

Perturbative particle transport experiment with SGI in NSTX-U L and H-mode plasmas

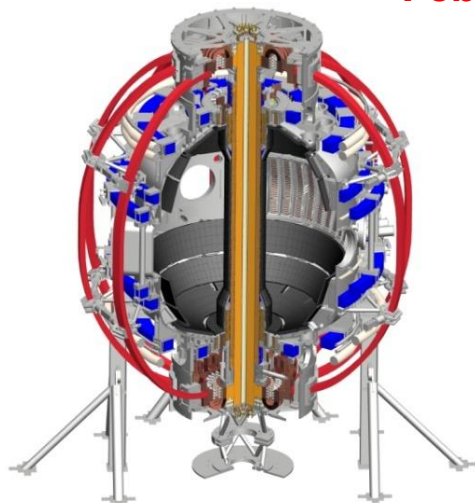
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1. PPPL, 2. UCLA, 3. LLNL, 4. UW-Madison, 5. Nova
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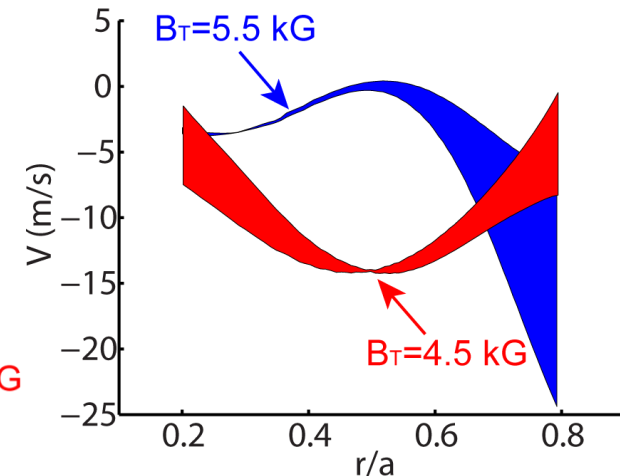
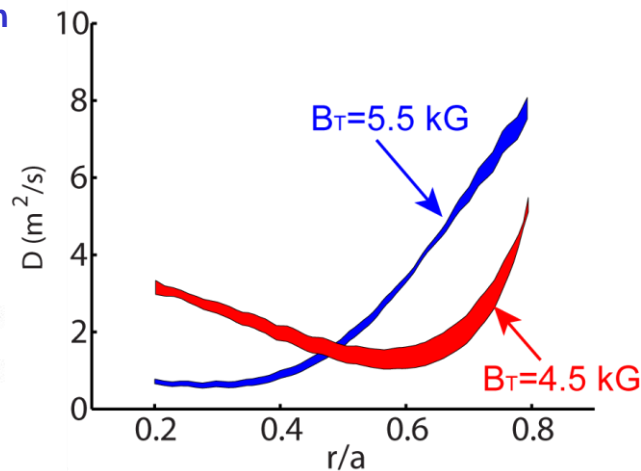
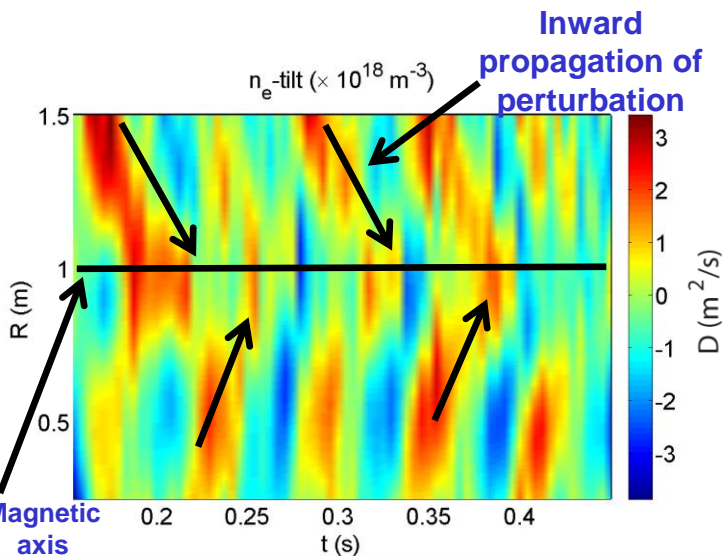
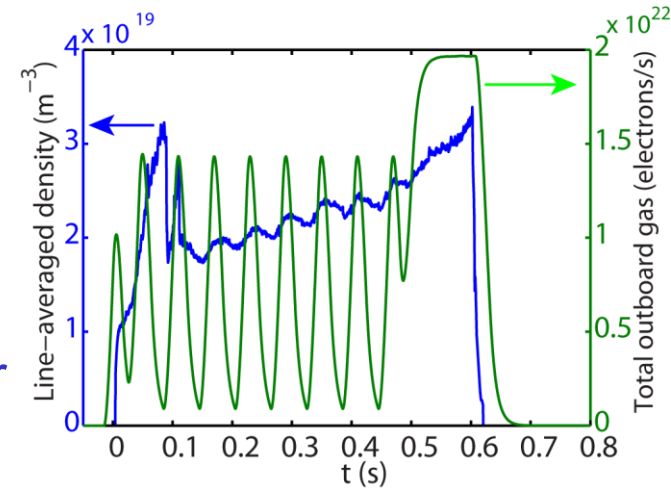
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Background and Motivations

- Particle transport in STs not well understood
 - Neoclassical or turbulent?
 - Particle balance analysis not able to separate diffusion and pinch
- Perturbative particle transport measurement used on other tokamaks
 - Use fast gas injection system coupled with profile reflectometer or Thomson scattering for density measurement



Experimental Plan

- Produce desired baseline plasma target: long-pulse MHD-quiescent NBI-heated L-mode plasmas (similar to shot 141716)
 - Pretty reproducible plasmas
 - Small MHD activities
 - MSE and CHERS measurements available
- Develop optimal SGI duty cycle, modulation cycle and density perturbation (should not cut into experimental time)
 - Large density modulation cycle $\gg 16$ ms (MPTS time resolution)
 - Moderate density perturbation
 - Avoid density accumulation
- B_T and I_p scan to change neoclassical/turbulent transport
 - 2nd NBI may be used to change flow shear
- If time permitted, carry out experiments with 3D fields and in H-mode plasmas
- One run day is needed and 0.5 day is minimum

Diagnostic Needs and Analysis

- Must-have diagnostics:
 - SGI
 - BES, reflectometer
 - CHERS, MPTS, MSE
 - Magnetics
 - other diagnostics required for conducting TRANSP analysis
- Planned analysis
 - LRDFIT, TRANSP, GS2, GYRO, GTS, XGC1

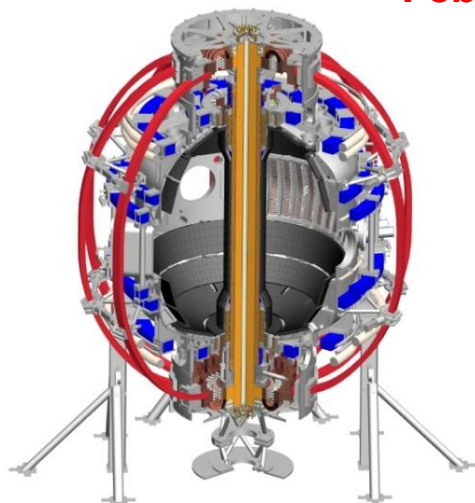
Validation of gyrokinetic codes in NSTX-U NBI-heated L-mode plasmas

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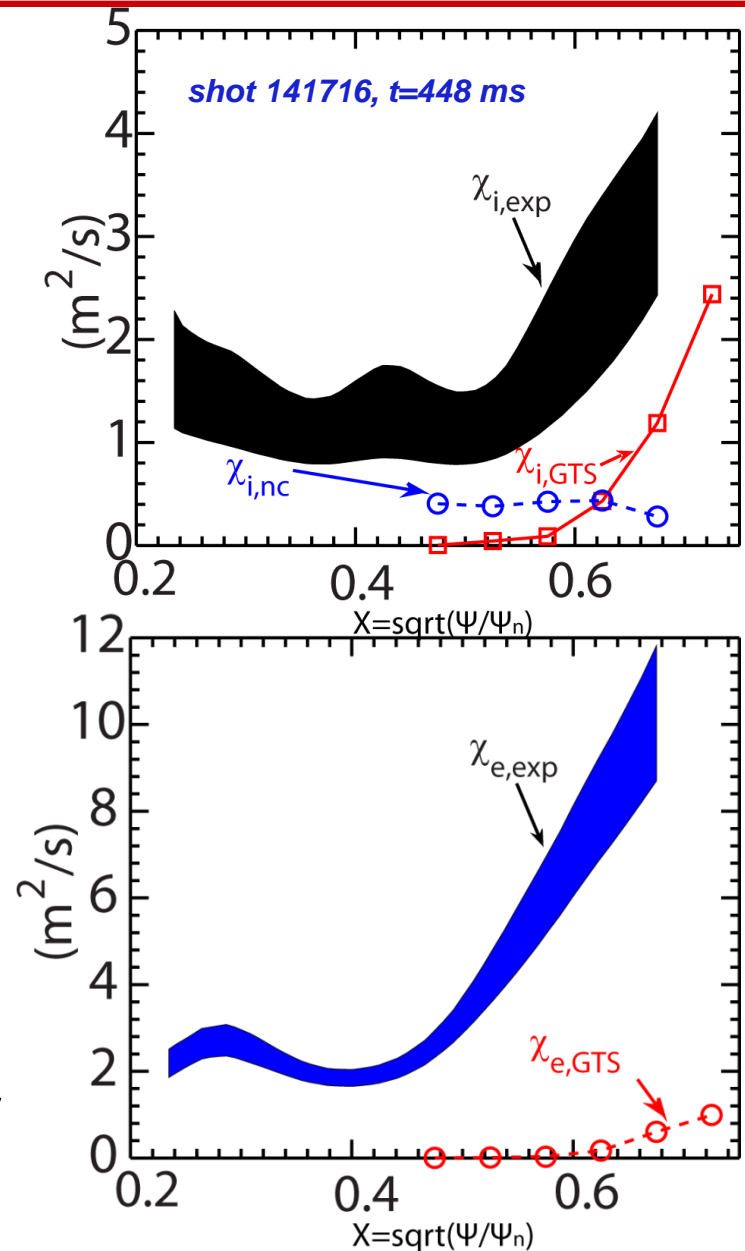


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Background and Motivations

- Validating gyrokinetic codes is important
 - To find limitations and improve codes
 - Compare transport level between experiments and nonlinear gyrokinetic simulations
 - Compare fluctuations through synthetic diagnostics
- L-mode plasmas offer some favorable properties to code validation
 - Easier to obtain stationary profiles
 - Easier to maintain MHD quiescence
 - No complications from edge transport barrier
- Will provide a data base for developing reduced transport models, e.g. TGLF, for NSTX-U parameter regimes.



Experimental Plan

- Produce desired baseline plasma target: MHD-quiescent NBI-heated L-mode plasmas (similar to shot 141716)
 - Pretty reproducible plasmas
 - Small MHD activities
 - MSE and CHERS measurements available
- B_T and I_p scan to change neoclassical/turbulent transport
- Change plasma shaping, e.g. elongation, to assess its effects on turbulence and transport if time permits
- If time permitted, carry out experiments with 3D fields and in H-mode plasmas
- One run day is needed and 0.5 day is minimum
 - If long-pulse MHD-quiescent quasi-stationary NBI-heated L-mode achieved earlier, may be able to share shots with perturbative particle transport XP because of similar B_T and I_p scans

Diagnostic Needs and Analysis

- Must-have diagnostics:
 - BES, reflectometer
 - CHERS, MPTS, MSE
 - Magnetics
 - other diagnostics required for conducting TRANSP analysis
- Planned analysis
 - LRDFIT, TRANSP, GS2, GYRO, GTS, XGC1

Investigate effects of q profile on transport and turbulence in NSTX-U H-mode plasmas

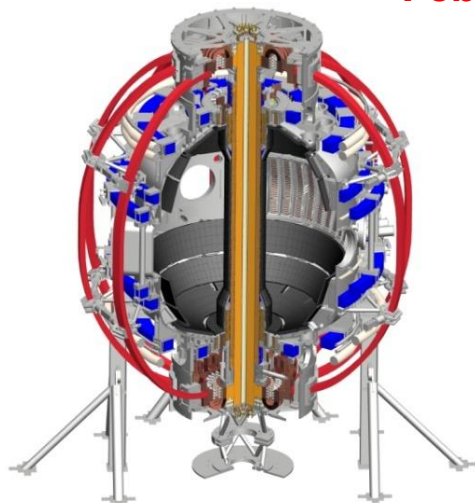
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Background and Motivations

- q profile affects tokamak stability and confinement
 - Forming ITB due to reversed magnetic shear (Yuh et al, PRL, 2011)
 - Improving confinement in hybrid scenario characterized by a broad region of low magnetic shear (Gormezano et al, NF, 2007)
- Theoretical analysis shows s/q plays an important role in q profile effects on confinement in conventional tokamaks (Citrin et al, PPCF, 2012)
 - ITG linear threshold has s/q dependence: $(R/L_{Ti})_{crit} = 2(1.1 + 1.4s + 1.9s/q)$
- For ST H-mode plasmas, ETG and micro-tearing modes may be more important
 - ETG linear threshold also has s/q dependence, similar to ITG
 - Micro-tearing modes have different s/q dependence than ETG and ITG
 - q profile effects can be used to identify operational modes
- Support JRT-15, R(15-1)
- Will provide a data base for developing reduced transport models, e.g. TGLF, for NSTX-U parameter regimes

Experimental Plan

- Achieve decent MHD-quiescent H-mode plasmas
- Different B_T and I_P combinations to change q profile with fixed NBI sources
 - Can share shots with cross-TSG B_T and I_P scan campaign
- For fixed q_{95} , use different combinations of NBI sources to modify q profile
 - Constant q_{min} and different q_{min}
- For different q_{95} (B_T and I_P combinations), use NBI sources to keep q_{min} constant
- Try to use 3D field to decouple rotation profile from q profile
- One run day is needed and 0.5 day is minimum
 - Depends on the details of sharing shots with other XPs

Diagnostic Needs and Analysis

- Must-have diagnostics:
 - BES, reflectometer
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