4th Asia-Pacific Conference on Plasma Physics, 26-31Oct, 2020, Remote e-conference

# Impact of a rippled magnetic field on flows

R. Varennes[1], L. Vermare[2], X. Garbet[1], V. Grandgirard[1], Y. Sarazin[1], G. Dif-Pradalier[1], D. Zarzoso[3], C. Gillot[1], P. Ghendrih[1], E. Bourne[1]

[1] *CEA, IRFM, F-13108 Saint-Paul-Lez-Durance, France.*
[2] *LPP, CNRS, Ecole polytechnique, 91128 Palaiseau, France.*
[3] *Aix-Marseille Université, CNRS, PIIM, UMR 7345 Marseille, France.*

One of the main objectives in fusion research is to find ways to reduce turbulent transport for a better plasma confinement. This is commonly achieved through the quenching of edge plasma turbulence, leading to the formation and the sustainment of a transport barrier, the H-mode. Such a barrier is characterized by a steep pressure profile, resulting from - and likely reinforcing - sheared flows which reduce turbulent transport. The triggering and sustainment of transport barriers is an active research topic. More specifically the origin of the radial electric field that drives sheared flows is a key element to understand the transition. One open issue is the role of toroidal modulations of the magnetic field due to a finite number of coils, or "ripple". The underlying loss of axisymmetry is responsible for a toroidal friction which, as predicted by neoclassical theory, can lead to magnetic breaking [1]. This friction modifies in turn the particle fluxes, and therefore the radial electric field due to the ambipolarity constraint. This effect has been investigated experimentally in JET [2], JT-60U [3] and Tore Supra [4], showing the ripple trend to decrease the toroidal rotation. The gyrokinetic code GYSELA had been used to estimate the range of validity of the neoclassical theory and the interplay between turbulent and neoclassical ripple induced fluxes. In realistic Tore Supra conditions, it has been observed that high turbulence regions are weakly impacted by ripple transport. However the radial electric field can increase by more than 50% in amplitude in regions of high ripple amplitude and low turbulence intensity. Transport barriers share the characteristics of such regions, suggesting that ripple may significantly contribute to the well of radial electric field that builds up in the barrier.

## References

[1] X. Garbet, *"Entropy production rate in tokamaks with nonaxisymmetric magnetic fields"*, Physics of Plasmas 17 (2010)

[2] M.F.F Nave et al., *"Influence of Magnetic Field Ripple on the Intrinsic Rotation of Tokamak Plasmas"*, Physical Review Letters 105 (2010)

[3] H. Urano et al., *"H-mode pedestal structure in the variation of toroidal rotation and field ripple in JT-60U"*, Nuclear Fusion 47 (2007)

[4] E. Trier, *"Radial electric field measurement in a tokamak with magnetic field ripple"*, Nuclear Fusion 48 (2008)