NINETEENTH FUSION ENERGY CONFERENCE

SESSION EX/S2 & TH/5

Friday, 18 October 2002, at 14:20

Chair: G. NAVRATIL (USA)

SESSION EX/S2 & TH/5: Resistive Wall Modes and Disruptions

Paper IAEA-CN94/EX/S2-1 (presented by E.J. Strait)

Discussion

M. Kikuchi: It is wonderful to hear about the sustainment of $\beta_N > 4$ with toroidal rotation. However, it is difficult to expect large toroidal rotation in a fusion reactor. What is the key issue to demonstrate the real feedback stabilization in DIII-D?

E.J. Strait: So far, the strong rotation induced by neutral beam injection has made it difficult to separate the effects of feedback and rotation in DIII-D. Therefore, a quantitative validation of models for feedback stabilization remains to be done. Two key issues here are the development of detailed models including both feedback and rotation (now in progress, see, for example, paper TH/P3-10 by M.S. Chu, this conference), and experiments in plasmas with reduced rotation, which we hope to do by using a larger proportion of RF heating.

O. Sauter: In the high β_N case you showed, did the 2/1 NTM appear because of the evolution of the current profile towards a 2/1 Δ' unstable case? If so, do you think you can modify the current profile to avoid the 2/1 onset?

E.J. Strait: In this case, the onset of the 2/1 NTM was probably a result of the evolution of the current profile, with slowly decreasing central q. In the future we hope to be able to avoid such instabilities through electron cyclotron current drive, either by control of the current profile or by direct suppression with current drive at the island location (as described by R. La Haye, paper EX/S1-3, this conference).

Paper IAEA-CN94/EX/S2-2 (presented by S.A. Sabbagh)

Discussion

J.A. Snipes: Why are coils outside the vessel more effective than coils inside the vessel at stabilizing modes? It should be the other way around.

S.A. Sabbagh: You are correct. The slide presented shows that the active feedback system design with control coils inside the vacuum vessel can reach $\beta_N = 0.94\beta_{Nwall.}$ However, the design with control coils outside the vacuum vessel can only sustain $\beta_N = 0.72\beta_{Nwall}$ (here, β_{Nwall} is the ideal N = 1 β_N limit with a wall modelling the NSTX conducting structure).

Paper IAEA-CN94/EX/S2-3 (presented by N.V. Ivanov)

Discussion

R.J. Goldston: Could you describe in more detail how you coupled currents into the SOL of the plasma?

N.V. Ivanov: The rail limiter was used as the electrode to introduce the halo current into the plasma. The current distribution depended on the distribution of the SOL plasma conductivity. We did not observe any disruptions from the limiter to the vacuum vessel wall.

Paper IAEA-CN94/EX/S2-4 (presented by D.G. Whyte)

Discussion

Y. Nakamura: In the forced disruption by massive gas injection, are there any particular physics reasons why the disrupting plasma remains well centred in the vessel?

D.G. Whyte: Massive gas injection provides a proper highly resisting plasma which decays quickly before the plasma moves further into the wall. Simulations suggest that the vertical instability growth rate is kept small by the rapid cooling of the central plasma.

E. Joffrin: How do you quantify and qualify the machine conditions after an event such as a jet pulse of Ar, He or Ne?

D.G. Whyte: UV spectroscopy in the breakdown of the subsequent discharge reveals no sign of injected gas desorbing from the walls, and the intrinsic carbon radiation is at a normal level. In fact high-performance discharges have been obtained immediately after gas jet injection.

F.W. Perkins: The picture you presented us is axisymmetric. Are there experimental observations that assure the absence of deviations from symmetry? I would guess that MHD instabilities would develop during the VDE stage as the bounding plasma surface passed through $q \approx 2$.

D.G. Whyte: Yes, we see the toroidal asymmetry of the halo currents as an indicator of this process. In natural VDEs we see a peaking factor of 2, indicating a substantial kink. With gas jet mitigation, the asymmetries disappear from halo currents, indicating a more axisymmetric termination.

Paper IAEA-CN94/TH/5-2 (presented by Y. Ishii)

Discussion

J.D. Callen: Apparently you are using a cylindrical model with only modes of the same helicity. Have you considered multiple helicity effects on your model and computations?

Y. Ishii: We have confirmed the current point formation and the nonlinear destabilization of the double tearing mode under a stochastic magnetic field by multihelicity simulations in toroidal geometry.

E. Joffrin: You are not including the plasma flow in your analysis. What do you think would be the consequences of plasma flow, which is present in reversed shear discharges?

Y. Ishii: Shear flow may affect the linear stability of the mode, but once the magnetic islands grow to overlap each other, we can expect the same nonlinear destabilization process. However, we should perform a simulation to confirm this process.