NINETEENTH FUSION ENERGY CONFERENCE

SESSION EX/C4

Friday, 18 October 2002, at 11:00

Chair: M. PORKOLAB (USA)

SESSION EX/C4: Transport in Toroidal Systems

Paper IAEA-CN94/EX/C4-1Ra+b (presented by G.R. McKee)

Discussion

K. Ida: How do the zonal flow and fluctuations change at the transition from L to H mode or H to L mode? What is the timescale of changes in flow and fluctuations?

G.R. McKee: We have not made measurements in H-mode as measurement of the turbulence flow field becomes difficult or impossible due to the suppression of turbulence in H-mode. We would like to measure zonal flow activity leading up to an L–H transition, but the inherent noise level in the measurements may prevent our attaining the high time resolution required. We will attempt this nonetheless.

Paper IAEA-CN94/EX/C4-2Ra+b (presented by F. Ryter)

Discussion

F.C. Schüller: In your analysis you described electron transport solely by heat diffusivity. Have you seen signs of convective transport? Are there good reasons to ignore the convective contribution to heat transport?

F. Ryter: In the experiments I presented here we see no sign of convection. In other experiments at lower current and therefore lower ohmic power, with off-axis ECH we might require some convection to explain the power balance results. However, the value of this convection remains low, at about 2 m/s, which is in agreement with the expectation for off-diagonal terms in the frame of ITG/TEM physics. The existence of convection remains to be assessed, however.

Paper IAEA-CN94/EX/C4-3 (presented by T. Minami)

Discussion

T.S. Hahm: Does the location of the neoclassical internal transport barrier (N-ITB) where the E×B shearing rate is high also correspond to the radial location where the plasma changes from the electron root state at the core to the ion root state towards the edge?

T. Minami: Yes, the location where the plasma changes from the ion root to the electron root almost corresponds to the location where the E×B shearing rate is high, which is derived from the ambipolar condition. The detailed result is described in my paper.

Paper IAEA-CN94/EX/C4-4 (presented by C. Hidalgo)

Discussion

K. Ida: Parallel flow is linked to the perpendicular flow to conserve the flow (div v = 0). Does the flow observed in the shear regime satisfy the flow conservation, when both parallel and perpendicular flows are generated by instability?

C. Hidalgo: Parallel and perpendicular flows must be linked to conserve the flow, as you have pointed out. However, it is less obvious to understand why both flows organized themselves near marginal stability. The present experimental results suggest that both parallel and perpendicular flows are linked near marginal stability via turbulent transport mechanisms.

Tendler: Do you have any evidence for the interplay between turbulent fluxes and curvatures of the profile?

C. Hidalgo: Our present goal is to investigate the dynamical relation between gradients, flows and transport. With the present experimental set-up it is very difficult to reach any conclusion about the role of curvature of the profile and its possible dynamical coupling with transport.

B. Coppi: To the extent that the parallel flows that you observed can be related to the spontaneous toroidal rotation phenomenon observed in tokamaks, there is a natural explanation for the saturation level of $v_{\|}/dr \sim c_s/L_n$ you mentioned. According to the "accretion theory", the angular momentum is carried inward by ion temperature gradient driven modes and this kind of condition comes out both from the relevant dispersion relation and quasi-linear theory. Spontaneous rotation (involving parallel flows) is observed in Alcator C-Mod, Tore Supra and JET.

Paper IAEA-CN94/EX/C4-5Ra+b (presented by H. Yamada)

Discussion

R.J. Goldston: Certain of your results seem to be very common with tokamaks, e.g. the electron internal transport barrier, but other parts are quite different, e.g. the lack of profile resilience. Are there aspects of the theory of microturbulence that could explain this?

H. Yamada: It is a challenging issue from the theoretical point of view. We have started studies in that direction. One of them is, as you know, the collaboration with PPPL concerning ITG/TEM. At this moment, we do not have a systematic picture. We should look into this issue intensively.

Yu.N. Dnestrovskij: Your conclusion on the absence of profile resilience concerns the electron temperature profile. But in your case the density profile is hollow and the product of density and temperature can be stiff. What is the matter?

H. Yamada: Yes, we are aware of that trend. However, the change of the density profile does not compensate the change of the electron temperature profile completely. The pressure profile also changes along with the heat deposition profile.

**Paper IAEA-CN94/EX/C4-6 (presented by D.L. Browe
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Discussion

F.C. Schüller: With PPCD you reduce fluctuations and get very good results. Now in the introduction you said that fluctuations give you the dynamo effect for field reversal. Suppressing fluctuations might help to improve confinement, but will it not on a longer timescale kill your field reversal?

D.L. Brower: For the high-confinement PPCD plasmas, magnetic fluctuations are suppressed and field reversal is maintained by externally driving inductive parallel current in the plasma edge. The MST group has an ambitious program going forward to extend the high-confinement period by employing non-inductive CW techniques such as lower hybrid current drive (LHCD), electron Bernstein wave current drive (EBW) and oscillating-field current drive (OFCD).

B. Coppi: What is the ratio of the resistive diffusion time to the Alfvén transit time for MST plasmas?

D.L. Brower: The ratio is approximately 3×10^6 for high-temperature MST plasmas.

B. Coppi: How is improved performance through reaching a single helicity state consistent with high-performance PPCD plasmas in MST?

D.L. Brower: The two approaches to improved confinement that you mention are independent. The first approach seeks a plasma state where all the MHD modes condense to a single mode, thereby eliminating the stochastic magnetic fields and poor confinement. The second approach seeks to improve performance by modifying the current density distribution to suppress all the modes.