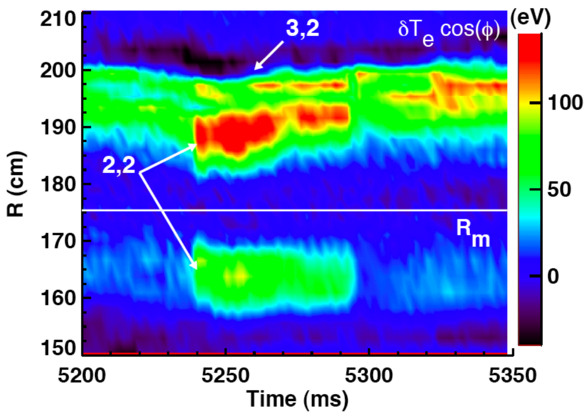
Structure and Role of Neoclassical Tearing Modes in Hybrid Plasmas*

R. Nazikian[1], M.E. Austin[2] M.S. Chu[3], W.W. Heidbrink[4], C.C. Petty[3],
P.A. Politzer[3], and M.A. Van Zeeland[3]

[1]*Princeton Plasmas Physics Laboratory, Princeton, New Jersey, USA*
[2]*University of Texas-Austin, Austin, Texas, USA*
[3]*General Atomics, San Diego, California, USA*
[4]*University of California-Irvine, Irvine, California, USA*

The role of neoclassical tearing modes (NTMs) has been central to the discussion of core current density sustainment and sawtooth suppression in Hybrid plasmas.[1,2] A leading hypothesis is that the m/n=3/2 NTM drives counter-current near q=1 by the radiation of kinetic Alfvén waves (KAWs). Central to this proposed mechanism is the presence of a significant m=2 sideband to the 3/2 resistive tearing mode that radiates m=2 KAWs with $k_{||} << 1/qR$ in the plasma core. This paper presents a more definitive identification of an m=2 sideband to the 3/2 NTM. The data, based on electron cyclotron emission (ECE) measurements, indicates that the strength of the m=2 sideband is typically of the order of the m=3 mode amplitude for $q_{min}>1$ and then increases rapidly just before the onset of sawteeth (figure). Radial ECE measurements will be compared to resistive tearing modes from PEST3 analysis and calculations will be provided on the expected current drive based on the observed eigenmodes. Experiments in DIII-D have also examined whether a redistribution of beam ions by the 3/2 NTM can explain the suppression of sawteeth. Analysis of fast ion measurements using the Doppler shifted D_α line (the FIDA diagnostic) will be compared with beam ion orbit simulations using the ORBIT code based on the measured radial mode structure in order to assess the impact of NTMs on the central beam driven current.



ECE measurements of temperature perturbations in a hybrid plasma (#126182) indicating the presence of a 3/2 island together with the transient appearance of a strong 2/2 sideband just before the onset of sawteeth (at 5420 ms). R_m is the magnetic axis location and R is the major radius.

[1] P.A. Politzer, et al., 32nd EPS Conf. on Plasma Phys., Taragona, 2005 ECA Vol 29C, O-1.001 (2005).
[2] M.S. Chu, et al., IAEA Fusion Energy Conf., Chengdu, China (2006) Paper EX/1-5.

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