SMR/1856-11

2007 Summer College on Plasma Physics

30 July - 24 August, 2007

Turbulence spreading and nonlocal transport in magnetized plasmas.

J. Juul Rasmussen

Risø National Laboratory
Technical University of Denmark
Roskilde, Denmark.

Summer College on Plasma Physics: 30 July–24 August 2007, Abdus Salam ICTP (Trieste, Italy)

Turbulence spreading and nonlocal transport in magnetized plasmas

J. Juul Rasmussen[1], V. Naulin[1], P. Mantica[2], and JET-EFDA Contributors[b]

1 Association EURATOM- Risø National Laboratory, Technical University of Denmark, OPL-128, 4000 Roskilde, Denmark
2 Istituto di Fisica del Plasma, Euratom-ENEA-CNR Association, Milano, Italy

Models governing anomalous turbulent transport in magnetized plasmas are traditionally based on local linear stability properties together with mixing length arguments to determine the particle and heat fluxes. These models which only account for the local properties of the plasma and the dynamics have been rather successful in describing the stationary pressure profile in response to various heat and particle sources. However, they fail to describe more complex transport phenomena such as up-gradient transport and in particular transient transport events in response to local perturbations as, e.g., edge cooling.

We shall here consider an alternative approach, taking non-local effects into account, for modeling the anomalous transport. This model is based on the concept of turbulent spreading, i.e., the turbulence itself is transported and may spread into regions that are linearly stable [1].The fluxes of the thermodynamically variables are determined directly by the intensity of the turbulent fluctuations and even in the linearly stable regimes the transport may reach anomalous levels. The coupling of the turbulence spreading process with particle and heat transport has been demonstrated in [2], providing close to marginal global plasma profiles even in the presence of radially localized sources. Inward pinches and non-local transport behavior are natural features of this model.

The model is applied to the heat modulation and cold pulse propagation experiments in the JET tokamak [3]. For parameters that fit the heat modulation results we found a cold pulse propagation that is faster than obtained from standard transport models, but not as fast as observed experimentally.

[1] Z. Lin and T. S. Hahm, Phys. Plasmas **11**, 1099, 2004; Ö.D. Gürcan, P.H. Diamond and T.S. Hahm, Phys. Plasmas **14,** 055902, 2007.
[2] V. Naulin, A.H. Nielsen and J. Juul Rasmussen, Phys. Plasmas **12**, 122306, 2005
[3] P. Mantica et al., EX/P1-04, IAEA 2002; J. Juul Rasmussen et al., 33rd EPS Conf. on Plasma Phys. Rome, June 2006 ECA Vol.**30I**, P-1.076 (2006).

[b]Appendix of M.L.Watkins et al., Fusion Energy 2006 (Proc. 21st Int. Conf. Chengdu, 2006) IAEA, (2006)