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Core impurity density and P_{rad} reduction using divertor condition modifications

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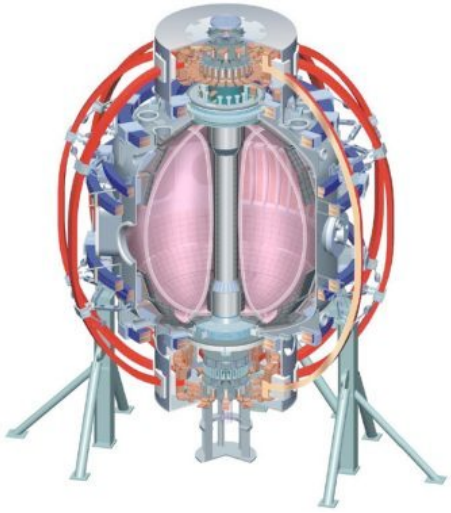

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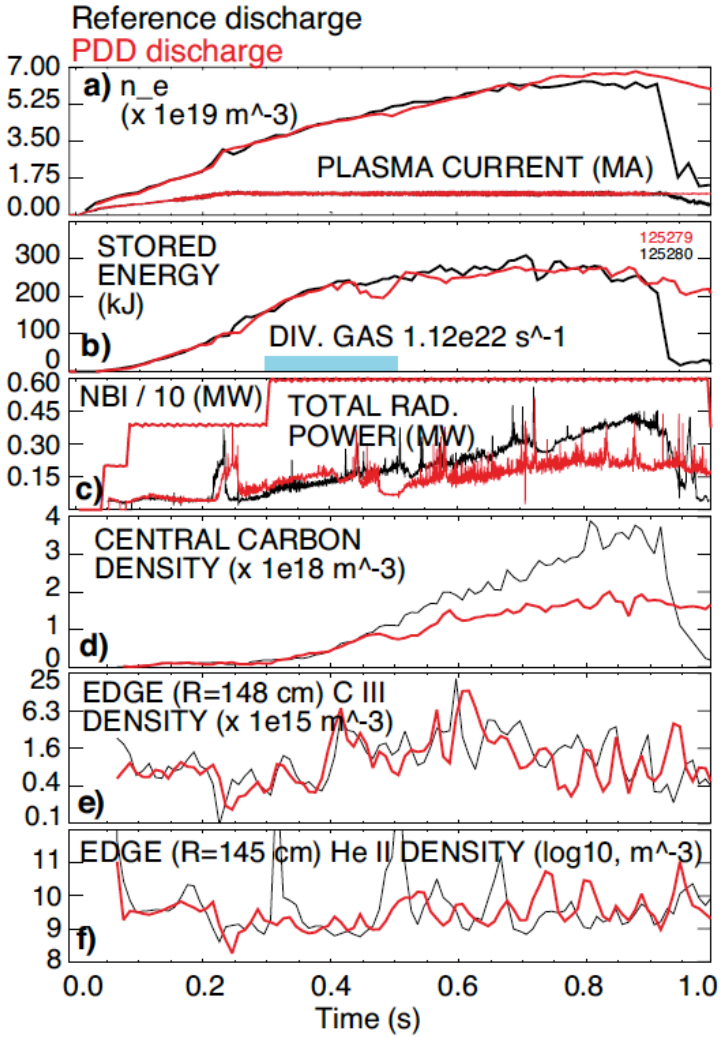
Summary of my APS poster "Modifications in SOL and divertor conditions with lithium coatings…"

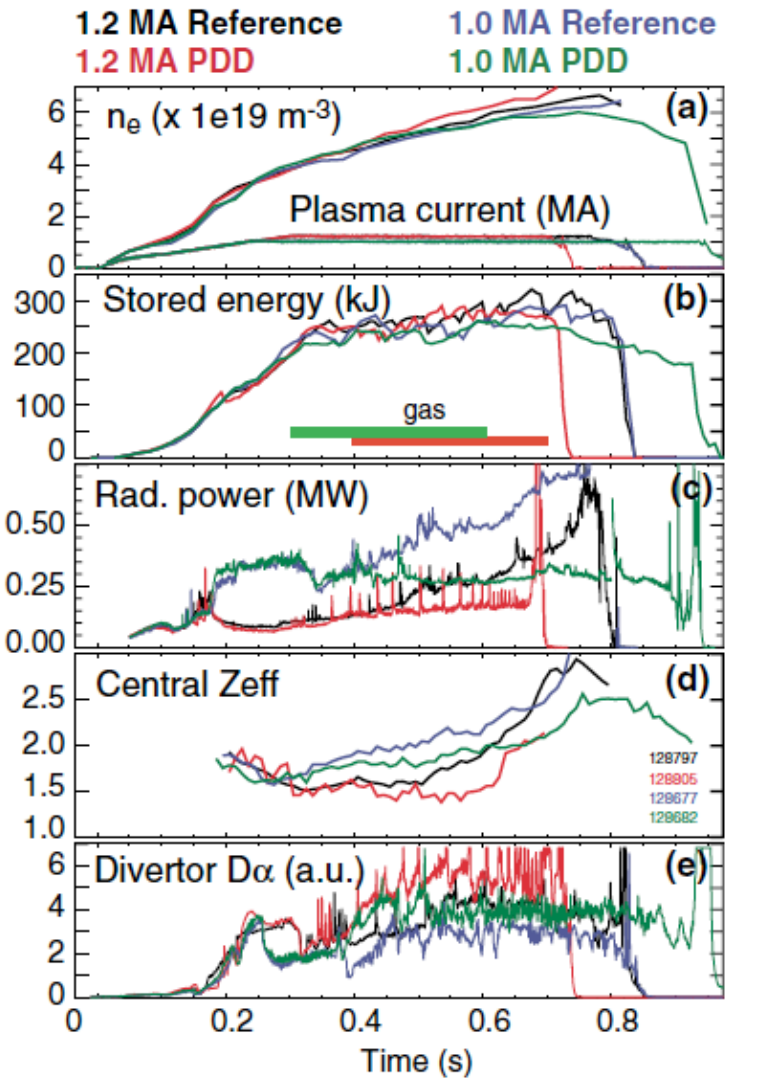
- Evaporative lithium coatings on carbon PFCs modify divertor and SOL sources
  - Lower divertor, upper divertor and inner wall recycling was reduced by up to 50 %
  - Local recycling coefficients reduced on inner wall and far SOL, remained similar in the outer strike point region
  - Lower divertor carbon source from physical sputtering also reduced
  - Divertor lithium influx increased, however, lithium was retained in divertor
- SOL transport regime changes from high-recycling to sheath-limited
  - Apparently small parallel T_e gradient
  - Detached inner divertor re-attaches, X-point MARFEs disappear
- Pedestal and core confinement improvement leads to
  - Reduction of ion inventory (density) by up to 50 % due to surface pumping
  - Effective screening of lithium from core plasma
  - Carbon and high-Z impurity accumulation
  - P_{rad} increases in the core, P_{SOL} significantly reduces

Significant core n_C and P_{rad} reduction observed in divertor heat flux mitigation experiments

Phys. Plasmas **16**, 022501 (2009)

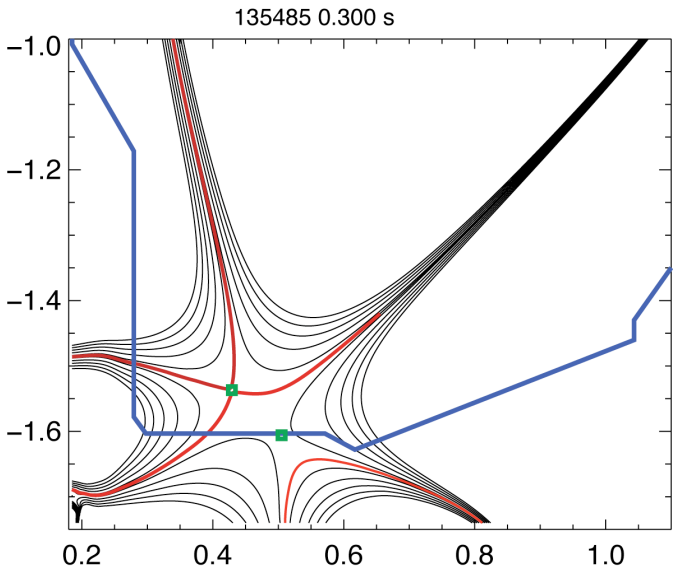


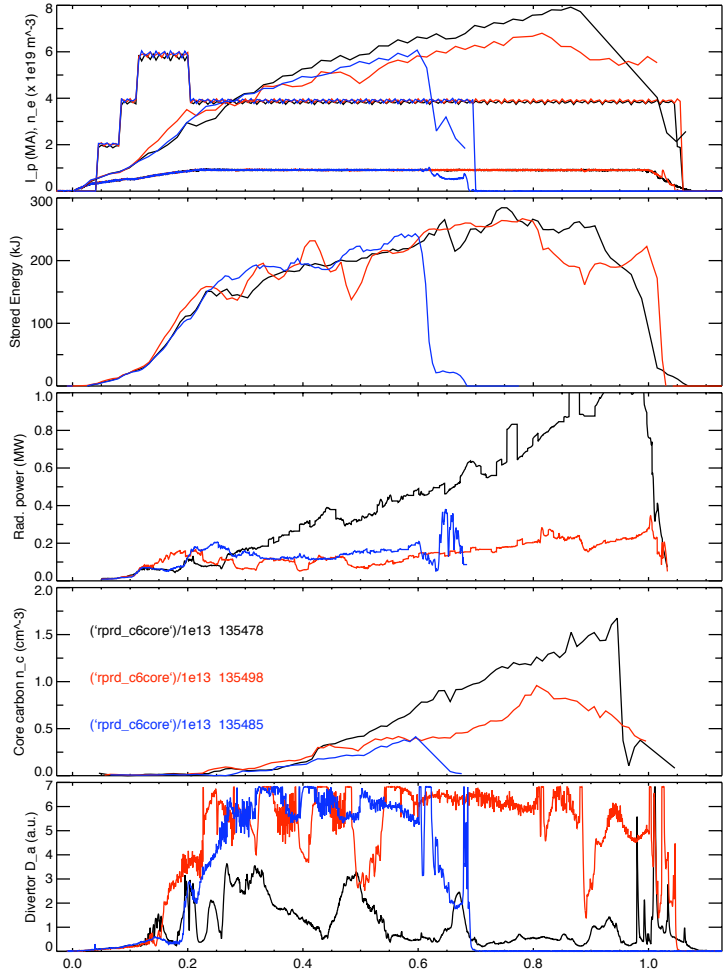
Nucl. Fusion **49** (2009) 095025



Significant core n_C and P_{rad} reduction observed in snowflake divertor experiments

- Standard high-δ fiducial (black)
- "Snowflaking" divertor in red and blue
- In both snowflake divertor cases, strong detachment of outer SOL is observed
- Used lithium at ~ 10 mg/min
- First detachment observation in NSTX without gas puffing





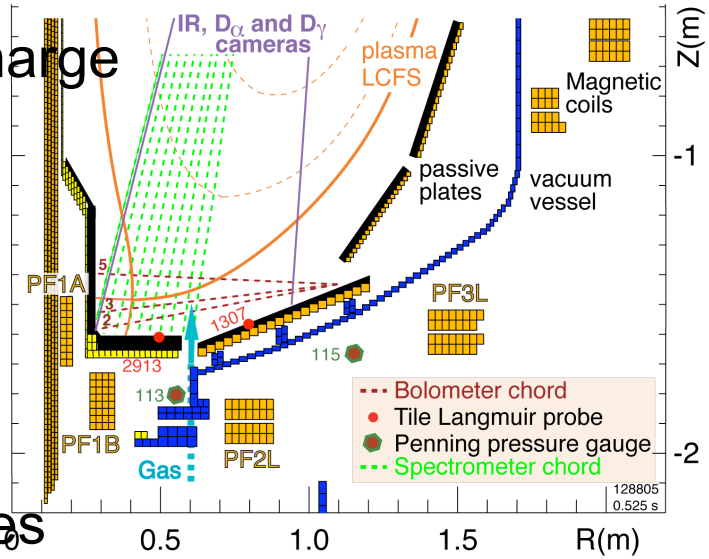
Use deuterium divertor injection to study effects on core impurity density

- In detached divertor
  - physical and chemical carbon sputtering rates are reduced
    - reduced impurity source ?
  - neutral pressure increased
    - increased energetic ion sink?
    - change parallel momentum balance (viscosity), E_r, SOL flows (both drift and source) → change radial impurity transport ?

- However, core n_C and P_{rad} reductions were observed even at low D_2 injection rates when OSP was not (or was marginally) detached
  - Gas shielding of metal surfaces in CHI gap?

Proposed run plan

- Request 1 run day
- Use 1) cold and 2) warm (T=215 C) LLD
- Use high-δ high-performance fiducial discharge
- Inject D_2 from Bay E divertor injector
  - Vary rates from 50 to 150 Torr l /s
  - Vary injection duration 50-200 ms
  - Inject during I_p ramp-up, in flat-top



- Measure carbon and radiated power profiles
  - in core plasma, in lower divertor

- Connect with impurity transport and edge 2D modeling
- Connect with pedestal stability analysis
  - Reduced “ear” density may change edge density gradient and affect ELMs