Coupling of heat and momentum transport in JET

Harm Knoops[1], Peter de Vries[2], Carine Giroud[2] and Niek Lopes Cardozo[3]
1. Dept. of Applied Physics, Eindhoven University of Technology, P.O. Box 513, 5600 MB Eindhoven, The Netherlands
2. JET, Culham Science Centre, EURATOM/UKAEA Association, Abingdon, OX14 3DB, UK
3. FOM Instituut voor Plasmafysica Rijnhuizen, PO Box 1207, 3430 BE Nieuwegein, The Netherlands

The heat transport to the walls in a fusion reactor needs to be minimised for efficient power generation. Transport in the plasma is mainly turbulence driven. Plasma rotation may be able to reduce turbulence and is therefore desired. Theory of turbulent transport in Tokamak plasmas often states that there is a strong coupling between heat and momentum transport. In standard ELMy H-mode plasmas this turbulence is often attributed to ion temperature gradient (ITG) driven modes. In order to understand turbulent transport in Tokamak plasmas a better knowledge of momentum transport is important.

At JET a detailed research into the coupling of heat and momentum transport has been carried out. The ion temperature T_i profile and toroidal velocity V_ϕ profile have been compared through their gradients. They were measured by charge exchange radiation spectroscopy (CXRS). From these measurements the normalised gradient lengths ($R/L_{V\phi}$ and R/L_{Ti}) are calculated. A series of discharges with different levels of ITG turbulence were studied. With these plasmas it was investigated how the relation between $R/L_{V\phi}$ and R/L_{Ti} changes with increase in turbulence. It has been found that for low ITG turbulence $R/L_{V\phi}$ is lower than R/L_{Ti} and for high ITG turbulence $R/L_{V\phi}$ can still increase, contrary to the threshold found for R/L_{Ti}.

Heat and momentum diffusivities have also been compared. In ITG theory it is assumed that these are the same, but in this research it has been found that momentum diffusivity is lower than heat diffusivity. The ratio of momentum and heat diffusivity (Prandtl number) was found to decrease with increasing turbulence.