§6. Magnetic Configuration of Kobe-Cusp DEC in GAMMA 10

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The single slanted cusp direct energy converter (Kobe-Cusp DEC) [1] has been installed in Kobe University to investigate the proof of principle of the direct energy conversion, where several interesting results were pointed in respect to the charge separation between ions and electrons and energy discrimination of injected ion beams [2]. Now we have a plan to connect the Kobe-Cusp DEC in the GAMMA 10 tandem mirror device in order to investigate the high performance of the direct energy conversion. The Kobe-Cusp DEC will be attached obliquely on the end plate in GAMMA 10 device.

The magnetic field lines due to the Kobe-Cusp DEC without the GAMMA 10 device are shown in Fig.1, where the currents of the coils A, B, and C are 13.6 , 15.4. 5.8 kAT, respectively. The stagnation point appears at the position of $\zeta = 0$ cm.

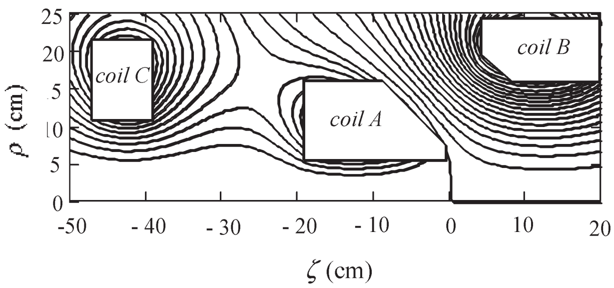

Fig.1 Magnetic field lines in the Kobe-Cusp DEC without the GAMMA 10 tandem mirror, where the currents of coils A, B, and C are 13.6 , 15.4. 5.8 kAT, respectively.

In this configuration the GAMMA 10 mirror device makes the axial magnetic field of around 50 G along the symmetric axis of the Kobe-Cusp DEC ζ. This axial magnetic field slides the stagnation position to $\zeta = 2$ cm and makes sharp the slope of the line cusp separatrix (Fig.2). The slope angle of the line cusp is able to be changed by controlling the coil currents. The whole magnetic field lines from the attached position to the GAMMA 10 ($\zeta = -150$ cm) is shown in Fig.3. In these configuration the radial magnetic field produced by the Gamma 10 mirror field is quite small compared to the axial magnetic field, for example, radial magnetic field $B_\rho < 10$ G at $\rho = 0$ cm, $\zeta = -100$ cm, which is compared to the axial component $B_\zeta = 600$ G.

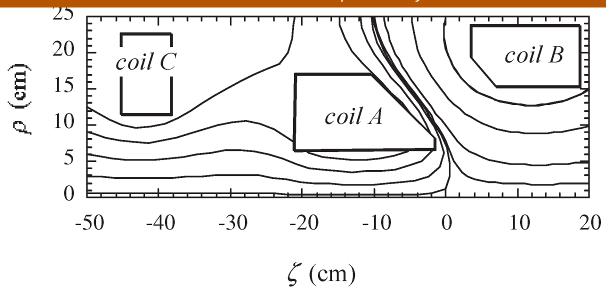

Fig.2 Magnetic field lines in the Kobe-Cusp DEC and the GAMMA 10 tandem mirror device. The coil currents are the same in Fig.1 and the GAMMA 10 device makes the axial magnetic field of around 50 G.

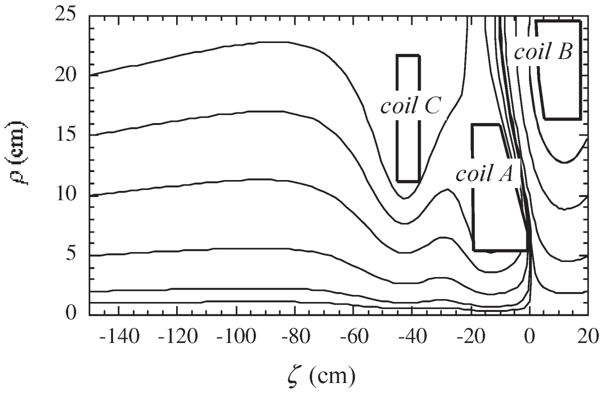

Fig.3 Magnetic field lines in the Kobe-Cusp DEC and the GAMMA 10 mirror device. The Kobe-Cusp DEC is attached at the end plate of the GAMMA 10 device, where the axial position of $\zeta = -150$ cm.

The quasi flux surface with a radius 3.6 cm at the axial position of $\zeta = -150$ cm crosses the right-lower corner of the coil A ($\rho = 5$ cm, $\zeta = 0$ cm). This means the injected GAMMA 10 plasma, especially electrons, outer than the radius of 3.6 cm has a possibility to contact to the coil can of the coil A. In order to study the performance of the Kobe-Cusp DEC the particle simulation in this configuration is necessary.

Reference

1) Tomita, Y., Yasaka, Y., Ishikawa, M., and Nemoto, T.: Trans. Fusion Science and Technol., **47** (2005) 43.
2) Takeno, H. and Yasaka, Y.: Trans. Fusion Technol. **39**, (2001).386.