NINETEENTH FUSION ENERGY CONFERENCE

SESSION EX/C2

Wednesday, 16 October 2002, at 10:40

Chair: C. CAMPBELL (EFDA)

SESSION EX/C2: H-mode & Transport Physics

Paper IAEA-CN94/EX/C2-1 (presented by O. Gruber)

Discussion

M. Shimada: Do you observe a window in pellet frequency where you can reduce ELM amplitude and maintain good H-mode confinement?

O. Gruber: For "natural" ELMs a strong inverse relation between ELM frequency and confinement time is observed. Increasing the ELM frequency by shallow pellet injection leads to a reduced expected ELM energy, and therefore benign divertor loads. The first attempt on ASDEX Upgrade with enhanced ELM frequency maintained good H-mode confinement, but we have to check if we can break, with pellet forced ELMs, the inverse relation over a wide frequency range.

J.G. Cordey: Have you obtained benign type II ELMs at the low collisionality regime in which ITER will be operated?

O. Gruber: The pedestal top collisionality of type II ELMs in ASDEX Upgrade is at $\nu^* \approx 1\pm0.5$, which is above the ITER collisionalities. However, densities close to the Greenwald density and collisionalities much below 1 can only be achieved in ITER itself. The increased edge bootstrap current at low ν^* leads to reduced edge magnetic shear which has then to be compensated by a higher shear from the magnetic configuration, i.e. more double-null-like, to keep the conditions for type II ELMS.

Paper IAEA-CN94/EX/C2-2 (presented by A. Isayama)

Discussion

X. Litaudon: How does the q-profile evolve in a JT-60 full current drive discharge? Does the q-profile evolve towards a reversed shear discharge due to the increase of the off-axis bootstrap?

A. Isayama: In the high $n\tau T$ discharge, NB is injected to a plasma with a flat q-profile ($q\sim2$ for $\rho\sim0.4$). After the NBI, q in the central region slowly decreases to 1.4. From t~6.1 s, the q-profile is almost unchanged, as indicated by l_i^{MSE}. In the whole phase, the q-profile is flat with weak positive shear, and does not show reversed shear in either experiment or simulation.

Paper IAEA-CN94/EX/C2-3 (presented by R.J. Groebner)

Discussion

K. Lackner: You concentrated on the relative widths of the temperature and the density pedestal. Did you look for any universality in the relative gradient length, i.e. $\eta_e = L_n/L_{Te}$?

R.J. Groebner: We have not yet examined η_e. That is a very good idea and I expect that we will undertake this study.

M.C. Zarnstorff: Your model should be sensitive to the neutral isotopic mass and to the difference between hydrogen (or deuterium) and helium through the atomic physics. Do you see this effect in the data?

R.J. Groebner: Yes. In fact, we did a pedestal similarity experiment by matching the dimensionless ion parameters in H and D plasmas. The width of the density step was larger in the H plasma than in the D plasma, as expected from the model. However, the evidence was not convincing to my colleagues and therefore I did not present it. It looked to some people as though the density profiles were simply shifted due to an error in separatrix location This situation underscores the difficulties in edge studies due to the fact that widths often approach the uncertainties in our ability to locate the separatrix and the resolution of our Thomson system.

N. Oyama: Did you analyse the pedestal width in the ELMy phase?

R.J. Groebner: We did. However, we eliminated data which were very near the ELMs. An ELM flattens the density profile and dramatically changes the width. The characteristic width of the pedestal is quickly re-established after an ELM.

Paper IAEA-CN94/EX/C2-5 (presented by R. Maingi)

Discussion

K. Ida: Is the in–out asymmetry of the pedestal density an indication of the compression of poloidal flow in the plasma with a strong toroidal effect? How is the asymmetry of the pedestal density related to the in–out asymmetry of toroidal flow, which compensates the compression effect?

R. Maingi: We have recently confirmed the in–out asymmetry and are just now looking at causality. Indeed the effect mentioned is a plausible one. Unfortunately we have v_{tor} measurements only on the outboard side and will be unable to confirm this effect with the present diagnostics.

Paper IAEA-CN94/EX/C2-6 (presented by P.G. Carolan)

Discussion

P. Thomas: We heard in paper OV/2-3 that an error field is implicated in the locked mode behaviour in MAST. Could this error field be affecting the H-mode threshold scaling?

P.G. Carolan: We believe that error fields are low in MAST and in fact mode locking is primarily an issue only at low density. Although the H-mode threshold power in MAST lies slightly above international scalings, the absolute power requirements are very modest and in fact, with optimised fuelling and magnetic configuration, transition to H-mode is assured even in ohmically heated plasmas. Therefore we do not believe that error fields are playing a significant role in H-mode access.

R.J. Hawryluk: Have you obtained H-mode discharges in the single null configuration?

P.G. Carolan: So far we have only observed H-modes in connected DND configurations but have not made significant efforts to develop an SND H-mode scenario.

R.J. Hawryluk: What is the improvement in energy confinement going from L-mode to H-mode?

P.G. Carolan: In the cases described in the talk, we were at the L–H transition to see more clearly the physics involved, so the improvements were relatively small, of the order of 10%. However, H-modes are obtained in MAST that increase in confinement time by a factor of about 2 over L-mode, as reported in Akers, R.J., et al., Phys. Rev. Lett. **88** (2002) 035002.

R.D. Hill: STs such as MAST and NSTX not only differ from present tokamaks in aspect ratio but also in degree of openness of the divertor. Neutral effects may in fact be as important as aspect ratio in producing new results. How can these effects be separated?

P.G. Carolan: Edge neutral behaviour is similar in MAST to that in conventional tokamaks and the different response to inboard and outboard gas refuelling indicates that the divertor is not dominating the neutral influx. This is not to say that there may not be other important effects from the open divertor such as in edge density gradients and radial electric fields.

F.C. Schüller: You found a coincidence between an ITB and a strong gradient in toroidal velocity. Do you think this means a relation between heat and momentum diffusivity or that velocity shear is instrumental in obtaining an ITB?

P.G. Carolan: We believe the toroidal shear is a strong signature for obtaining an ITB and is probably associated with micro-instability suppression. However, we have not completed transport analyses investigating thermal and momentum transport at this stage.