SESSION TH2

Thursday, 22 October 1998, at 10.55 a.m.

Chairman: P.K. Kaw (India)

THEORY 2

Paper IAEA-CN-69/TH2/1 (presented by S. Murakami)

DISCUSSION

J.D. CALLEN: You apparently use a quasilinear ECH operator which assumes a random phasing of resonant interactions between a particle and the ECH wave. Is such an approximation valid, or are the resonant trapped electrons in resonance over their complete bounce motion?

S. MURAKAMI: We use a quasilinear term assuming a Maxwellian distribution, so such effects are not included in our calculation.

C. ALEJALDRE: In the calculations of the power deposition profile using ray-tracing, did you assume a Maxwellian or non-Maxwellian electron distribution function?

S. MURAKAMI: We assumed a Maxwellian distribution in the ray-tracing calculation and do not think that the non-Maxwellian effect on the ray-tracing is very large in the results presented here.

Papers IAEA-CN-69/THP1/03 and 04 (rapporteured by M. Wakatani)
DISCUSSION

W.A. COOPER: In reversed shear tokamaks, the flux surface averaged parallel current density $< j \cdot B / B^2 >$ emerges as a strong stabilizing influence for ideal ballooning modes. What influence does this parameter have on the resistive interchange criterion in reversed shear tokamaks?

M. WAKATANI: When $q_{(0)}$ is increased for a fixed $q_{(a)}$, the current density decreases. From this point of view, $< J \cdot 1B/B^2 >$ also has a stabilizing effect on the resistive interchange mode. We have not, however, checked this quantitatively.

Y. NAGAYAMA: In your simulation of the sawtooth crash, cold plasmas merge at the centre. What mechanism drives this merging? Is the kink flow like the cold bubble model for tokamak sawteeth?

M. WAKATANI: For the merging of cold plasmas, the flow driven by the ideal interchange mode is important. From this point of view, our model is similar to Wesson's model for the sawtooth.

X. GARBET: With reference to internal disruptions in a stellarator, is the final state identical to the initial state? Is the reconnection complete?

M. WAKATANI: Yes, the final state is almost identical to the initial state if we look at the pressure gradient at the q = 2 surface. The point at which the post-cursor m = 2 oscillation remains is different from the tokamak sawtooth.

Paper IAEA-CN-69/TH2/3 (presented by F. Zonca)

DISCUSSION

R.M. NAZIKIAN: Have you looked at a TAE stable ITER profile and concluded whether it is unstable to the EPM?

F. ZONCA: We have done the analysis in the case of a "circular equivalent" of a real ITER equilibrium and have concluded that the central energetic particle β is roughly a factor of 2 below the EPM excitation threshold. The same analysis for "shaped" ITER equilibria remains to be done.

M. YAGI: What is the essential difference between the kinetic Alfvén wave (KAW) and the AITG?

F. ZONCA: KAW and AITG are two different branches of the shear Alfvén wave. In the case of what is commonly meant by KAW, frequency is high with respect to both ω_{*pi} and ω_{ti}. Thus, the destabilization mechanism - which is very efficient for AITG - is essentially ineffective for KAW. A second, crucial difference is that KAWs usually do not form eigenmodes (except near the plasma centre), whereas AITG are true plasma eigenmodes destabilized by the free energy source of the thermal plasma.

Paper IAEA-CN-69/TH2/4 (presented by B.N. Breizman)

DISCUSSION

A. JAUN: Concerning the splitting of Alfvén eigenmodes, are you not surprised that a phenomenon relying on the subtle balance between drive and damping can be observed experimentally for several seconds?

B.N. BREIZMAN: There are two reasons why this is not very surprising. Firstly, the drive and the damping do not have to be exactly balanced for the effect to be seen. We can easily allow the system to be 20-30% above the threshold. Secondly, both the drive and the effective collision frequency of the resonant particles are controlled by the same knob, which is the ICRF power.

G.Y. FU: With regard to pitchfork splitting, what are the free parameters in getting good agreement with experiments?

B.N. BREIZMAN: The parameters we use are the growth rate γ and the collisionality of the energetic particles. I would not call them free parameters, since they can be determined independently. This can, in fact, be a good consistency check for the theory.

G.Y. FU: Can this theory explain why pitchfork splitting is not observed in many cases?

B.N. BREIZMAN: The splitting is controlled by the ratio γ/υ_{eff}. The theory says that there should be no splitting when γ/υ_{eff} is smaller than 0.5, which may well be the case in many experiments.

N.N. GORELENKOV: Have you considered the possibility of explaining the pitchfork effect by including the interaction of TAE and KTAE?

B.N. BREIZMAN: Yes, we considered such a scenario; it does not work.

Ya.I. KOLESNICHENKO: Your basic non-linear equation does not take into account the spatial dependence of wave amplitudes. Does this mean that you believe that the radial structure of TAE modes has no influence on the non-linear stage of the instability?

B.N. BREIZMAN: The non-linear equation <u>does</u>, in fact, take into account the spatial structure of the mode, but we do indeed assume that the mode structure does not change in time. This assumption can be easily justified in the near-threshold regime for both the linear and the non-linear stages of the instability.

Paper IAEA-CN-69/TH2/5 (presented by A. Sen)

DISCUSSION

E. LAZZARO: In your evaluation of the ECRH induced self-consistent bootstrap term, you have effectively modified the shape of the island by inclusion of an x^3 term. To assess properly the relevance of the bootstrap stabilizing term in comparison with the usual heating term, one should recalculate all the non-linear averages leading to the Rutherford type equation for the island growth on the modified flux surfaces. Has this been done? Also, have you considered that an unflattened pressure profile within the island would require reassessment of the "seed island" width?

A. SEN: We have calculated the effect of asymmetry only on the new self-consistent bootstrap current term, since the contribution from this term vanishes in the absence of asymmetry. The effect of asymmetry on the conventional terms is likely to change the numerical coefficients somewhat and has not been included in our present calculation.

H. ZOHM: One of the advantages of ECCD is that it is simple to change the radial location of absorption. In your poloidally injected NBI scheme, how can you vary the radial location in case the resonant surface moves or is at a different location (e.g. at different q)?

A. SEN: In principle, the radial location can be changed by altering the angle of incidence of the neutral beam. However, the practical details and the need to do so would have to be worked out for a given experimental situation.