NSTX-U

NSTX-U is sponsored by the
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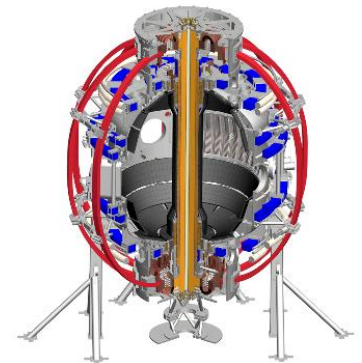Fusion Energy Sciences

T&T considerations of proposed polar region changes

T&T TSG meeting
May 9, 2017

Impact of polar region options on research flexibility

- No ceramic breaks would eliminate CHI capability

- Tile fish-scaling required in several regions to manage high heat fluxes of 2MA/10MW/5s → Eliminates reversed B_T
  - Langmuir probes, gas feeds / divertor MGI, other sensors in tiles will also need to be redesigned in concert with PFCs

- (Near) perfect snowflake divertors (SFDs), other advanced divertors will have reversed helicity for some tile regions
  - Need requested SFD equilibria ASAP to assess tile impact / options
  - Bi-directional tiles may be an option for lower $q_\perp$ divertor regions

- Pedestal/ELM/H-mode threshold studies - need additional specs of requested range of ΔR_{SEP}, duration, κ, δ, R_{strike}
  - Up/down asymmetric boundary increases q_{peak}, reduces Δt_{flat}

- BP SG/TT TSG charged to provide info to PFCR-WG/JEM

Agenda

- Determine how proposed polar region changes impact Transport & Turbulence research goals
  - Removal of CHI gap
  - Discharge length limits due to PFC heating constraints
  - Fish-scaled PFCs $\rightarrow$ uni-directional strike-points (BT CW, Ip CCW), implications on triangularity & X-point height

- Document plasma shapes (A, R0, κ, δ, ζ, DR_{SEP}, R_{strike}), Ip, BT, P_{NBI} (V_{NBI}), min/max pulse or flat-top durations, etc… required by Transport & Turbulence physics goals and diagnostic requirements

T&T thrusts from 5 year plan

- Thrust 1: Characterize H-mode global energy confinement scaling in the lower collisionality regime of NSTX-U

- Thrust 2: Identify regime of validity for instabilities responsible for anomalous electron thermal, momentum, and particle/impurity transport in NSTX-U

  - Low-k modes ($k_\perp \rho_s \leq 1$): ITG/TEM/KBM, MT $\Big\}$ drift waves
  - High-k mode ($k_\perp \rho_s \gg 1$): ETG
  - GAE/CAE-KAW $\Big\}$ Alfvén eigenmodes

- Thrust 3: Establish and validate reduced transport models

FY15/16 XPs

1549	**Perturbative momentum** transport in NSTX-U L and H modes	**Guttenfelder**
1574	**Correlation of *AE bursts with fast core Te profiles**	**Tritz**
1520	**Ip/Bt** scaling	**Kaye**
	XMP to demo feasibility of TS measurements with SGI modulation	**Ren**
1521	**Validation of gyrokinetic codes in NSTX-U NBI-heated L-mode plasmas**	**Ren**
1550	**Impurity transport** vs torque in NBI heated H-Modes	**Delgado-Aparicio**
1551	**Core Impurity Transport** Measurements at Fixed q-Profile using the new **ME-SXR Diagnostic**.	**Munoz-Burgos**
1584	**2D observations of GAM and zero-frequency zonal flows**	**Smith**
	XMP to demo Ne puff is non-perturbative (see XMP 112 above)	**Munoz-Burgos**
1585	**Localized 3d field** effects on momentum transport and confinement	**Park**
1575	**Reversed shear confinement** with off-axis neutral beams	**Yuh**
1576	**Investigating small-scale edge turbulence with GPI**	**Mandell**
	Investigation of core energy transport via **HHFW heating**	Crocker
	Impurity transport in electron **RF–heated scenarios**	Delgado-Aparicio
	Investigating influence of rotation profile on transport and turbulence	Guttenfelder
	Impact of **3D radial field perturbations** on turbulence, transport and ELMs	McKee
	Perturbative particle transport experiment with SGI in NSTX-U L and H-mode plasmas	Ren
	Investigate effects of q profile on transport and turbulence in NSTX-U H-mode plasmas	Ren
	Characterization of intrinsic impurity transport in NBI-heated H-mode discharges	Scotti
	Dependence of low-k turbulence properties on rho* in the ST	Smith
	Perturbed edge impurity transport	Tritz

T&T desires

- Stationary conditions $\Delta t_{stat} \gg \tau_E$ for good profile averaging & turbulence statistics (say >300 ms, longer always better)

- Would love to study effects of shaping on T&T, but do we really require any specific shapes to address T&T research thrusts?

- Discharges that allow all measurements required for hi-fidelity T&T validation studies:

  – Profiles: TS, CHERS, MSE, bolometry

  – Turbulence:

    ▪ High-k scattering

    ▪ BES

    ▪ Reflectometer

    ▪ LBO/ME-SXR/TGIS

    ▪ DBS/CPS

- NBI that supports above measurements, as well as modulation capability

- HHFW (SOL constraints?)

- 3D fields?