

Development of a solenoid magnet with high-Tc superconducting wire

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Many efforts have been made to realize superconducting apparatus far proposed after the discovery of high-Tc superconductor. Magnets with high-Tc superconducting (HTS) wire must provide many applications relevant to accelerator facilities. However, only a few magnets have been actually constructed and used [1].

We have designed and manufactured two solenoidal coils with HTS wire. They will be used as a mirror coil of an ECR ion source operating at 2.45 GHz. The HTS coils are fabricated by Sumitomo Electric Industries, Ltd. The tape is a flexible composite consisting of filaments of nominal composition $(\text{Bi,Pb})_2\text{Sr}_2\text{Ca}_2\text{Cu}_3\text{O}_x$ in a silver matrix, which also provides mechanical robustness and transient thermal stability. The tape is 4.2 mm wide and 0.21 mm thick. Each coil consists of two double pancakes, 292 turns of tapes in total. Coils are conduction cooled by a double-stage cryocooler and are designed to operate at 30 K. The performance of coils was investigated at 77 K and found to be better than anticipated. Critical currents I_c were measured with self-field both for each double pancake and for coils after assembling. The I_c is about 50 A and 40 A for the pancake and the coil, respectively. The operating current will be higher than 90 A at 30 K.

Figure 1 shows a schematic layout of coils and a vacuum chamber. Magnetic fields along the axis calculated by the code TOSCA is shown in Fig. 2. The inner and outer diameter of the coil is 156 mm and 225 mm, respectively. The width is 18.5 mm and the centers of two coils are separated by 250 mm. Figure 3 shows photograph of coils mounted on a bobbin.

The cryostat is under construction now. Whole the system including a hexapole magnet and an RF guide for ECR ion source will be completed in summer of 2003.

References

- [1] D.M. Pook *et al.*, 9th Int. Conf. on Modern Materials and Technologies. CIMTEC'98, Italy, June 1998.

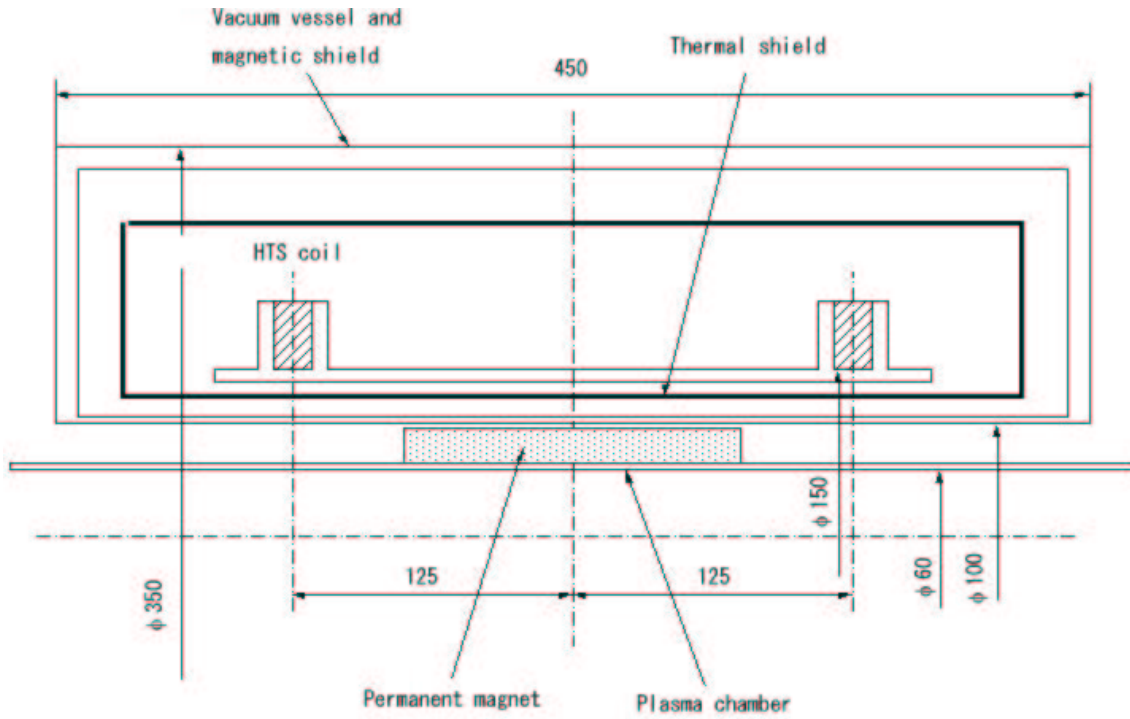


Figure 1: Schematic layout of the ECR ion source with HTS coils.

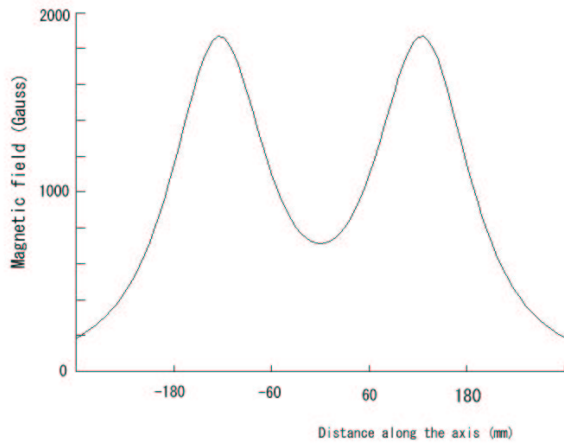


Figure 2: Magnetic fields along the axis.

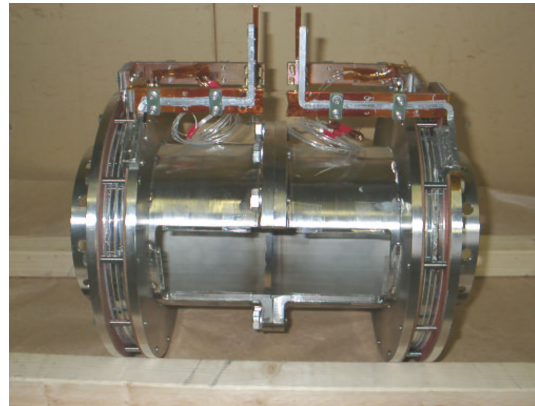


Figure 3: Photograph of the HTS coils mounted on the bobbin.