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Magnetic shear effects on plasma transport and turbulence at high electron to ion temperature ratio in DIII-D and JT-60U plasmas

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Negative magnetic shear has been demonstrated to mitigate the confinement degradation typically observed with increasing the electron to ion temperature ratio (Te/Ti), and the mechanisms are now understood in terms of fluctuation measurements and gyrokinetic (GK) simulations in DIII-D steady-state plasmas. The impact of Te/Ti on plasma transport and confinement is a critical issue for ITER and DEMO, where electron heating by alpha particles will be dominant. In the new experiments in DIII-D negative magnetic shear (NS) discharges, the Ti profile was maintained as Te/Ti increased through electron cyclotron range of frequency (ECRF) heating, while in positive magnetic shear (PS) plasmas, a large reduction in Ti was observed at increased Te/Ti. The different transport behavior has been explained by the turbulence measurements and GK simulations; the increase in Te/Ti had less impact on broadband turbulent fluctuations in the NS plasmas compared with that in the PS plasmas. The difference reflects changes in thermal energy confinement; the ion thermal diffusivity remained constant in the NS plasma but increased in the PS plasma when ECRF was applied. The reduced confinement degradation at high Te/Ti with NS has been commonly observed in DIII-D and JT-60U.

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