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Feasibility study of heavy ion beam probe in CFQS quasi-axisymmetric stellarator

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Heavy ion beam probe (HIBP) is a powerful diagnostic tool which can directly measure the plasma potential in high-temperature plasma without perturbing a background plasma [1-3]. Moreover, HIBP can measure potential and density fluctuation simultaneously with high time and spatial resolution. Thus it has a great advantage for studying the physics of radial electric field, E_r, turbulence, and those effects on the transport of plasma.

The CFQS quasi-axisymmetric (QA) stellarator is now being constructed under a joint project of National Institute for Fusion Science and Southwest Jiaotong University [4-6]. QA stellarator will achieve tokamak-like good confinement without current drive because its magnetic field configuration has similar properties to that of tokamak from a neoclassical point of view in vacuum. While, in experiments, the anomalous transport will be dominant. In QA configuration, the transport barrier formation like H-mode in tokamaks will be expected due to the intrinsic low-viscosity. Therefore, we will study physics of improved confinement mode by measuring E_r, which plays an important role in suppression of turbulence leading to confinement improvement. In order to reveal those physics experimentally, the HIBP employed in CHS [2] will be installed onto CFQS. The major radius and the magnetic field strength of CFQS are 1 m and 1 T, respectively. Thus, the required probe beam energy is approximately 100 keV, and for beam ion species, cesium or rubidium are appropriate. In this paper, results of the feasibility study for CFQS HIBP will be presented.

References

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