Investigation of potential acceleration forces in EAST and J-TEXT plasmas

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Abstract

In order to produce intrinsic rotation, bulk plasmas must be accelerated by the net force exerted on them, which results from both driving and damping forces. So, to study the possible mechanisms of intrinsic rotation generation, it is only needed to understand the characteristics of the driving and damping terms. Experiments were performed on EAST and J-TEXT for ohmic plasmas with counter- and co-current toroidal acceleration generated by density ramping-up and ramping-down. Additionally on EAST, co-current toroidal acceleration was also formed by use of LHCD or ICRF, and was again driven by the net co-current toroidal force. For the current experimental results, the toroidal acceleration was between - 40 km/s^2 in the counter-current direction and 60 km/s^2 in the co-current direction. According to the toroidal momentum equation, the toroidal electric field ($\boldsymbol{E}_\phi$), the toroidal viscous force, and electron-ion toroidal friction etc. may play roles in the evolution of toroidal rotation. To evaluate the contribution of each term, we first analyze the characteristics of $\boldsymbol{E}_\phi$. $\boldsymbol{E}_\phi$ is one of the co-current toroidal forces that acts on the plasma as a whole and persists for the entire discharge period. It was shown to drive the co-current toroidal acceleration at a magnitude of 10^3 km/s^2, which was much larger than the experimental toroidal acceleration observed on EAST and J-TEXT. So $\boldsymbol{E}_\phi$ plays an important role in producing co-current toroidal acceleration and co-current toroidal intrinsic rotation. Meanwhile, it indicates that there must be a strong counter-current toroidal acceleration resulting from the counter-current toroidal forces. Electron-ion toroidal friction is one of the counter-current toroidal forces because electrons move in the counter-current direction in order to produce a toroidal plasma current.

Key words: **Toroidal acceleration**, **Toroidal electric field**, **Intrinsic rotation**

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