Establishment of island divertor configuration in the J-TEXT tokamak

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The island divertor configuration has been proposed first in 1977 for tokamak [1] and established successfully in stellarators [2], such as W7-AS, LHD and recently in W7-X. This concept provides a very efficient way to exhaust heat and particles, which is crucial for long-pulse high-performance plasma operation. What's more, a stable, thermally fully detached island divertor regime has been realized and demonstrated in W7-X [3]. Therefore, applying the island divertor configuration to tokamak is of great promise and significance.

Recently, the establishment of island divertor configuration has been demonstrated successfully in the J-TEXT tokamak. The edge 3/1 (or 4/1) islands have been excited by applying the resonant magnetic perturbation (RMP) with dominate m/n = 3/1 (or 4/1) component to a plasma with edge safety factor $q_a >\sim 3$ (or 4). Once the edge 3/1 (or 4/1) islands have been excited, the radial profiles of the electron temperature, electron density, floating potential, the intensity of carbon impurity radiation, the edge poloidal rotation varied significantly in the scrape off layer (SOL). After the excitation of the edge islands, the edge safety factor was decreased by increasing the net plasma toroidal current, so as to move the edge islands outwards to intersect with the divertor targets. The poloidal profiles of the floating potential measured at the target plates, varied during the outward movement of edge island, indicating that the edge island was opened by the divertor target, i.e. the establishment of the island divertor configuration. It has been found that the island divertor configuration is not only beneficial for spreading heat load on the divertor target, but also to provide effective screening of carbon impurities.

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