Heat Flux and Radiated Power in the NSTX Divertor

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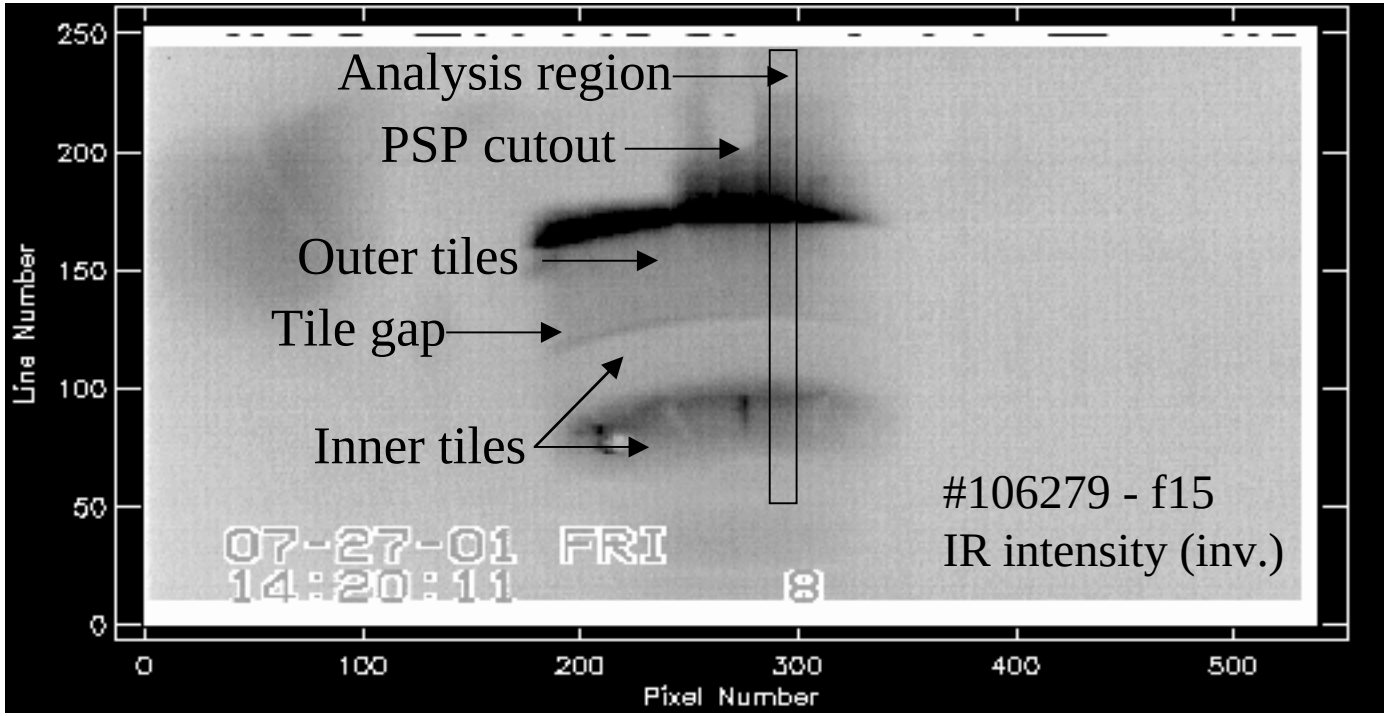
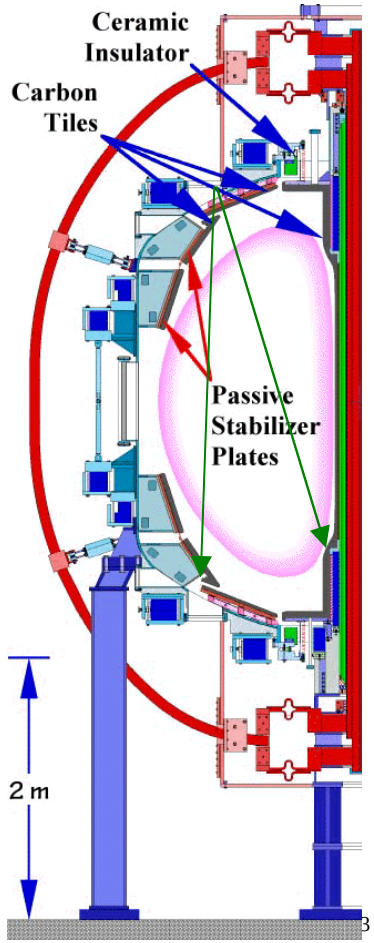
Divertor power balance a part of boundary research program in NSTX

- The major goals of the Divertor and Boundary Physics studies are the control of impurities, efficient heat removal and understanding a role of the edge plasma that plays in the global energy confinement of the plasma.
- Implementation of diagnostics and plasma modeling are needed to understand both detached and attached divertors and their effect on the core and SOL plasmas.
- Diagnostics installed for determining divertor power balance:
  - 4-channel divertor bolometer array to measure radiation for emission profiles
  - Infrared camera to measure the surface temperature from which the heat flux is derived

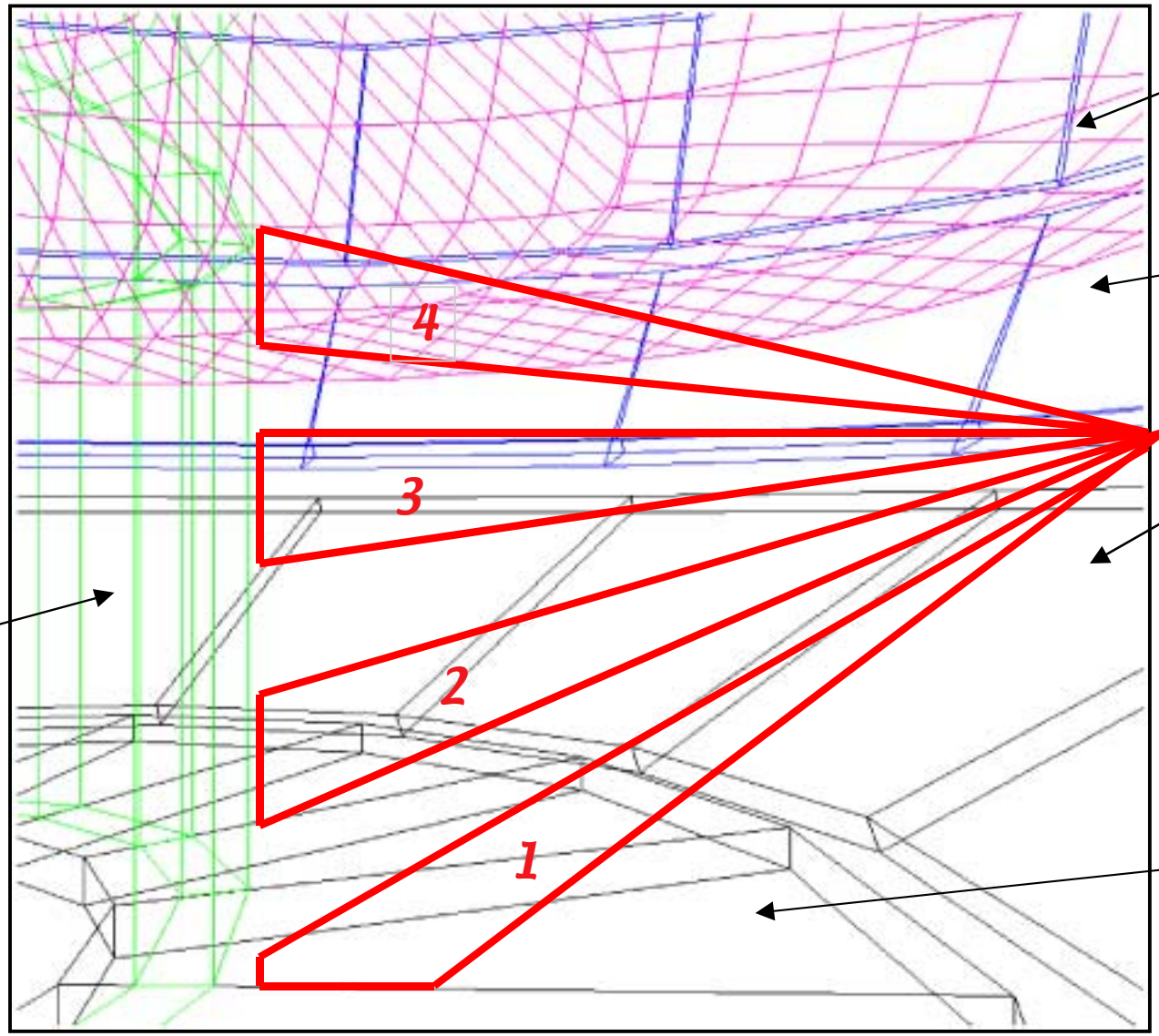
IR camera view allows radial profile measurements

IR camera: 7-13 μm range, 30 Hz, 25 ms thermal e-folding time, spatial resolution ~ 1 cm with present optics





Divertor bolometer view resolves vertically



Main plasma

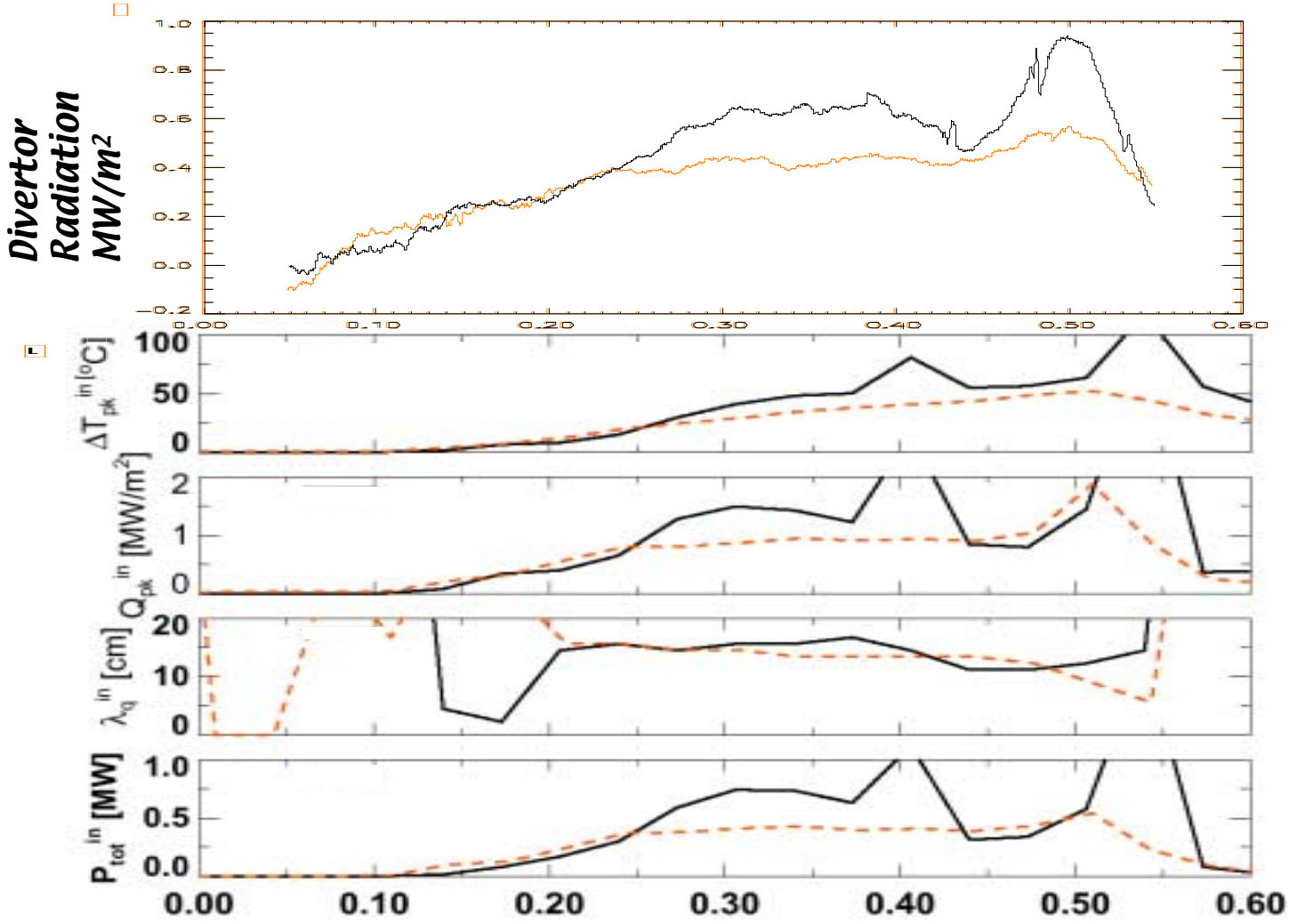
Passive plate

Outer strike plate

Center Stack Pedestal

Inner strike plate

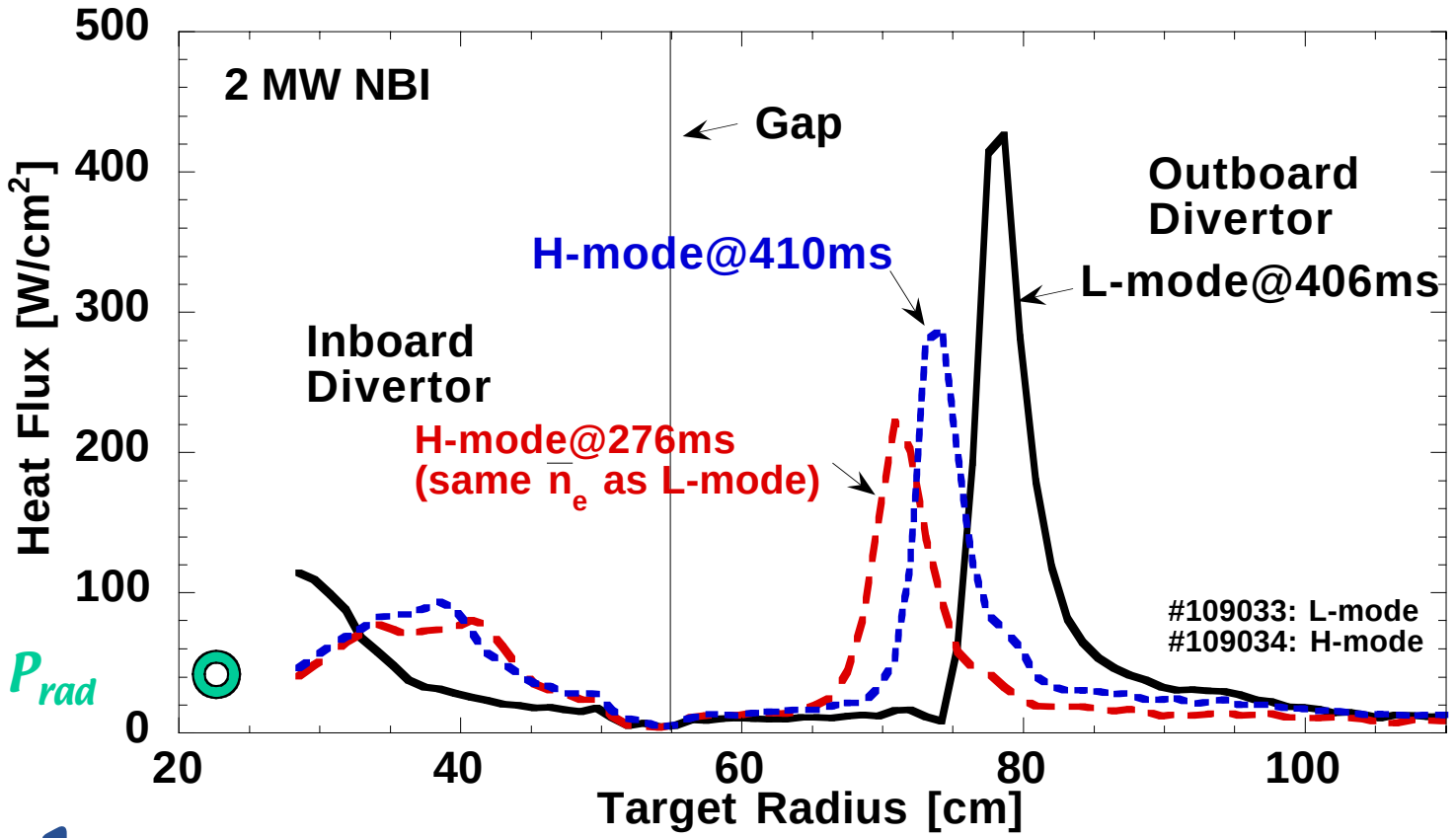
H-mode power scan: Higher heat flux,wall temp. width of strikepoint independent of P_{NBI}



2-source H-mode

1-source H-mode

Higher divertor heat flux in L-mode
Radiated power flux increases from 30 to 42 W/cm² in L-mode



R. Maingi

The Five Main Diagnostic Components of XP 217

- **The Four Main Component XPs are**

  - Heat Flux -- IRTV cameras (R. Maingi)
  - Edge Profiles -- Fast Probe (J. Boedo)
  - D_α camera Core Fueling (V. Soukanovskii)
  - Divertor Radiation -- Bolometry (S. Paul)
  - Edge-turbulence GPI camera (S. Zweben, R. Maqueda)

- **New diagnostics implemented successfully**
  - Fast Probe
  - Divertor Bolometers

Stated goals of ECX (XP-217)

- Main mode of operation for the XP:
  - Expect lower single null divertor geometry
  - Mostly NBI - Later HHFW
  - Need L-mode, H-mode -- ELM-Free
  - Need some Center Stack Limited comparison shots
  - Configuration scan -- need DND

- Achieved conditions:
  - LSN achieved with 1 and 2 NBI sources
  - 1 source L-mode/H-mode comparison
  - L-mode had higher peak heat flux

Remaining Objectives in XP 217

- **Power scan is first priority -- higher power levels + Ohmic comparison**

  - Still need about 15 shots per power scan
  - It will take (with plasma operation) awhile to get accurate probe position.
  - Will have to place probe at safe position with each new condition then move in on subsequent shots
  - Helium puff (for GPI) does not need dedicated shot
  - Pitch angle for GPI restricts I_p and B_t: shot development

- **Configuration scan requires double null divertor (DND)**
- **Need 200 ms heat flux equilibrium**
- **Shape scan requires about six shots**