

New approach to the control of particle recycling using divertor pumping in LHD

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Superior control of particle recycling and of plasma density has been established in the Large Helical Device (LHD) using greatly enhanced active pumping of the closed helical divertor (CHD). In-vessel cryo-sorption pumping systems inside the CHD in five out of ten inner toroidal divertor sections have been developed and installed step by step in LHD. The total effective pumping speed obtained was $67 \pm 5 \text{ m}^3/\text{s}$ in hydrogen, which is approximately seven times larger than previously obtained. As a result, a low recycling state was observed with the CHD pumping for the first time under the helical divertor configuration in LHD featuring excellent density control even under intense pellet fueling conditions. A global particle confinement time is used for comparison of operation with and without the CHD pumping. The global particle confinement time was evaluated from the density decay after the fueling of hydrogen pellet injection or gas puffing in NBI plasmas. A short global particle confinement time after the fueling was obtained during the CHD pumping, demonstrating the control of the particle balance with active pumping in CHD for the first time in LHD.

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