Intrinsic rotation in tokamaks

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Tokamak plasmas rotate in the absence of momentum input due to the turbulent redistribution of momentum. In future large, dense tokamak reactors, this intrinsic rotation may be the only significant source of rotation available, making it important to have a reliable, first principles model for it. Any model for intrinsic rotation must be able to reproduce the complex dependences on plasma parameters observed in experiments, such as the direction reversals that occur once a density or plasma current threshold is crossed. The gyrokinetic equations for turbulent momentum redistribution will be presented and then simplified using an expansion in the smallness of the poloidal magnetic field over the total magnetic field. The physical interpretation of the different new terms in the equations will be given, demonstrating that they lead to several mechanisms of intrinsic rotation generation that compete among themselves. A new version of the gyrokinetic code GS2 which includes the new terms will be presented. Particular attention will be devoted to how the new version of GS2 treats the radial variation of the gradients of temperature and density without a radially extended computational domain.

Work funded by the RCUK Energy Programme, the EU's Horizon 2020 research and innovation programme, and the US Department of Energy.