

## §14. Divertor Study of Toroidal and Mirror Field Configurations

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One of the authors previously proposed the tokamak-helical hybrid called TOKASTAR (Tokamak-Stellarator Hybrid) with mirror field divertor configuration to improve the magnetic local shear near the bad curvature region and divertor configuration. This is characterized by simple and compact coil systems with enough divertor space relevant to reactor designs. Based on this TOKASTAR concept, a miniature C (compact) -TOKASTAR machine ( $R \sim 35$  mm) with a toroidal mode number  $N = 2$  was constructed. The rotational transform of this compact helical configuration is rather small to confine hot ions, but can be utilized as a compact electron plasma machine for multi-purposes.

The C-TOKASTAR has a pair of spherical winding helical coils and a pair of poloidal coils (Fig.1). Existence of magnetic surface and electron confinement property in C-TOKASTAR device were investigated<sup>1)</sup> by an electron-emission impedance method (Fig.2). We also constructed a slightly larger machine TOKSATAR-2<sup>2-4)</sup> (major radius = 10 cm) with possible pure tokamak mode.

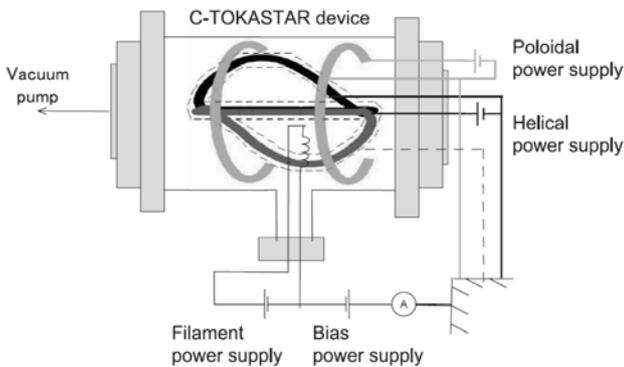


Fig.1 Experimental layout of stellarator diode method in C-TOKASTAR.

The particle orbit analysis is also carried out for TOKASTAR configuration evaluation. The guiding-center drift-orbit approximation is used to calculate the orbit trajectory of fast ions. Figure 3 shows typical passing particle and lost particle relevant to magnetic divertor configuration linked to toroidal and mirror field.

- 1) Y. Taira, K. Yamazaki, H. Arimoto, T. Oishi, T. Shoji, Plasma and Fusion Research: Regular Articles **5** (2010) S1025
- 2) T. Oishi, K. Yamazaki, H. Arimoto, K. Baba, M. Hasegawa, H. Ozeki, T. Shoji, M. I. Mikhailov, Proc.

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- 3) K. Baba, K. Yamazaki, H. Arimoto, T. Oishi, K. Okano, M. Hasegawa and T. Shoji, Plasma and Fusion Research: Regular Articles **5** (2010) S2036.
- 4) K. Okano, K. Yamazaki, H. Arimoto, T. Oishi, K. Baba, M. Hasegawa and T. Shoji, Plasma and Fusion Research: Regular Articles **5** (2010) S2037.

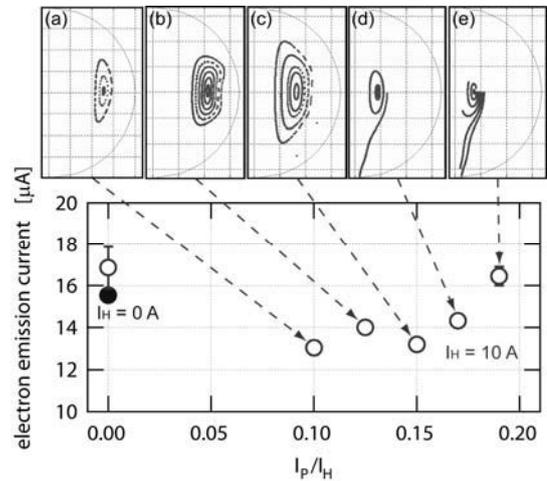


Fig.2 Variation of quasi-steady electron emission current with changing magnetic configuration. The horizontal axis  $I_p/I_H$  denotes the ratio of poloidal field coil current and helical field coil currents.

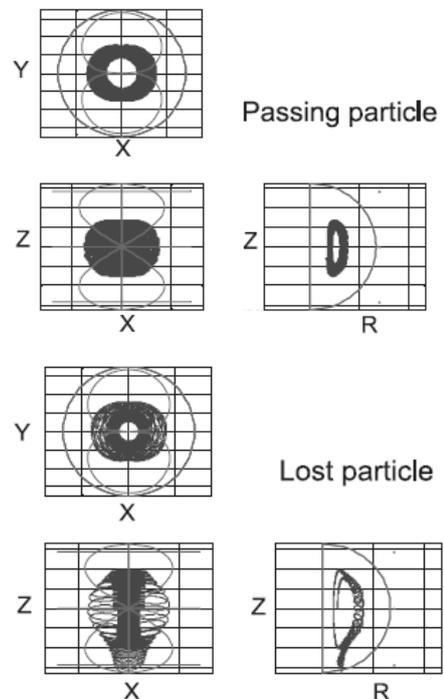


Fig.3 Typical orbits of passing (upper figure) and lost (lower figure) particles in C-TOKASTAR with normalized Larmor radius  $r_{ci}/a_p$  of 0.006. Here  $r_{ci}$  and  $a_p$  are ion Larmor radius and plasma minor radius, respectively.