

CRITICAL ISSUES FOR UNDERSTANDING AND CONTROL OF THE RWM IN AN ST

Gerald Navratil



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RWM STABILIZATION PHYSICS ISSUES

- DIII-D EXPERIMENTS CLEARLY SHOW RWM STABILIZATION DUE TO ROTATING PLASMA & MODE INTERACTION - NOT SLOW ROTATION OF THE MODE DRAGGED THROUGH THE RESISTIVE WALL. WHAT IS THE DISSIPATION MECHANISM FOR RWM IN ROTATING PLASMA THAT LEADS TO STABILIZATION?

LEADING CANDIDATE IS WARD&BONDESON SOUND WAVE DAMPING MODEL WHICH IS LARGEST AT LOW ORDER RATIONAL q SURFACES: ST q -PROFILE DIFFERS SUBSTANTIALLY FROM AT SO MEASUREMENT OF LOCAL MOMENTUM TRANSFER OF PLASMA TO MODE IN NSTX MAY PROVIDE IMPORTANT NEW INFORMATION ON ROTATION STABILIZATION PHYSICS.

- IDENTIFICATION OF THE RWM STABILIZATION PROCESS IN ROTATING PLASMA WILL PREDICT THE SCALING OF THE THRESHOLD Ω_{CRIT} FOR ROTATIONAL STABILIZATION?

IN DIII-D THIS IS SEEN TO BE 2-3% OF THE TOROIDAL ALFVÉN SPEED OR ~ 6 KHZ:

$$\Omega_{\text{CRIT}} \sim 3.8 B(\text{T}) / [\sqrt{n(10^{20} \text{ m}^{-3})} R(\text{m})] \text{ KHZ}$$

FOR NSTX [$R \sim 1$ m; $B = 0.3$ TO 0.6 T; $n \sim 0.3$]: $\Omega_{\text{CRIT}} = 2$ TO 4 KHZ

UNDERSTANDING THE STABILIZATION THRESHOLD AND SCALING IN AN ST WILL PROVIDE CRITICAL NEW INFORMATION.

RWM ACTIVE CONTROL ISSUES

- DIII-D EXPERIMENTS ON ACTIVE MODE CONTROL SHOW IMPORTANT ROLE OF “AMPLIFICATION” OF THE RESONANT COMPONENTS OF THE ERROR FIELD BY THE RWM ABOVE THE NO-WALL BETA LIMIT IN A ROTATING PLASMA IN SLOWING DOWN OF PLASMA TOROIDAL ROTATION. SUPPRESSION OF RWM “AMPLIFIED” RESONANT FIELD BY ACTIVE FEEDBACK IDENTIFIED AND SUPPRESSED THE CRITICAL COMPONENTS OF THE ERROR FIELD [**NOT ALL COMPONENTS - ONLY THE RESONANT COMPONENTS**]
 - VALEN MODELING AND ANALYTIC THEORY OF RWM ACTIVE CONTROL SHOW OPTIMAL CONTROL CONFIGURATION HAS MINIMAL COUPLING TO THE PASSIVE STABILIZER AND MAXIMAL COUPLING TO THE PLASMA.
- NSTX HAS THE OPPORTUNITY TO BE THE FIRST POP CLASS DEVICE TO USE THE MIDPLANE GAP IN THE STABILIZER TO INSTALL SUCH AN ADVANCED FEEDBACK CONTROL SYSTEM.**
- SUPPRESSION OF RESIDUAL RESONANT ERROR FIELDS TO HELP MAINTAIN ROTATION ABOVE STABILIZATION THRESHOLDS AND ACTIVE FEEDBACK CONTROL CAN BE ACHIEVED WITH A SINGLE CONTROL COIL SET. THE HIGH FREQUENCY RESPONSE OF THE SYSTEM ALLOWS STABILIZATION UP TO THE IDEAL WALL BETA LIMIT W/O ROTATION AND IN COMBINATION WITH ROTATION STABILIZATION & RESONANT ERROR FIELD SUPPRESSION PROVIDES MAXIMUM FLEXIBILITY AND ROBUST CONTROL.

