PC-TF early run campaign experiment discussion

PC-TF Pre Forum Meeting

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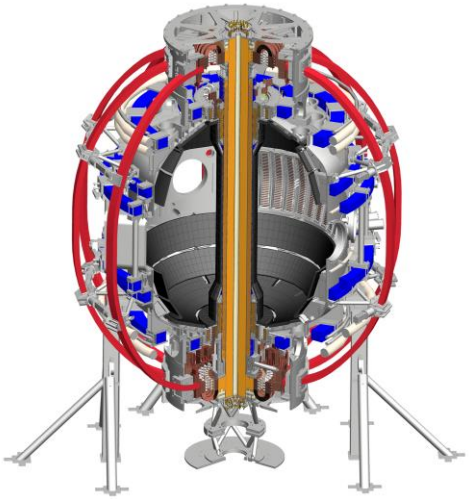
NSTX Upgrade



Fusion Energy Sciences

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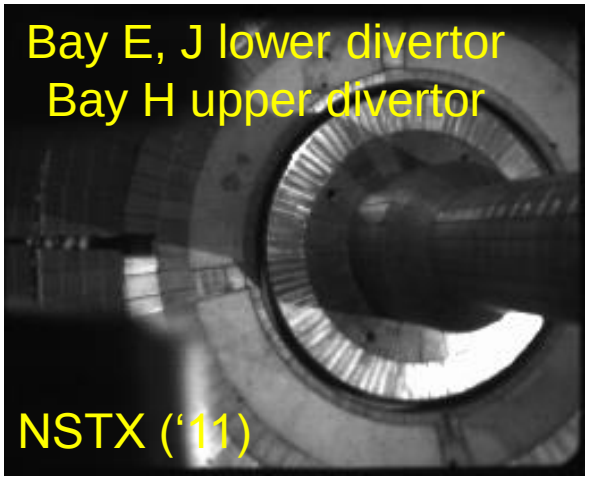
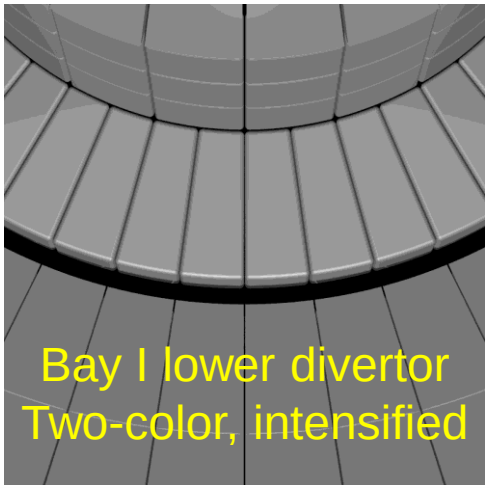
Sources evaluation and mitigation to be addressed in particle control task force

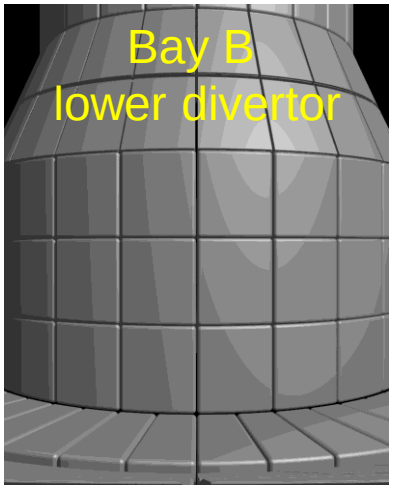
- PC-TF experiments scope include (among others):
  - Wall coating and preparation/optimization for increased particle pumping
  - Reduction/control of impurity ion source rates
  - Natural and paced ELMs for impurity and main ion flushing
- Impurity mitigation XPs need an established impurity-accumulating target (Li-conditioned, ELM-free? B with infrequent ELMs?) and profile diagnostics between shots
  - Will it happen within first two months?
- Impurity sources to be mostly evaluated in piggy-back
  - Better characterization of the mixed material environment
  - Cross-cutting with MP-TSG (and DivSOL-TGS)

Upgraded LLNL diagnostics for full poloidal coverage of impurity emission

- Wide angle filtered camera views: lower (2 views), upper divertor
- Two-color, intensified high-resolution lower divertor view
- Radial divertor view (lower dome)
- 1D CCD cameras with lower divertor, center stack views
- Lower divertor spectrometers VIPS2, DIMS







Simultaneous monitoring of different lines for divertor impurity influxes

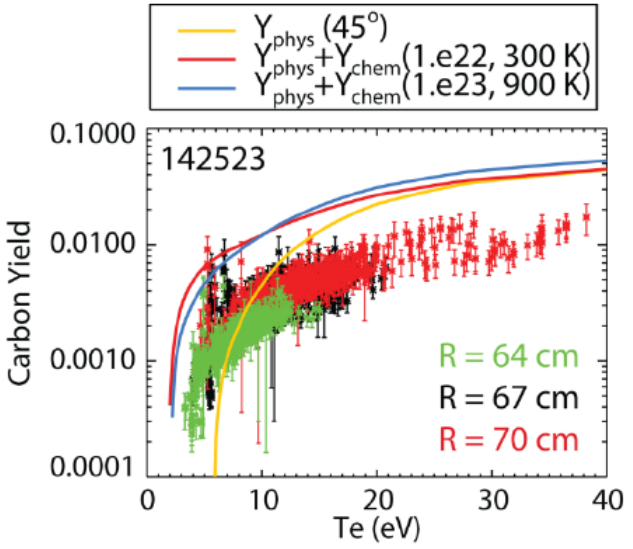
- Simultaneous measure of divertor carbon influxes (plasma parameter-independent), chemical and physical contribution to carbon sources in lower divertor
  - C II lines with different dependencies on plasma parameters
    $\rightarrow C^{1+}$ influx determination
  - Gerö band (CD) and C II line $\rightarrow$ chemical vs physical contribution
  - 430 nm region (VIPS2) $\rightarrow$ complement two-color view for Yc
  - 909 nm region (DIMS) $\rightarrow C^{0+}$ influx, evaluation of f_{chem}/f_{phys}
- 1D-CCD to provide routinely D-α, Li I emission profiles
- Upper divertor camera will inform on evolution of upper divertor PFCs

Proposed XPs

- Carbon/lithium sources evolution from boron to lithium conditioning (piggy-back on Li first introduction XP)
- Characterization of toroidal asymmetries in carbon/lithium sources (piggy-back)
- Evaluation of tile edges effects on carbon sources with new tiles (piggy-back, XMP?)
- Divertor gas puff for core impurity mitigation (XP)

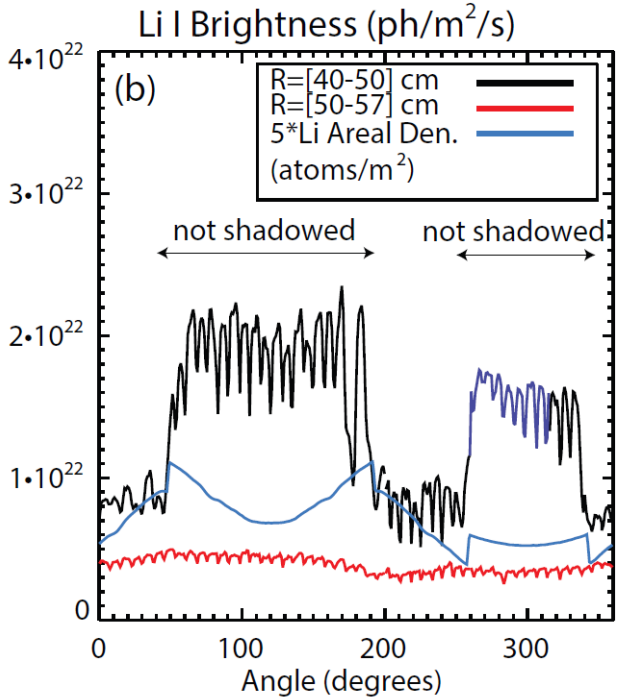
1: Carbon/lithium sources evolution from boron to lithium conditioning

- Reduction in C sputtering yield observed after large lithium depositions in NSTX
- Carbon inventory increase attributed to ELM disappearance, weaker screening, unknown role of wall sources
- Improved diagnostic suite to measure evolution of impurity sources (C and Li) during first transition to lithiated PFCs
- Contribute to first lithium introduction XP
- Experiments in helium would further inform on role of physical vs chemical effects



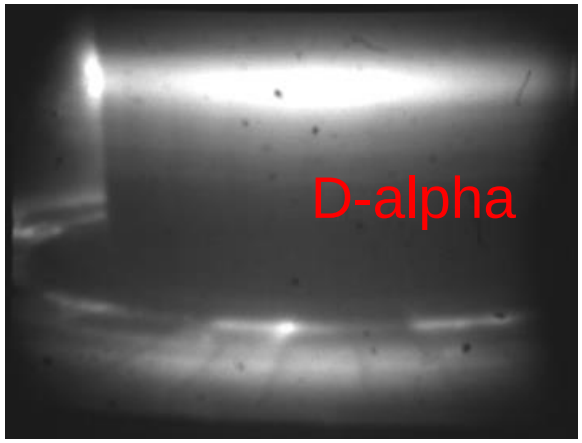
2: Characterization of toroidal asymmetries in carbon/lithium sources

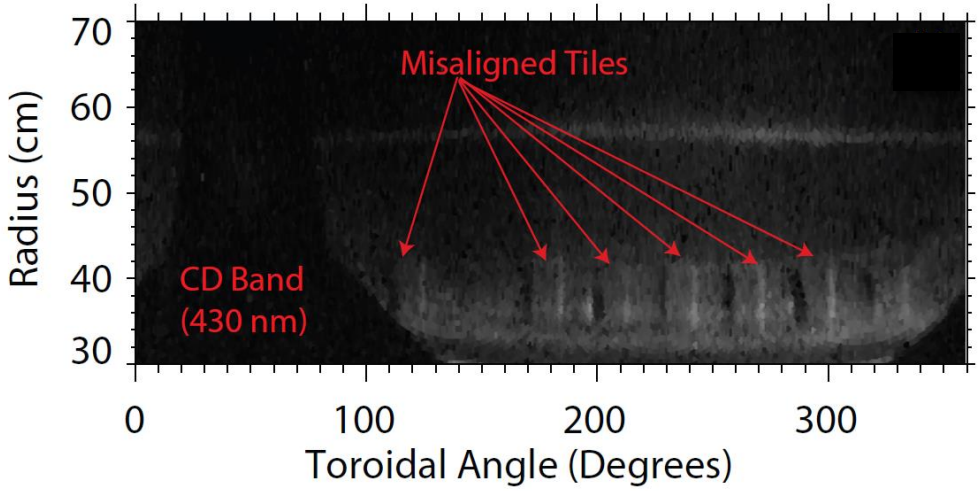
- Toroidally-asymmetric lithium influxes observed following lithium deposition profile
  - T-enhanced sputtering, droplet ejection?
- Toroidal asymmetries in carbon influx not observed (but routine monitoring of C^{1+})
- Wide angle views (C I) to evaluate toroidal asymmetries in divertor carbon influxes due to boronization, lithium-conditioning
- Combined with boron/lithium erosion imaging
- Wide-angle IR camera will help understand mechanisms driving asymmetries



3: Evaluation of tile edges effects on carbon sources with new tiles

- Tile-to tile misalignments evident on NSTX CS, first row and outboard tiles, leading to tile edges effects
- New tiles installed with emphasis on better tile-to-tile alignment
- Wide angle cameras, two-color camera, radial view to determine effects of tile-misalignment on carbon sources
  - As a function of OSP radius, flux expansion, etc…





4: Divertor gas puff for core impurity mitigation

- Divertor deuterium gas puff reduced core carbon inventory by up 30% in XP1002
  - MIST modeling indicates reduction of edge source
  - Experimental data (+ UEDGE) indicated improved screening rather than reduced impurity influx
  - Added benefit of heat flux mitigation
- XP1002 extension in ELM-free NSTX-U discharges:
  - Re-establish gas puff levels for impurity mitigation
  - Optimization of gas timing to maintain source reduction
  - Move gas puff as early as divertor formation to avoid low n_e divertor with poor trapping in early H-mode
  - Improved diagnostic to evaluate changes in sources (phys. vs chem.) on lithiated graphite as T_e is reduced
  - If successful, add triggered ELMs (LGI or RMPs), to combine source reduction and core flushing