NINETEENTH FUSION ENERGY CONFERENCE

SESSION EX/D1 & TH/3

Thursday, 17 October 2002, at 10:40

Chair: T. THOMAS (France)

SESSION EX/D1 & TH/3: Edge and Divertor

Paper IAEA-CN94/EX/D1-1 (presented by G.F. Matthews)

Discussion

D.D. Ryutov: In the regimes where the heat flux is supposedly steady state, do you see any signs of short bursts of the heat flux (possibly localized toroidally and radially), as predicted by some transport models? If such bursts are present, how would they affect your conclusions regarding the tolerable heat flux?

G.F. Matthews: Our analysis indicates that in moderately collisional plasmas ($\nu^*_{in} > 10$) radial transport is dominated by classical ion conduction, which reduces to ion orbit loss in the collisionless regime. Hence at low collisionality the power deposition width is related to the poloidal ion gyroradius, which is the characteristic length of orbit loss As collisionality increases, this orbit loss footprint is broadened according to ion diffusion. This applies to the dominant power carrying layer just outside the separatrix. Further out in the SOL, turbulent transport may again become important.

Paper IAEA-CN94/EX/D1-2 (presented by G.F. Counsell)

Discussion

K.H. Burrell: I was interested in the profiles of edge density and temperature in H-mode from Thomson scattering. There is no obvious edge temperature pedestal in these data even though the edge density pedestal is obvious. Is the T_e pedestal width much broader than the density width, so the inner edge of the T_e pedestal is off the edge of the plot, or is there no edge T_e pedestal at all?

G.F. Counsell: The apparent absence of a temperature pedestal on the outboard mid-plane Thomson scattering data during H-mode is only a consequence of diagnostic sensitivity in the region of low density (where there is a reduced signal to noise ratio). The Thomson scattering data from the more sensitive inboard channels show both clear density and temperature pedestals, which typically have a similar width. For a range of H-mode conditions, T^e_{ped} lies in the range 80–200 eV (around 10% of the axial value) and n^e_{ped} lies in the range $(2–5)\times 10^{19}$ m^{-3} (roughly equal to the axial value).

Paper IAEA-CN94/EX/D1-4 (presented by V. Rohde)

Discussion

A.S. Kukushkin: In view of the presentations given here from different experiments on the existence of a non-diffusive plasma transport in the edge, it would be most interesting to have the tungsten coating around the outer mid-plane. Is this possible?

V. Rohde: Due to the ICRH antenna and the diagnostic and heating ports at the outer mid-plane of ASDEX Upgrade, this is not possible. Tungsten erosion measurements using probes on the mid-plane manipulator at this position have begun.

R.J. Hawryluk: Was boronization used as a wall conditioning technique? If so, does boronization contribute to the low tungsten concentration and what are the implications for long pulse operation on ITER?

V. Rohde: Boronization or siliconization is routinely used to reduce the oxygen content of ASDEX Upgrade. This is not connected to the low tungsten concentration for two reasons: (1) detailed investigations were done without wall conditioning; (2) post-mortem tile analysis indicates that half of the tungsten tiles are erosion dominated, i.e. show clean tungsten surfaces even after a campaign. Implications for ITER: The erosion rate should be lower than those measured by probe in ASDEX Upgrade, because these are dominated by erosion during ramp-up/ramp-down. As the core tungsten concentration mostly depends on the transport, calculations with expected profiles are necessary. First estimates indicate the possibility to use tungsten in ITER.

Paper IAEA-CN94/EX/D1-5 (presented by R. Mitteau)

Discussion

D.D. Ryutov: You have presented convincing arguments that the SOL width is ~5 mm, compatible with the observed "snakeskin" structure and magnetic ripple amplitude of 1 cm. On the other hand, Dr. Jacquinot has indicated that the heat transport in the Tore Supra edge is caused by avalanches whose radial extent is ~8 cm. This would have produced a more or less uniform heating of the limiter (no "snakeskin"). Could you please comment on that.

R. Mitteau: It is correct that an 8 cm e-folding length would render the heat flux pattern on the toridal limiter almost uniform. The 8 cm length cited by J. Jacquinot in his overview talk OV/1-2 is, however, the radial extension of some avalanche events, localized both in time and spatially. Even more precisely, it is the size of the box used for the calculation. This transport mechanism dominates classical diffusion, but the resulting e-folding length is smaller. It can be found as small as 2.5 mm (Ghendrih, TH/P2-14). Experimental observations on the limiter are at 5 mm so that theoretical evaluations are only a factor of 2 from the measurement. The reality is actually even more complex as we have other independent measurements both on the limiter and at different poloidal locations. The complete series is as follows: IR thermography, filling the gap between the two main interaction areas: 1 mm; visible light from recycling at the surface and measurement of the distance of the interaction areas: 5 mm; calorimetry of independent limiter modules: 10 mm; fast moving Langmuir probe on the opposite side: 20 mm; calorimetry of outboard limiter: 30 mm. The reality is much more complicated than the usual simple scrape-off layer modeling. This theme is currently under investigation at Tore Supra.