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Modelling Intrinsic Rotation Reversals in JET Plasmas

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Recent experiments in JET studied intrinsic rotation in Ohmic plasmas, which provided the first clear observation of rotation reversals in a large tokamak [1]. Main ion rotation measurements were made in H, D and T plasmas for a large density range that spanned over both the Linear Ohmic Confinement (LOC) and the Saturated Ohmic Confinement (SOC) phases. Two rotation reversals were clearly observed for each hydrogen isotope, with rotation profiles changing from peaked to hollow at a density close to the LOC-SOC transition, then to peaked again with increasing density. Most theories for intrinsic rotation attribute the observed rotation to a turbulent redistribution of momentum within the plasma core. For a preliminary analysis of the effect of the density on the core rotation observed at JET, we focus on one of the turbulence drives, namely the effect of neo-classical parallel velocity and heat flow on the turbulence [2-3]. Using a version of the GS2 code [4] that includes neoclassical flows, non-linear modeling of rotation profiles covering the whole density range has been performed for the H plasmas. GS2 simulations had previously shown that as the ion–ion collisionality increases, the momentum flux reverses direction in qualitative agreement with the low-density rotation reversal observed in many tokamaks [5]. In the GS2 simulations shown here, the signs (but not the magnitude) of the modelled velocity gradients agree with observations for both the rotation profiles measured during the low-density LOC phase and those measured during the higher-density SOC phase. In both cases the change in rotation shear seems to be driven by the change in the shape of the density and temperature profiles, not the change in ion–ion collision frequency.

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