NSTX

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T&T TSG Suggestions For LLD Exploration XP

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PPPL

NSTX Transport & Turbulence TSG

January 8, 2010

v0

Tier 1, 2, and ITER-related proposed XPs

TT1	S. Kaye	Impact of rotation on turbulence and energy and momentum transport
TT7	D. Smith	Investigation of low-k fluctuations as a source of anomalous momentum transport
TT26	W. Solomon	Determination of NTV offset rotation on NSTX
TT4	D. Battaglia	L-H power threshold for D and He plasmas using RF current drive w/symmetric phasing
TT14	S. Zweben	Ultra-high Speed GPI Measurements of the L-H transition with RF Heating
TT15	Y. Ren	Study of the Parametric Dependence of High-k Turbulence
TT8	D. Smith	Investigation of multi-scale turbulence
TT12	S. Kubota	Survey of Low-, Intermediate-, and High-kr turbulence, Simultaenously and Everywhr
TT13	S. Kubota	Ohmic H-Mode
TT11	K.C. Lee	Reynolds Number Measurement on H-mode Transition
TT18	H. Yuh	Sustained ITBs and H-Mode ITBs
TT21	R. Bell	Joint NSTX DIII-D poloidal rotation experiment
TT25	W. Solomon	Characterization of intrinsic torque using torque transients
TT10	K. Tritz	Investigation of *AE induced electron transport
TT6	D. Smith	Investigation of ETG turbulence isotropy
TT2	S. Kaye	Density dependence of L-H threshold
TT17	R. Maingi	Dependence of PLH on Radius_triangularity of the X-point
TT9	D. Smith	Survey of low-k fluctuations in NSTX
TT5	D. Battaglia	L-H power threshold versus lithium deposition and LLD temperature
TT16	E. Mazzucato	The spectrum of short scale turbulent fluctuations in NSTX

How can T&T XPs benefit from an initial survey between cold and warm LLD ops?

Present ACS Proposed Shot List: Rev. 0 (from S. Gerhardt)

- Start with “warm” LLD, shape chosen as indicated before, run in priority order.
  - Load I_P=700 kA, B_T=0.48, P_{inj}=4MW (7 shots)
    - Repeat, raising/lower power to pin approximate β-limit
    - Be sure to ramp down I_P.
  - Change to B_T=0.4 (I_P=700 kA), P_{inj}=4MW. (7 shots)
    - Repeat, raising/lower power to pin approximate β-limit
    - Optimize power & gas waveforms for long pulse.
  - Change to I_P=1100 kA (B_T=0.4), P_{inj}=4MW. (7 shots)
    - Repeat, raising/lower power to pin approximate β-limit
    - May need to reduce I_P given the lower elongation and (potentially) triangularity.
  - Change to I_P=1100 kA (B_T=0.48), P_{inj}=4MW. (7 shots)
- Braking/RMP pulses could be added to select cases.
  - or NB pulses to probe modifications of ideal stability.
- Repeat each (some) scenario(s) with a cold LLD.
  - In each case, repeat with 4MW power, then an additional shot matching the approximate β-evolution of the warm-LLD case (more or less power)

Shot counts could be wildly off pending difficulty of LLD operations.

Macro TSG requests (From S. Sabbagh)

- Targets / control use
  - Reduced ν^* H-mode target over a large range of plasma current (3 - 4 shots)
    - ASC shot list has plan for high κ, I_p scan, including low l_i target – should suffice, need to specify (coordinate) what strikepoint configuration(s) to use – all high delta should be ok for Macro XPs
  - Full range of NBI power in H-mode targets at low and high ν^* (2 - 3 shots)
    - ASC shot list has cold/warm LLD and power scan – more specific definition of the actual shots to take should be made as a group
    - Suggestion is to choose two configurations yielding large range of ν^*, and have 3 NBI source scan for each (6 shots). One purpose of NBI source scan is to produce NTM (ramp n = 1 field?)
  - Run with n = 3 braking (1 - 2 "long pulse" shots; low/high ν^* comparison shots (2))
    - Can re-run XP933 shot 133743 for comparison, or add to any new H-mode target. Use long pulse to allow different n = 3 braking steps, reaching steady-state V_ϕ. (part of ASC shot list)
    - Run in high/low ν^* comparison shots; Run at least one shot down to very low rotation to reproduce superbanana plateau regime conditions (as done in CY 2009)
  - Run RWM control, B_p sensors and CY2009 settings to compare (2+ shots)
    - Can be added to any shot, but best done for boundary configuration close to CY2009 fiducial, now with LLD – cover both high and low ν^*, and low l_i. (easily added to ASC shot list)
    - One of these shots should include a condition spun down to low rotation (see "braking" above)
  - Run RWM control with B_p and B_r sensors (~ 2 shots)
    - Can be added to any shot, but suggest a limited number; use settings from 128487
  - Reduced q_{95} target as starting point for ELM stability, other studies (3+ shots)
    - Can use XP818 reduced q_{95} ELMing target 127889 (or later equivalent). If allowed, run LSN and USN variants.
    - Looking for an ELMing case, may need to run off a cold LLD and/or use USN variant

T&T 2011 Milestone

Research Milestone R(11-1):

- **Research Milestone R(11-1): Study turbulence regimes responsible for ion and electron energy transport.**
- ***Results from 2006-2008 indicate that the scalings of electron and ion energy transport with magnetic field and plasma current differ in the ST, and also differ from high-aspect-ratio tokamak scalings. Understanding electron transport is particularly important as the electron channel is the dominant energy loss channel in NSTX plasmas, while ion transport commonly approaches neoclassical levels. High-k scattering measurements from 2007-2008 indicate that ETG turbulence is a leading candidate for anomalous electron energy transport. However, low-k fluctuations may also contribute to electron transport. The low-k portion of the turbulent density fluctuation spectrum will be measured with a Beam Emission Spectroscopy (BES) diagnostic, and low-k magnetic-field fluctuations will be measured using MSE and/or MSE-LIF diagnostics (if technically ready). Experiments will be performed to vary plasma parameters such as collisionality, ExB shear, magnetic shear, plasma current, and magnetic field to span the instability drive space of candidate micro-instabilities (ITG, CTEM, micro-tearing, and ETG) thought to possibly be responsible for anomalous energy transport. The measured k spectrum of the turbulence will be measured as function of plasma parameters and correlated with energy diffusivities inferred from power balance analysis, and these results will be compared with linear and non-linear instability calculations to identify, where possible, the micro-instabilities responsible for the observed transport. Improved understanding of electron and ion energy transport in the ST is highly desirable to reduce the uncertainty of extrapolation to next-step STs. This research also contributes broadly to a fundamental understanding of transport***

T&T 2012 Milestone Ideas

- Splitting the current 2011 milestone into a better defined phenomenological portion for 2011 with extensive theory/simulation comparisons for 2012
- Particle transport
- L-H transition thresholds with changing zonal flows/GAMs and other turbulence
- Reconciliation of poloidal flow with neoclassical theory/simulations
- Predictive capability