23st EU-US Transport Task Force Meeeting, Seville, Spain, 11-14 September 2018

Transport of impurities in a turbulence spreading transport model

V. Naulin[1], J. Juul Rasmussen[1], and J. Gath[1]

[1]*DTU Physics, Technical University of Denmark, Kgs. Lyngby, Denmark*

Corresponding author: Volker Naulin Email: vona@fysik.dtu.dk

The turbulence dominating anomalous transport in magnetically confined plasma is generated due to instabilities driven by the free energy available in gradients exceeding in magnitude the local stability limit. Once turbulent fluctuations have been created they arrange for transport that diminishes the driving gradient and pushes it towards the stability limit. Quantities advected by the turbulence get mixed towards homogenisation.

The turbulence once created in a specific location will itself spread out and continue to arrange for increased mixing levels, eventually even far away from the location of origin. This process - referred to as turbulence *spreading* - leads to transport events, which are decoupled from the local gradients and the transport is therefor called non-local. In magnetically confined plasmas the most obvious of such non-local transport processes is associated with the transport induced by localized blob structures traversing the Scrape Off Layer of plasmas [1]. These are created in or near the edge shear layer and break the flux gradient relationship for transport in the SOL, what is the reason, besides the induced high intermittency, for the impossibility to describe SOL transport via locally defined transport coefficients.

In the plasma core these nonlocal effects are more difficult to identify as usually the gradients are extremely close to the marginally stable profiles and spreading of turbulence thus is difficult to observe. The effects of turbulence spreading can however be underlying some otherwise difficult to explain transport effects, such as ultrafast propagation of cold pulse events, cold pulse polarity reversal and potentially the transition between LOC and SOC regimes in ohmic plasmas [2].

Here we present results from simulations using the turbulence spreading transport model [2,3] coupled with a passive mixing model for trace impurity transport. The turbulence spreading is shown to arrange for impurity profiles much flatter than expected from neoclassical effects.

[1] V. Naulin, J. Nucl Mater. (2007) 363–5, 24 – 31
[2] F. Hariri, V. Naulin, J. Juul Rasmussen, G.S. Xu, and N. Yan, Physics of Plasmas (2016) **23**, 052512
[3] V. Naulin, A.H. Nielsen, and J. Juul Rasmussen, Physics of Plasmas (2005) **12**, 122306 V. Naulin, J. Juul Rasmussen, P. Mantica, D. del-Castillo-Negrete, and JET-EFDA contributors. J. Plasma Fusion Res. SERIES, (2009), **8,** 55-59.

Preference: ☐X poster in session: