NSTX

Supported by

U.S. DEPARTMENT OF ENERGY | Office of Science

Carbon sources and transport characterization in Li-conditioned H-mode plasmas in NSTX

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

Filippo Scotti

Lithium Research Topical Science Group

Princeton Plasma Physics Laboratory PPPL

Research Forum 2011

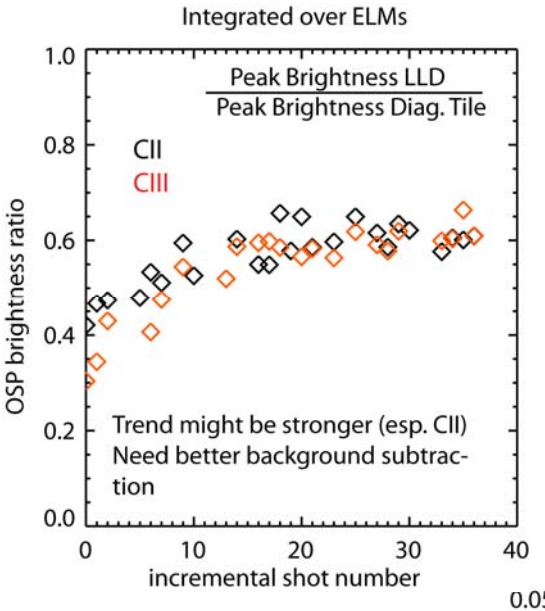
Culham Sci Ctr
U St. Andrews
York U
Chubu U
Fukui U
Hiroshima U
Hyogo U
Kyoto U
Kyushu U
Kyushu Tokai U
NIFS
Niigata U
U Tokyo
JAEA
Hebrew U
Ioffe Inst
RRC Kurchatov Inst
TRINITI
KBSI
KAIST
POSTECH
ASIPP
ENEA, Frascati
CEA, Cadarache
IPP, Jülich
IPP, Garching
ASCR, Czech Rep
U Quebec

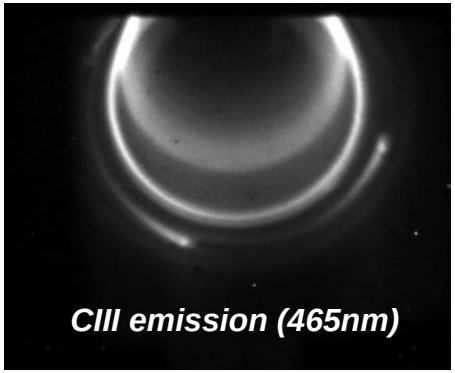
XP GOALS:

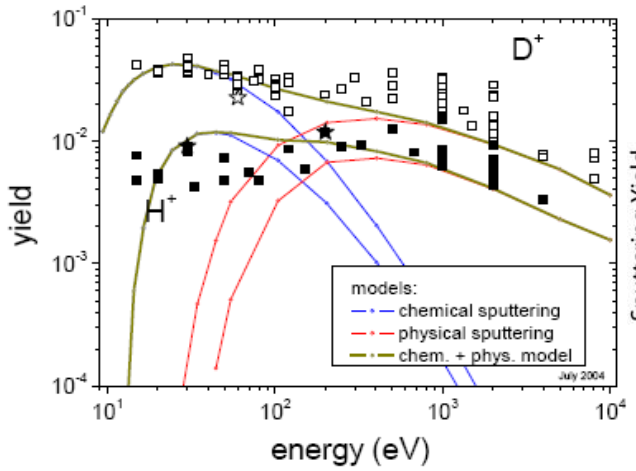
- Assess carbon sources distribution in Li-conditioned ELM-free H-mode discharges
- Assess source repartition in different SOL/divertor regimes
- Study C transport in Li-conditioned discharges
- Contribute to decision for NSTX-U plasma facing components (e.g. Molybdenum on divertor/center stack?)

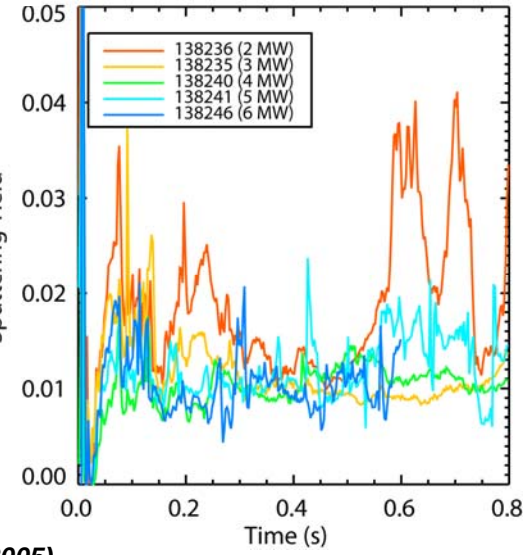
Li-conditioned ELM-free discharges show severe core carbon accumulation despite Li coatings on PFCs

- Li-conditioned ELM-free H-mode show severe core C accumulation
- Li coated PFCs show degradation of Li coatings at OSP in post-vent tiles
- At OSP C sputtering yields of ~1% and peak flux densities of ~10^21 ions/m2/s. No increase with surface T suggest minor role of chemical sputtering. Uncertainty on SXB coeff.
- Analysis complicated in low δ shots.
- LLD surf. shows increased C contamination through the day after overnight evaporation.





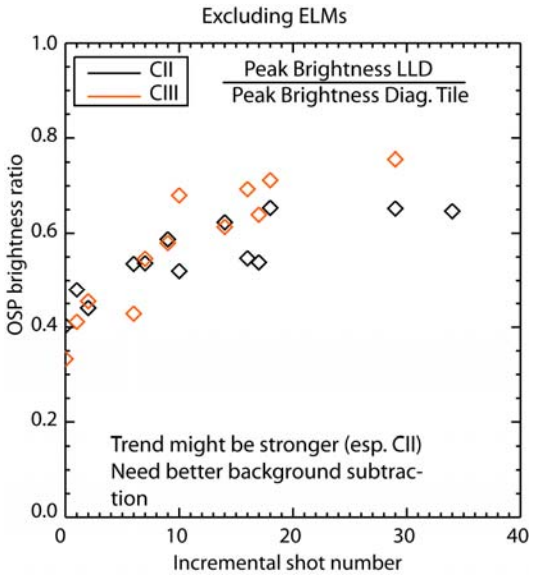


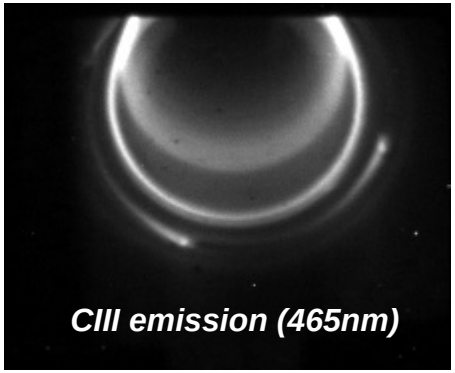


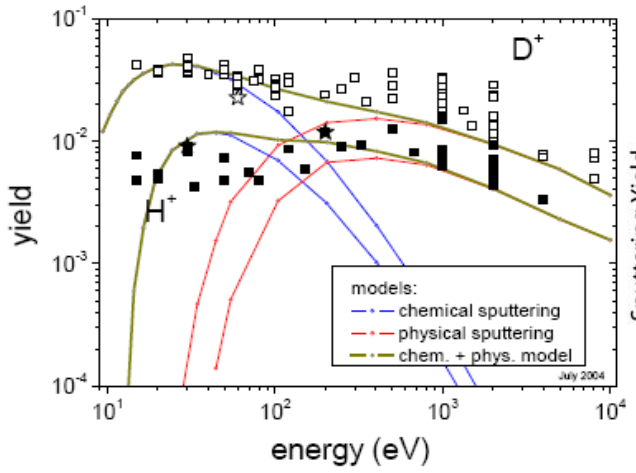
M. Balden, J. Roth, J. Nucl. Mater. 280, 39-44 (2000)
C. Hopfand W. Jacob, J. Nucl. Mater. , 342, 141–147 (2005)

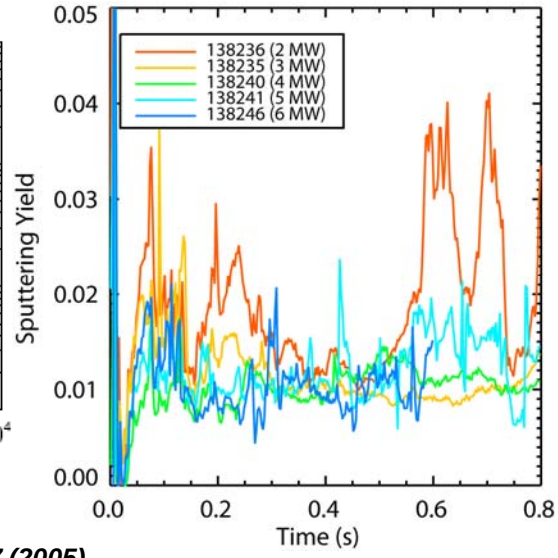
Li-conditioned ELM-free discharges show severe core carbon accumulation despite Li coatings on PFCs

- Li-conditioned ELM-free H-mode show severe core C accumulation
- Li coated PFCs show degradation of Li coatings at OSP in post-vent tiles
- At OSP C sputtering yields of ~1% and peak flux densities of ~10^21 ions/m2/s. No increase with surface T suggest minor role of chemical sputtering. Uncertainty on SXB coeff.
- Analysis complicated in low δ shots.
- LLD surf. shows increased C contamination through the day after overnight evaporation.









M. Balden, J. Roth, J. Nucl. Mater. 280, 39-44 (2000)
C. Hopfand W. Jacob, J. Nucl. Mater. , 342, 141–147 (2005)

Divertor deuterium gas puff was effective in reducing core C concentration – Importance of OSP source?

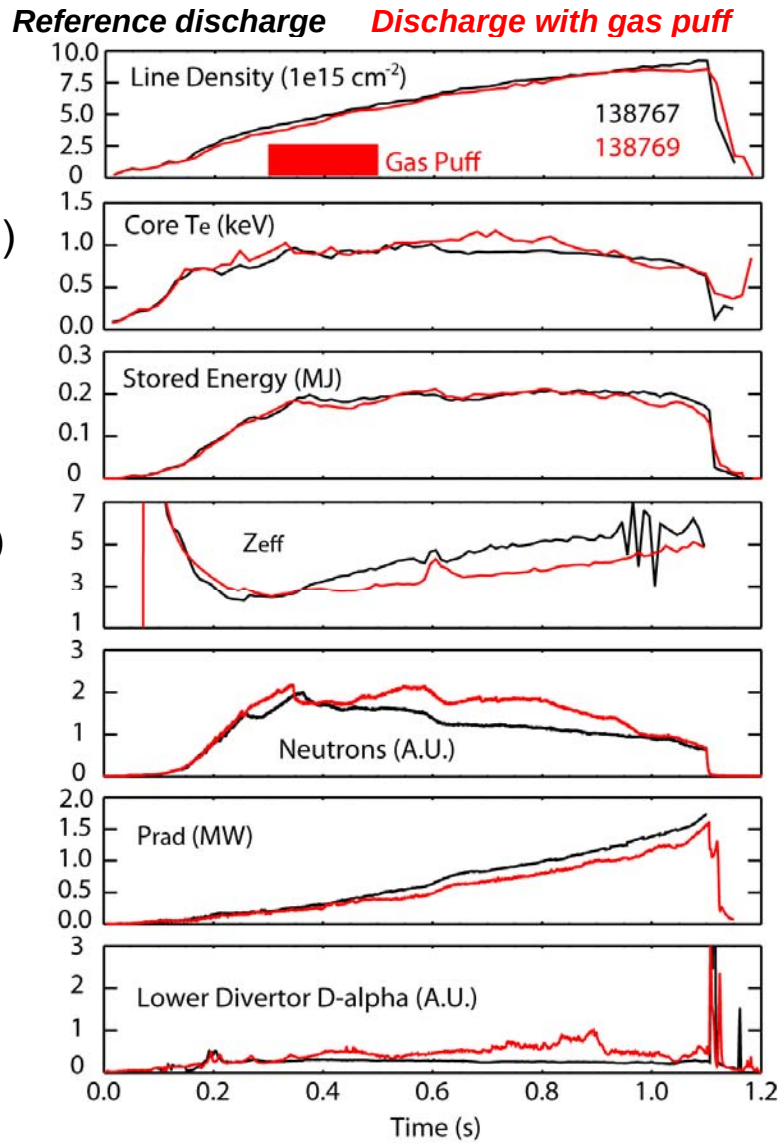
- In FY10, divertor D_2 gas puff reduced core n_C by 30%. Importance of divertor source in Li-conditioned shots.
- Impossible to discern reduced sputtering (decreased Te) vs change in SOL transport (induced SOL flow ?) or divertor retention (increased n_e).
- Other general observations:

  - Currently no precise idea on C sources repartition

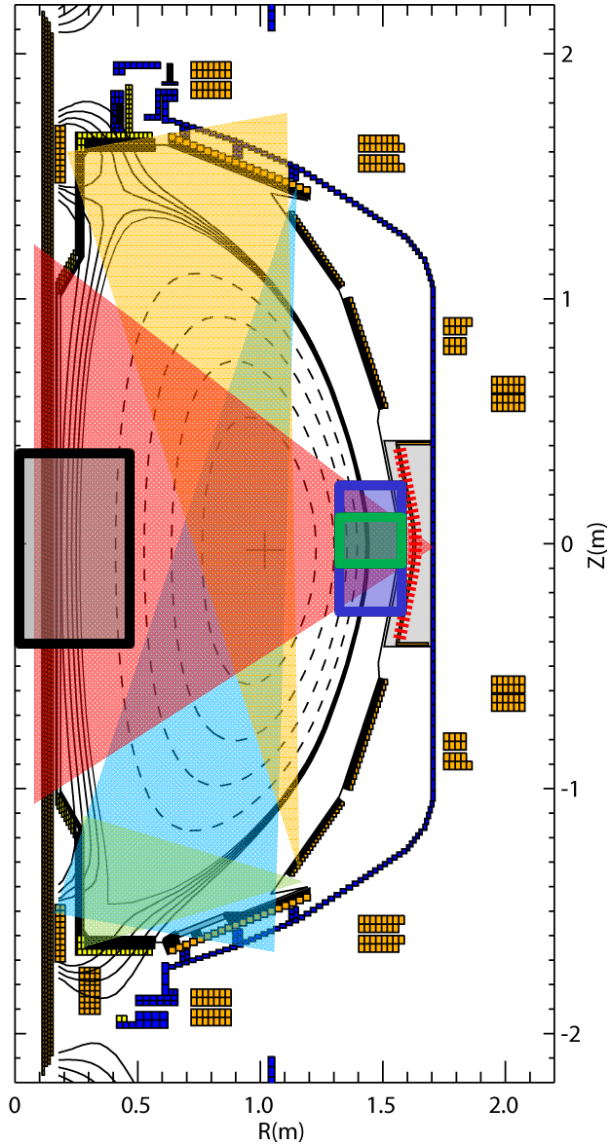
  - Density screening effect in P_{NBI} scans (and Ip scans?)

  - Reduced main wall fast ions sputtering in high Ip discharges (XP-950)

  - Outer gap scan (XP-950) not clear but inner gap was changing too



Increased poloidal coverage of carbon emission profiles for edge influxes determination



- *Phantom Cameras 710 and 7.3 (Lower Div)*
  - *C II (2 wl for line ratio and better influx determination),*
  - *CIII, CIV*
- *DIMS + VIPS2 (Lower Divertor)*
  - *CII, CIII, CD4*
- *Phantom Camera 7.3 (Lower Divertor Tang)*
  - *CII, CIII*
- *1D CCD Camera(Upper Divertor)*
  - *CII*
- *1D CCD Camera (Center stack)*
  - *CII*
- *Phantom Camera Miro 4 (Midplane inboard)*
  - *CII*
- *New ENDD Dalsa camera (Midplane outboard)*
  - *CII*
- *ERD (Midplane outboard) - R. Bell*
  - *CIII*
- *Analysis tools: TRANSP, NCLASS, MIST, edge multi fluid 2D code (e.g. UEDGE)*

Objective is scan C impurity source at OSP and main wall and assess sources repartition and dependence on SOL regime

- Reference shots 138767 (XP1002, high delta, 4MW, 900kA) to touch base with FY10 data. ELM-free regime preferred
- Scan OSP radius (R=35 - R=48), constant X-point height and ISP on CS
  - to scan OSP C source
- Repeat for different Li evap.
  - to determine relative importance of OSP source in different SOL regimes
- Repeat with divertor gas puff :
  - determine effect of reduced C sputtering vs SOL flows and gas efficiency in different SOL regimes
- Scan inner and outer gap with OSP on Mo and look for correlation with core C (is it possible now to do a better job than XP950 with increased diagnostic coverage?)
- Other techniques to influence main wall sources? Gas puff?
- Connect to edge turbulence/transport measurements
- Experimental run time 1 day