Momentum transport studies in JET H-mode discharges with an enhanced toroidal field ripple

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The momentum transport properties of neutral beam heated H-mode discharges with an enhanced toroidal field (TF) ripple have been studied in JET. JET has the capability to alter its TF ripple, by independently charging the odd and even TF coils. In these experiments its value was changed from its standard value of 0.08% to 1% at the the outer separatrix. This had a significant impact on the toroidal rotation and its profile. The toroidal torque deposition by the tangential neutral beam injection (NBI) system in combination with a significant TF ripple was calculated using the ASCOT code. Power and momentum balance analysis were used to determination of the effective heat and momentum diffusivities. Moreover, by tuning TF ripple resulted the velocity gradient could be modified independently from the magnitude of the velocity itself, enabling a determination of the diffusive and convective transport terms.

The experiments showed that lower velocities and flatter rotation profiles were obtained in discharges with a high TF ripple. However, the torque deposition in the core was found to be little affected as the TF ripple was increased (it only affects the torque in the outer part). The flattening of the rotation profiles can be attributed to smaller inward momentum convection. An average inward momentum pinch of approximately $V_p \approx 3.4$(m/s) and a normalised pinch value of $RV_p/\chi \approx 6.6$ was derived to explain the observations. The experiments show that the momentum at the outer part of the plasma affects the peaking of the rotation and momentum density profiles. For standard operations, the ratio of the effective momentum and heat diffusivities is usually below unity in JET, however by increasing the TF ripple values close to unity were obtained, as the effect of the inward convection becomes smaller.

Under the assumption that the heat and momentum diffusivities are equal, an estimate of the levels of the momentum pinch in all discharges in the JET rotation database was made. For H-mode discharge these ranged from $0.3\text{(m/s)} < V_p < 17\text{(m/s)}$, with a normalised momentum pinch of $2 < RV_p/\chi < 10$. A larger normalised momentum pinch was found in discharges with a smaller density profile gradient length.

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