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Isotope Effects on Long Range Correlation and the Nonlinear Coupling with Turbulence in Heliotron J

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The hydrogen/deuterium (H/D) isotope effects for long range correlation (LRC) and the nonlinear relationship with turbulence were observed for the first time in a helical device, Heliotron J. The fluctuation amplitude and the correlation in toroidal direction in the low frequency range < 4 kHz are enhanced as the D₂ gas becomes dominant during the shot-to-shot experiment. Turbulence scale size increases as D₂ gas is dominated in the discharge, which is consistent with the conventional turbulence theories and the past experimental works [1,2]. Nonlinear coupling between the LRC and turbulence, which should relate to the generation of the LRC, is also enhanced along with the increase in the LRC. This observation gives an implication that the isotope effects on the confinement improvement and/or on the threshold in L-H transition are dominated by the increase of nonlinear coupling on turbulence and the resultant enhancement of the zonal flow activity in D plasmas.

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