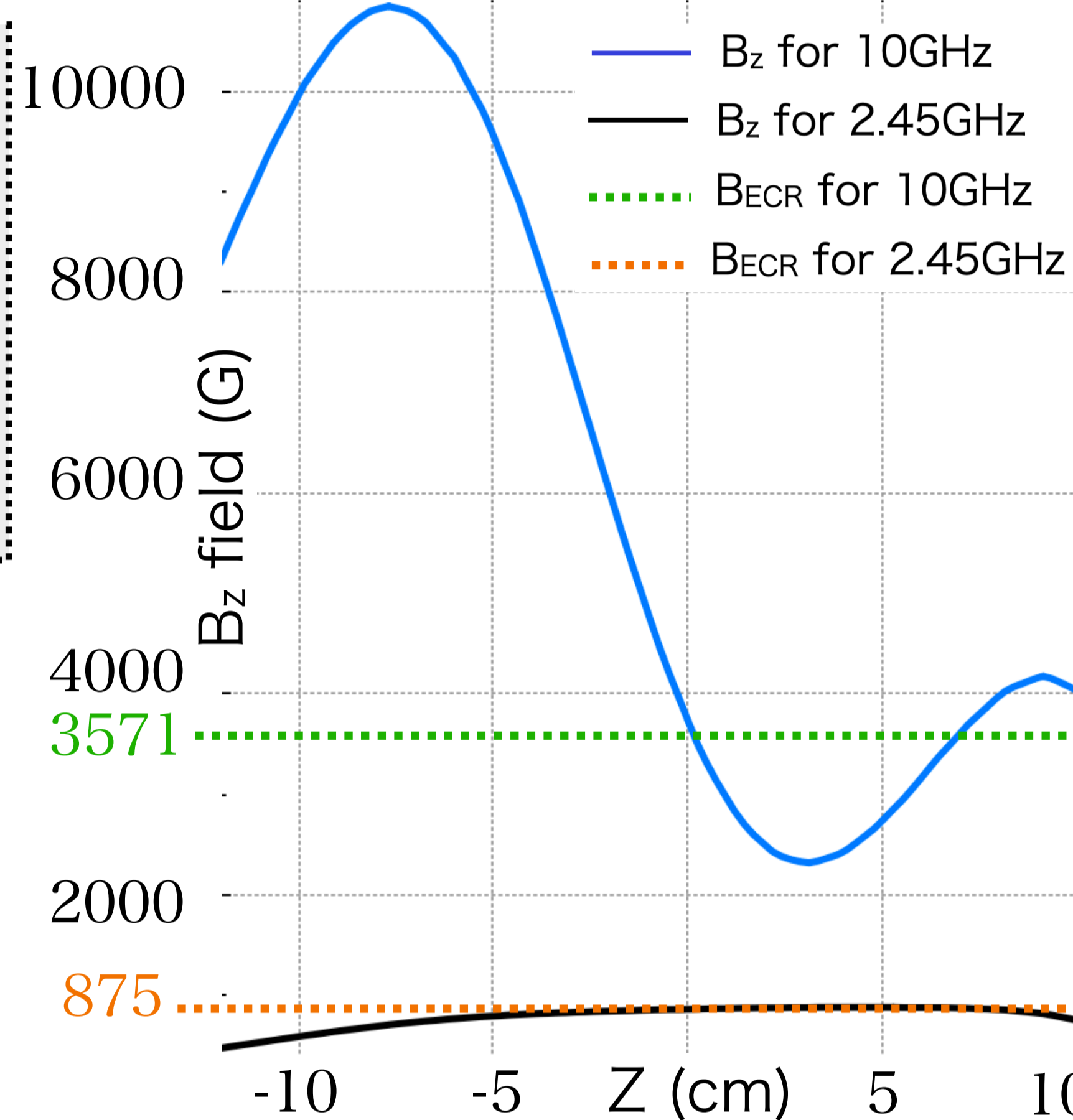
B-field configuration (2.45 GHz and 10 GHz mode)

Mirror ratio (10 GHz, 500 A)

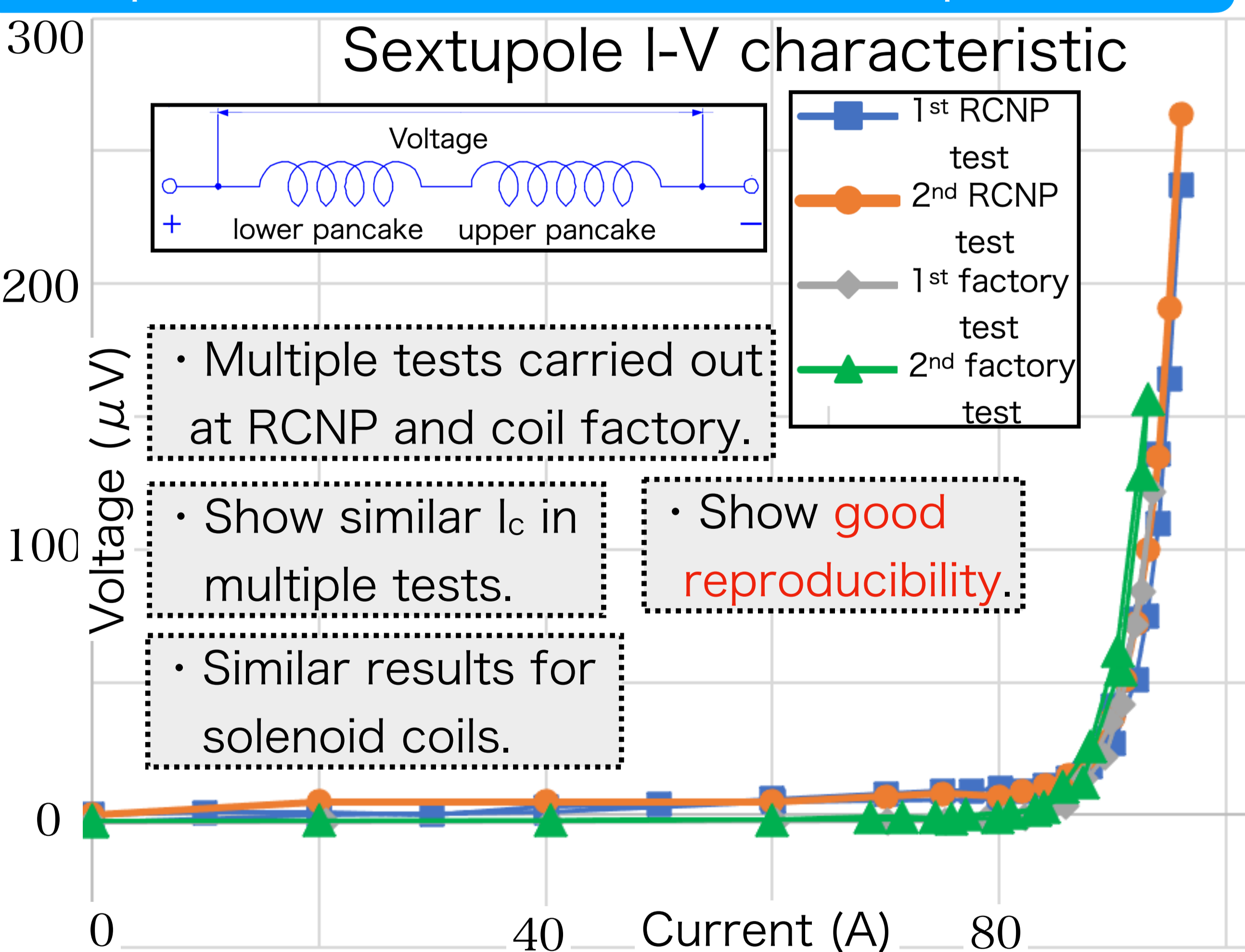
$$\frac{B_{inj}}{B_{ECR}} \sim 3, \frac{B_{ext}}{B_{ECR}} \sim 1.2,$$

$$\frac{B_{min}}{B_{ECR}} \sim 0.65, \frac{B_{rad}}{B_{ECR}} \sim 2$$

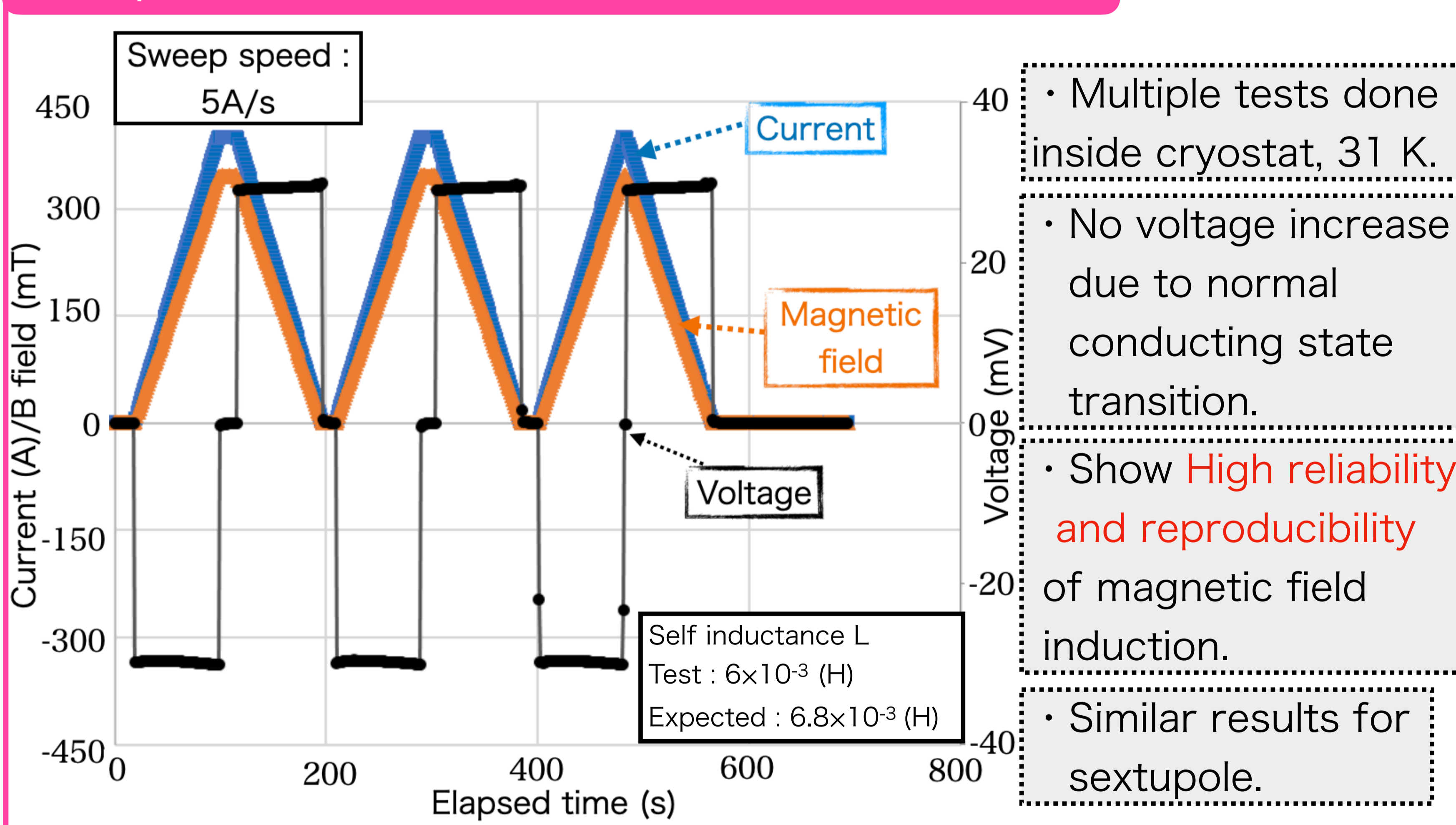
- Min-B figuration for 10 GHz operation.
- No mirror field for 2.45 GHz operation.



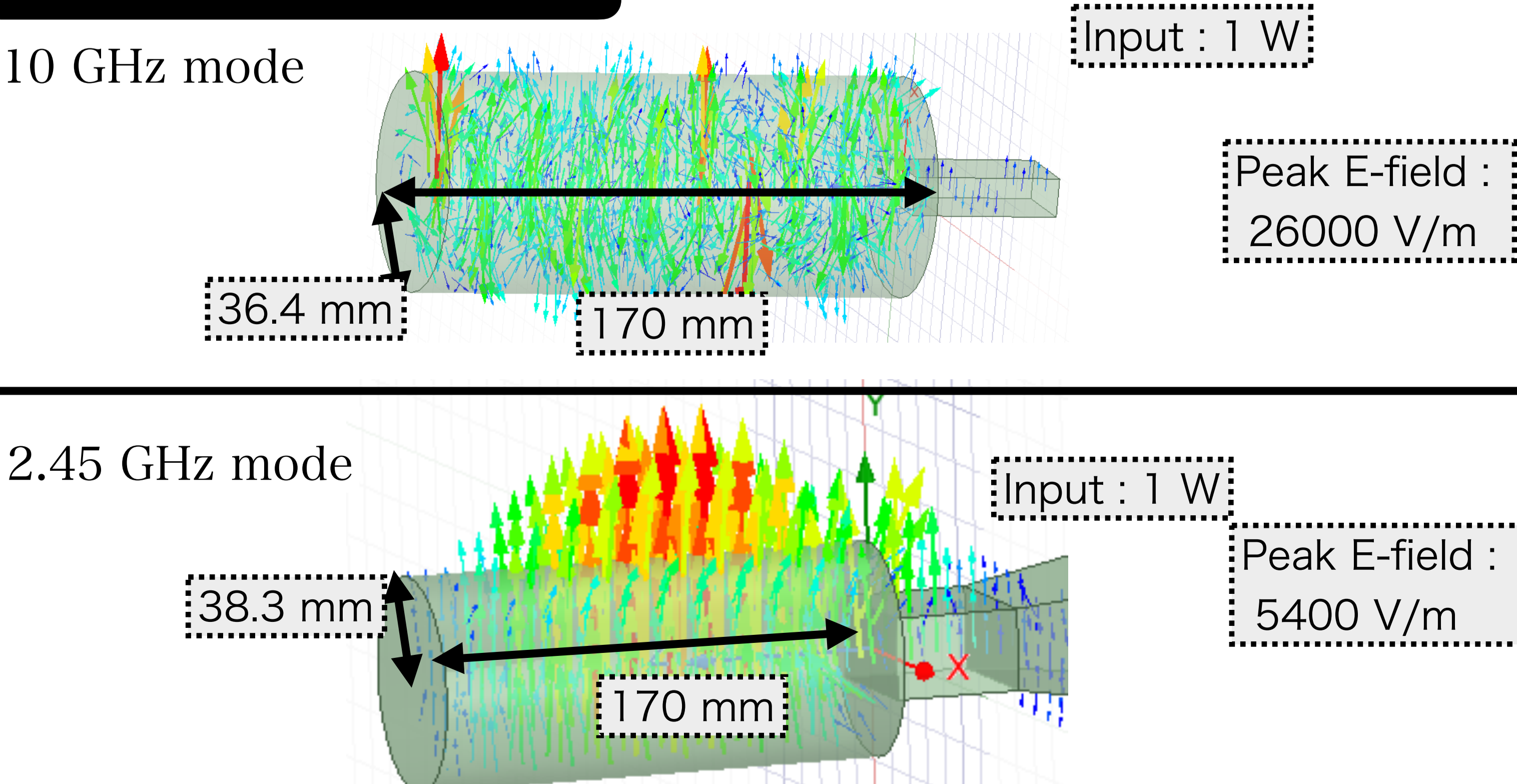
77K performance test results (Sextupole coils)



31K performance test results (Solenoid coils, M2)



rf modes calculation



Conclusion

- REBCO solenoids and sextupoles has been constructed, performance tests showed good reliability and reproducibility.
- We intend to construct the HTS-ECR and carry out performance tests for a longer elapsed time in next year.
- Magnetic field and electric field configuration has been designed for HTS-ECR.
- HTS-ECR made by REBCO coils is expected to be capable of producing electron, He²⁺ ion or even heavy ion.