SESSION EX6

Thursday, 22 October 1998, at 4.10 p.m.
Chairman: U. Samm (Germany)

TRANSPORT AND DIVERTORS 2

Paper IAEA-CN-69/EX6/1 (presented by V.V. Parail)

DISCUSSION

I.H. HUTCHINSON: Concerning the edge barrier scaling, it is a pity that you do not have a measurement of the pedestal width itself, which you invoke to explain the results, because there seems to be a lot of poorly verified steps in the argument. My question relates to the function of shear f(s) that you use to express the presumed ballooning limit on pressure gradient. What function do you use for this and, if it is some simplified formula, why would you expect this to apply to a strongly shaped edge like JET, whose ballooning stability is likely to be strongly influenced by local shear variation, edge current density and related non-constant quantities?

V.V. PARAIL: In our analysis we use linear proportionality of $(\nabla P)_{crit}$ to magnetic shear s. Since the magnetic configuration was the same in the series of hot ion H-mode presented, the shear dependence does not play any role. Ballooning stability was indeed calculated carefully in discharges where direct measurements of the barrier width were available. This analysis confirms the idea of ballooning stability both qualitatively and quantitatively.

G.M. STAEBLER: The magnetic shear dependence in your model has the same effect as making the growth rate profile rise towards the edge. Have you examined whether other factors besides magnetic shear e.g. a/L_T, could fit the data as well?

V.V. PARAIL: We only used a simple expression for the growth rate. However, we know from many other experiments (with pure electron heating) that the internal transport barrier can be triggered by the negative magnetic shear alone. More work is definitely needed to clarify this point.

Paper IAEA-CN-69/EX6/2 (presented by R.S. Granetz)

DISCUSSION

R.J. GOLDSTON: What would we learn from a comparison of Alcator C-Mod and DIII-D data with respect to size scaling, β scaling and n_e scaling? It might give us an idea how one of the width parameters scales with R.

R.S. GRANETZ: Measurements in the H-mode edge with high-resolution diagnostics in DIII-D and C-Mod reveal that there is not just one pedestal! Different physical quantities (T_e, T_i, n_e, X-ray, etc.) can have different pedestal widths and, in some cases, different scalings. This complicates any direct comparison between the machines. In both tokamaks, one or more of the pedestal widths (p_e in DIII-D and X-ray ($\propto n_e n_z$) in C-Mod) scale in an inverse sense with plasma current, but not all parameters do (T_e in C-Mod). Both machines also have some pedestals that scale with β_p (p_e in DIII-D and T_e in C-Mod). Neither machine sees any dependence on toroidal field. DIII-D sees no effect of triangularity, whereas the X-ray pedestal width scales linearly with triangularity in C-Mod. Finally, both machines find that some pedestals are narrower in H-modes that have good particle confinement (ELM-free and type I ELMy) compared to H-modes with poor particle confinement (EDA and type III ELMy).

Paper IAEA-CN-69/EX6/3 (presented by J.S. Mao)

There was no discussion.

Paper IAEA-CN-69/EX6/4 (presented by R.D. Monk)

DISCUSSION

D.D. RYUTOV: Have you noticed any changes in the surface structure of the divertor plates after one experimental campaign?

R.D. MONK: Surface analysis of the divertor tiles in the Mark IIA divertor showed the presence of deuterium saturated (D/C > 0.4) at the inner divertor, which we think is responsible for the tritium retention.

M. KAUFMANN: An important contribution to the understanding of divertor physics has been obtained in JET, particularly with the closed divertor. Most of the results agree with observations on ASDEX Upgrade, but there are distinct differences. A detailed comparison is needed.

R.D. MONK: I quite agree.

Paper IAEA-CN-69/EX6/5 (presented by A. Sakasai)

DISCUSSION

M. von HELLERMANN: Have you made any attempt to study He exhaust during reversed shear operation with central He beam fuelling? What can you say about the role of gas puff from the plasma edge not penetrating the reversed shear transport barrier, gas puff timing and formation of the reversed shear transport barrier?

A. SAKASAI: We have not yet carried out an He exhaust experiment using He beam injection in reversed shear plasmas but plan to do so in future. When He gas puff was used as peripheral fuelling, helium particles penetrated the ITB. The helium density inside the ITB was actually higher than outside it, and its profile was peaked, similar to the electron density profile.

U. SAMM: The central He density with ITB is not reduced by pumping, whereas He at the edge is exhausted efficiently. Could it be that the central He is also exhausted, but a more transparent edge plasma for recycling the He leading to a higher fuelling efficiency compensates for this effect?

A. SAKASAI: Yes, it is possible, even though the edge He density is reduced. Our previous study without He pumping indicated that the central He density inside the ITB was increasing with time and the edge density reached a constant level using He gas puff with the strong ITB.

Paper IAEA-CN-69/EX6/6 (presented by S.L. Allen)

DISCUSSION

A. GROSMAN: Am I correct in my understanding that the D_2 flow is directed towards the plate for the outer leg and outwards for the inner leg? Is this related to the direction of the ExB drift?

S.L. ALLEN: The UEDGE results for an attached plasma show that the main ion flow (deuteron) is - primarily - towards the divertor plate at both the inner and outer strike points. The results also show that the flow patterns are complex and 2-D measurements are required for careful comparison of the physics in the model.

G. MATTHEWS: In the example given of a PDD discharge with good confinement, were the ELMs type I or III? Is there any evidence that in this regime the ELM heat pulses are dissipated before they reach the target?

S.L. ALLEN: The PDD discharge shown is a normal type I ELMing H-mode discharge. Some of the ELM heat pulse does reach the target and the profile is broadened. In “puff and pump” discharges with argon, preliminary analysis indicates a reduction in the ELM heat pulse (see paper IAEA-CN-69/EXP4/03 by M.R. Wade et al.).

P. GHENDRIH: You have demonstrated that carbon is the major radiating species in the low field divertor leg, and also that there is no net erosion or deposition of carbon on the downstream target plates. Where does the radiating carbon come from?

S.L. ALLEN: We have not measured net erosion at the outer strike point in PDD discharges - note, however, that uniform erosion and redeposition can result in no net erosion but a carbon source. Our next set of experiments will address the erosion/redeposition at the inner strike point with the DiMES probe. We will also complete a set of helium plasma experiments. Preliminary (L-mode) results show a 50 times reduction in the carbon emission, which would suggest that chemical sputtering is important.