NSTX

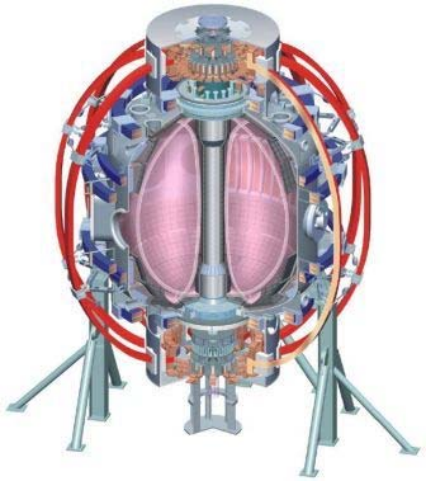
Supported by

U.S. DEPARTMENT OF ENERGY | Office of Science

Turbulence and Transport TSG Research Planning Meeting

Yang Ren
Howard Yuh
Greg Hammett

B318, March 7th, 2011



College W&M
Colorado Sch Mines
Columbia U
CompX
General Atomics
INEL
Johns Hopkins U
LANL
LLNL
Lodestar
MIT
Nova Photonics
New York U
Old Dominion U
ORNL
PPPL
PSI
Princeton U
Purdue U
SNL
Think Tank, Inc.
UC Davis
UC Irvine
UCLA
UCSD
U Colorado
U Illinois
U Maryland
U Rochester
U Washington
U Wisconsin

Culham Sci Ctr
U St. Andrews
York U
Chubu U
Fukui U
Hiroshima U
Hyogo U
Kyoto U
Kyushu U
Kyushu Tokai U
NIFS
Niigata U
U Tokyo
JAEA
Hebrew U
Ioffe Inst
RRC Kurchatov Inst
TRINITI
KBSI
KAIST
POSTECH
ASIPP
ENEA, Frascati
CEA, Cadarache
IPP, Jülich
IPP, Garching
ASCR, Czech Rep
U Quebec

T&T TSG Responsibilities for FY 2011-2012 (I)

- **FY2012 Office of Fusion Energy Sciences 3 Facility Joint Research Milestone:**
  - Conduct experiments on major fusion facilities leading toward improved understanding of core transport and enhanced capability to predict core temperature and density profiles. In FY 2012, FES will assess the level of agreement between predictions from theoretical and computational transport models and the available experimental measurements of core profiles, fluxes and fluctuations. The research is expected to exploit the diagnostic capabilities of the facilities (Alcator C-Mod, DIII-D, NSTX) along with their abilities to run in both unique and overlapping regimes. The work will emphasize **simultaneous** comparison of model predictions with **experimental energy, particle and impurity transport levels** and fluctuations in various regimes, including those regimes with significant excitation of electron modes. The results achieved will be used to improve confidence in transport models used for extrapolations to planned ITER operation.

T&T TSG Responsibilities for FY 2011-2012 (II)

- **NSTX FY2011 research milestone R(11-1): Measure fluctuations responsible for turbulent electron, ion and impurity transport**
  - The thermal transport scalings of electrons and ions with magnetic field and plasma current in NSTX H-mode plasmas have been found to be different from those of high-aspect-ratio tokamaks. Furthermore, recent experiments show that lithiated wall conditions can affect global confinement of NSTX H-mode plasmas and lead to different scalings with magnetic field and plasma current from un-lithiated plasmas. High-k scattering measurements have identified ETG turbulence as one candidate for the anomalous electron energy transport for both H and L-mode plasmas. However, low-k fluctuations and fast-ion-driven modes, e.g. GAE, may also contribute to electron transport. Furthermore, low-k fluctuations may also contribute significantly to momentum, ion thermal, and particle/impurity transport. In addition to measuring high-k fluctuations, the low-k turbulence and fast-ion-driven modes will be measured with a Beam Emission Spectroscopy (BES) diagnostic. Additional low-k fluctuation measurements will be made using the upgraded reflectometer, interferometer, and gas puff imaging systems. The turbulence k spectrum will be measured as function of plasma parameters and coupled with power balance analysis. Experiments on particle transport will be carried out by using gas puffs coupled with density measurements and low-k to high-k turbulence measurements. Impurity transport will be studied by coupling impurity puff and edge SXR measurements.

Research Priorities and ITPA Participations

- Research priorities for FY 2011-2012:
  - 1st
    - Measure fluctuations responsible for turbulence particle and impurity transport (R11-1, 2012 JRT)
    - Investigate mechanisms for turbulence electron thermal transport (R11-1)
  - 2nd
    - Confinement scaling to very low aspect ratio
    - L-H transition physics
    - Role of turbulence in driving intrinsic rotation and the ρ* scaling of intrinsic torque
- NSTX participated ITPA joint experiments and activities on transport:
  - TC-9 Scaling of intrinsic rotation with no external momentum input
  - TC-10 Experimental identification of ITG, TEM and ETG turbulence and comparison with codes
  - TC-12 H-mode transport and confinement at low aspect ratio
  - TC-14 RF rotation drive
  - TC-17 rho-star scaling of intrinsic torque
  - TC-19 Characteristics of I-mode plasmas

Diagnostic Availability and Simulation Tools

- FiReTIP (Lee)
  - The availability of multiple channels?
- ME-SXR (Clayton)
  - Routinely?
- High-k Scattering (Ren)
  - Routinely
- BES (Smith)
  - Routinely? How many channels?
- Reflectometer (Kubota)
  - Routinely?
  - The availability of k_r backscattering?
- Polarimetry (Zhang)
  - May be available (see presentation)

- GYRO (Guttenfelder, Peterson)
- GTS (Wang, Ethier)

Thoughts on 1st Priority XPs

- Particle transport
  - SGI coupled with FiReTIP, reflectometer and SXR (K.C. Lee, Kubota)?
  - Coupled with turbulence diagnostics
- Impurity transport
  - Impurity gas puff with ME-SXR (Clayton)
  - Coupled with turbulence diagnostics
- Electron thermal transport
  - Isolating and identifying micro-tearing mode in high-beta and high-Z_{eff} regime (Guttenfelder)
  - Turbulence characteristics for HHFW H-mode saturated stored energy versus HHFW power (Hosea)
  - Z_{eff} and small-scale turbulence in NSTX (Mazzucato)

Thoughts on 2nd Priority XPs

- L-H transition physics
  - L-H Threshold Power Study: Ramp-Up vs Steady I_p Phase (Kaye)