§51. Analysis of the Accelerated Proton Trajectory by ICRF Waves during Long Pulse Discharges

Shoji, M., Watanabe, T.

ICRF heated long pulse discharge experiments were carried out in the 6th experimental campaign.1) A minority heating method was employed in helium plasmas as the majority ions and protons as the minority species. Two ion cyclotron resonance (ICR) layers were located at the saddle point of the mod-B surface for optimizing the proton heating efficiency. One pair of ICRF antennas supported from vacuum ports (3.5-U&L) was used for the long pulse discharge experiments.

A CCD camera observed local heating of a vertically installed divertor plate (hot spot) in a long pulse discharge as shown in Fig. 1 (a). Bright thin lines on a divertor leg are also observed. The ICRF antennas are located at the next to the port where the CCD camera is installed. The hot spot appeared during ICRF heating, indicating that the accelerated protons by ICRF waves locally hit the divertor plate to produce the hot spot.

We calculated the trajectories of the accelerated protons started from the points on upper and lower ICR layers in the plasma periphery in front of the ICRF antennas. Figure 1 (b) illustrates the proton trajectories (dark gray dots) with the magnetic field line plots (light gray dots). The images of the dots looked from the position of the camera (Fig. 1 (c)) is consistent with the observation, showing that the observed bright thin lines are due to the accelerated protons from the points on the two ICR layers. Figure 1 (d) is the enlarged image of the distribution of the strike points of the accelerated protons on the vertically installed divertor plate. The distribution of the strike points quite agrees with that of the observed hot spot (Fig. 1 (a)). The proton trajectory analysis indicates that the hot spot is produced by the protons from the two ICR layers. The change of the ICRF heating scheme (e.g. the change of the position of the ICR layers) is a possible solution for extending the duration time of ICRF heated long pulse discharges without serious damage to divertor plates.

Reference
1) Kumazawa, R. et al., Plasma Phys. Control. Fusion **45**, (2003) 1037

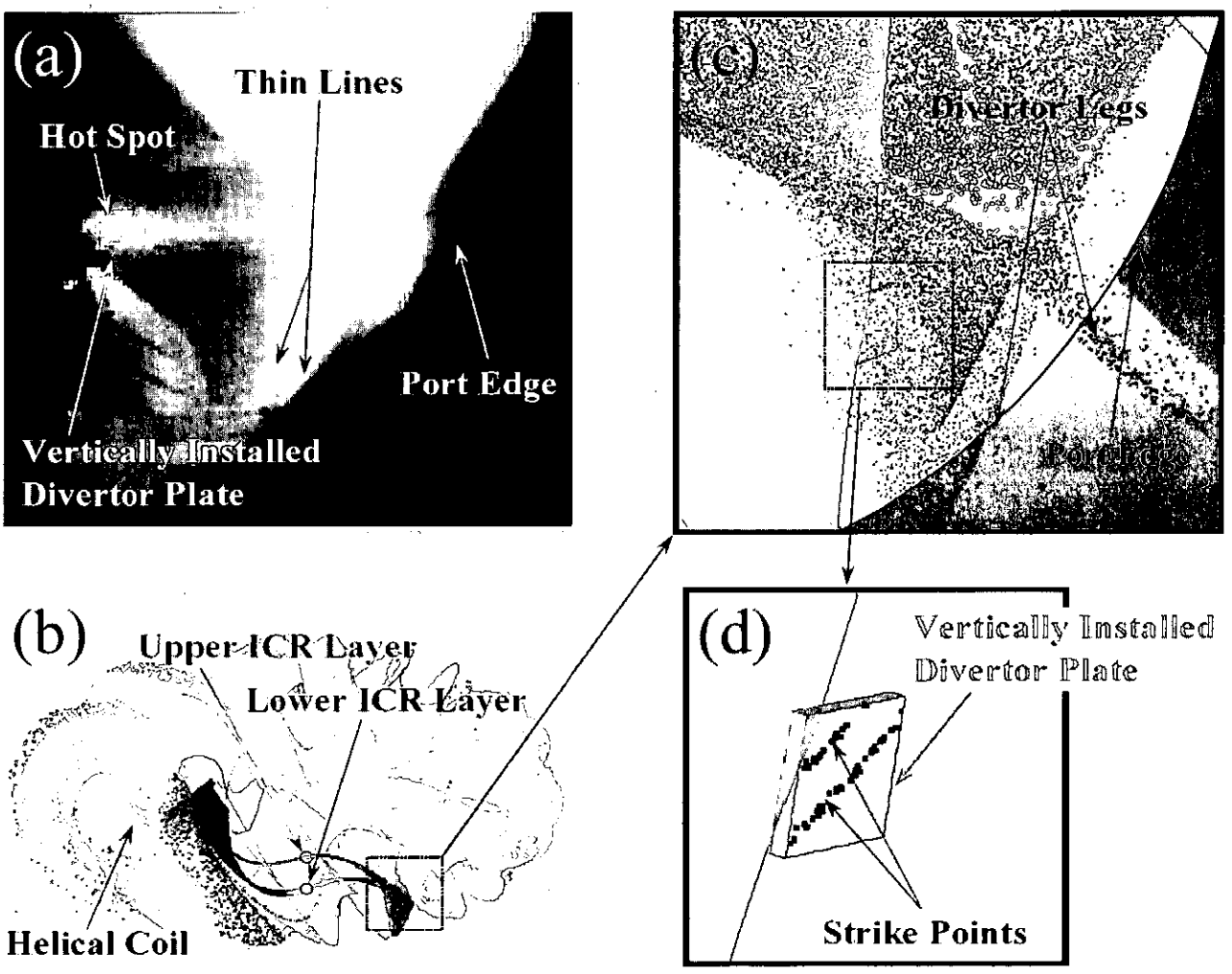

Fig. 1. A hot spot on a vertically installed divertor plate during a long pulse discharge (a), calculation of three-dimensional trajectories of accelerated protons with magnetic field lines (b), enlarged view of the trajectories looked from a CCD camera position (c), and the distribution of the strike points of the accelerated protons on the divertor plate (d).