Impurity sources and carbon particle balance in boronized and lithium-conditioned discharges

NSTX-U FY15 Research Forum – PC-TF

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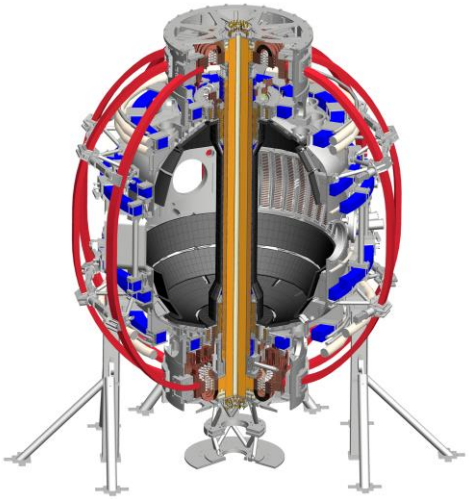
NSTX Upgrade



Fusion Energy Sciences

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PPPL

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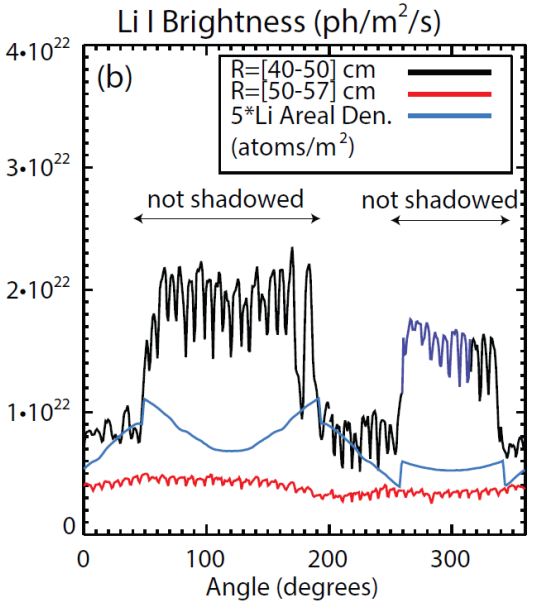
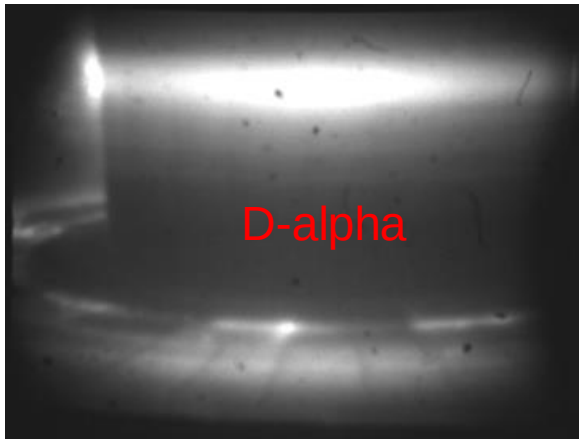
Goal: Evaluation of impurity sources, particle balance with boronized and lithiated PFCs

- Evolution of C, B, Li, O sources with Li introduction and as Li accumulates in vessel not fully understood
  - Some reduction in C sputtering observed after large lithium deposition
  - Carbon inventory increase attributed to ELM disappearance, weaker screening, unknown role of wall sources
- Enhanced spectroscopic diagnostic suite (see backup) to allow for full poloidal coverage and redundant, simultaneous measurements of impurity brightness from same charge states
- To be addressed during B→Li transition XP and piggy-back on other XPs, e.g., B_T+Ip scan for scaling with eng. parameters:
  - Would benefit from Boundary-DOC
- Support Thrust MP-1, MP-2 of NSTX-U Five year plan

Experimental plan: Carbon/lithium sources, poloidal distribution, toroidal asymmetries

- Characterization of B, C, Li, O sources/sputtering evolution:
  - Before/after boronization
  - After first lithium introduction
  - As a function of lithium dose
  - As lithium inventory builds up in the machine
- Evaluation of poloidal distribution of impurity sources
- Evaluation of toroidal asymmetries in impurity sources:
  - Asymmetric lithium deposition
  - Tile edges effects
- Attempt at carbon particle balance

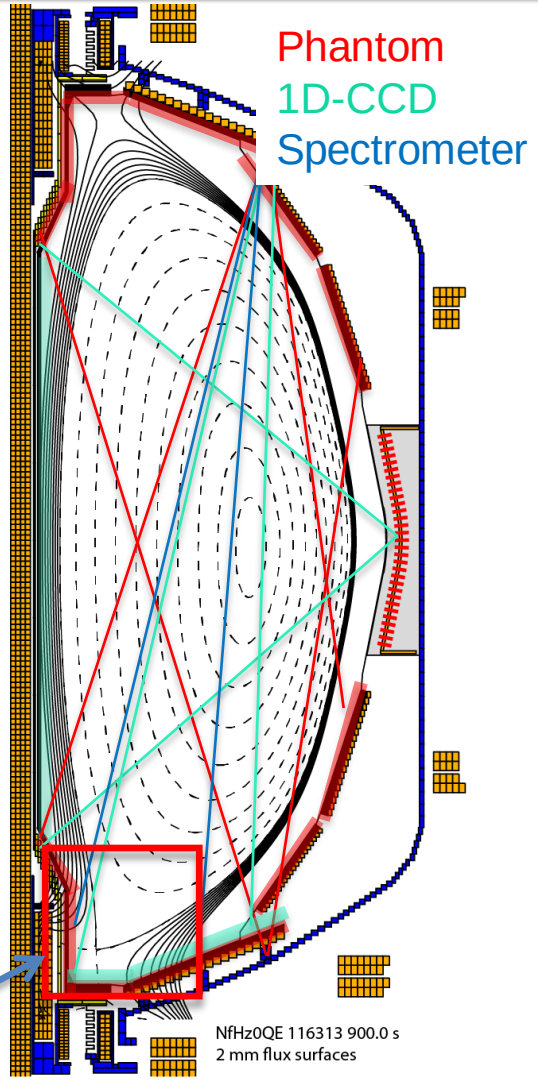




Backup

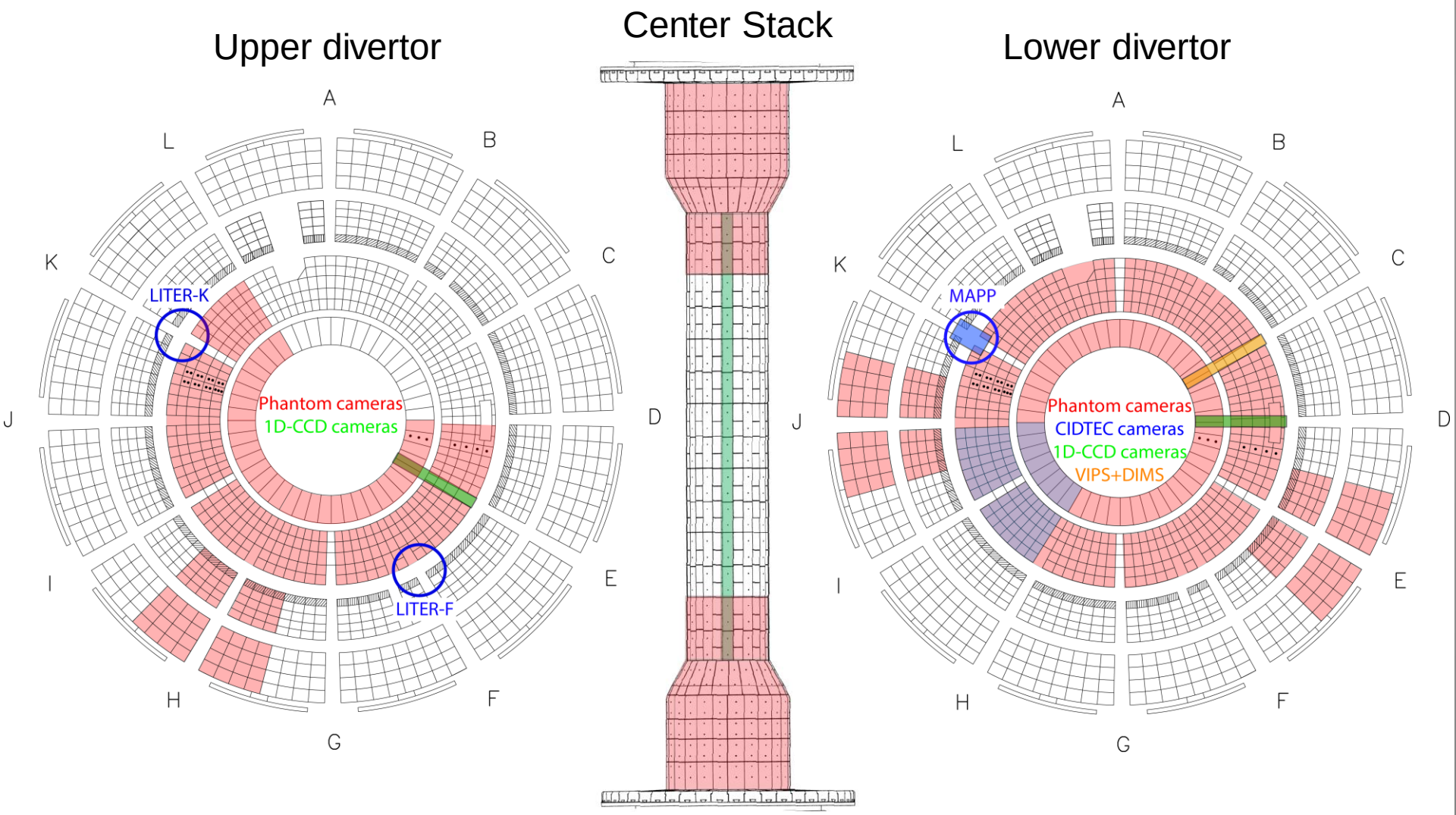
Tools: Upgraded diagnostics for full poloidal, toroidal coverage of impurity emission

- ~Full poloidal coverage of impurity emission + full toroidal divertor coverage
  - Phantom (4), CIDTEC (2), 1D-CCD (9) cameras, 3 spectrometers
- High resolution views for MAPP and inboard divertor
- Views are centered at toroidal location of probes (Bay D, Bay J)
- Availability/reliability of probes limited extrapolation of influxes
  - Redundancy approach implemented for FY2015



Tangential view by R.Maqueda – X-Plasma

Tools: Upgraded diagnostics for full poloidal, toroidal coverage of impurity emission



Strategy: Simultaneous monitoring of different lines for divertor impurity influxes

- **Simultaneous** measurement of multiple lines of same charge state (carbon and lithium) to avoid uncertainty in plasma parameters (T_e, n_e) in lower divertor
  - C II lines with different dependencies on plasma parameters
    → C^{1+} influx determination (426, 514, 723 nm)
  - Li I lines with different dependencies on plasma parameters
    → Li^{0+} influx determination (460, 610, 670 nm)
  - Gerö band (CD) + C II line
    → chemical vs physical contribution
  - 909 nm region (DIMS)
    → C^{0+} influx, evaluation of f_{chem}/f_{phys}
- Upper divertor views to inform on evolution of upper PFCs