Heat Flux and Radiated Power in the NSTX Divertor

S.F Paul, R. Maingi and the Boundary Physics ET

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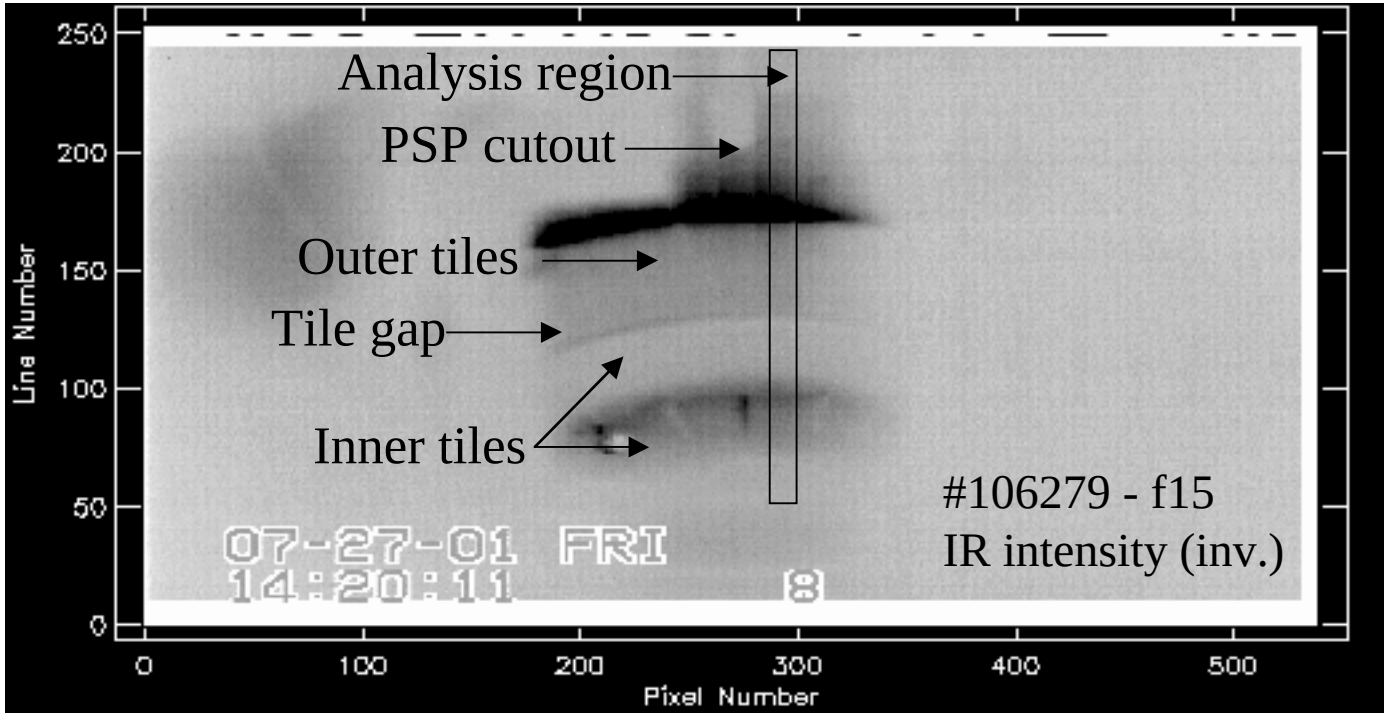
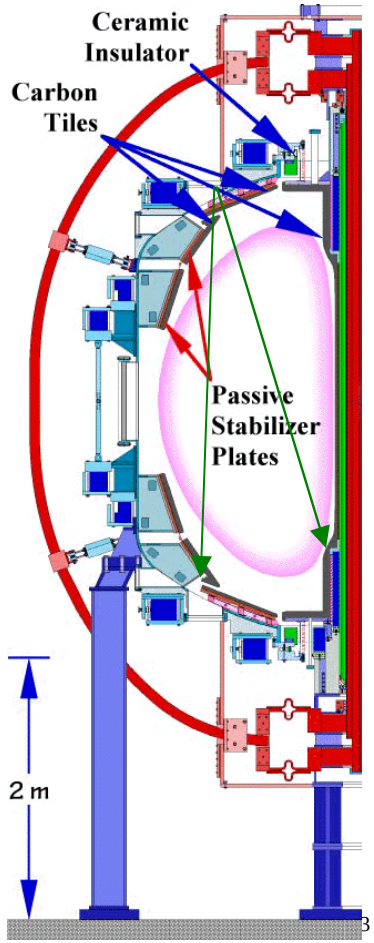
Divertor and plasma boundary research in NSTX

- 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

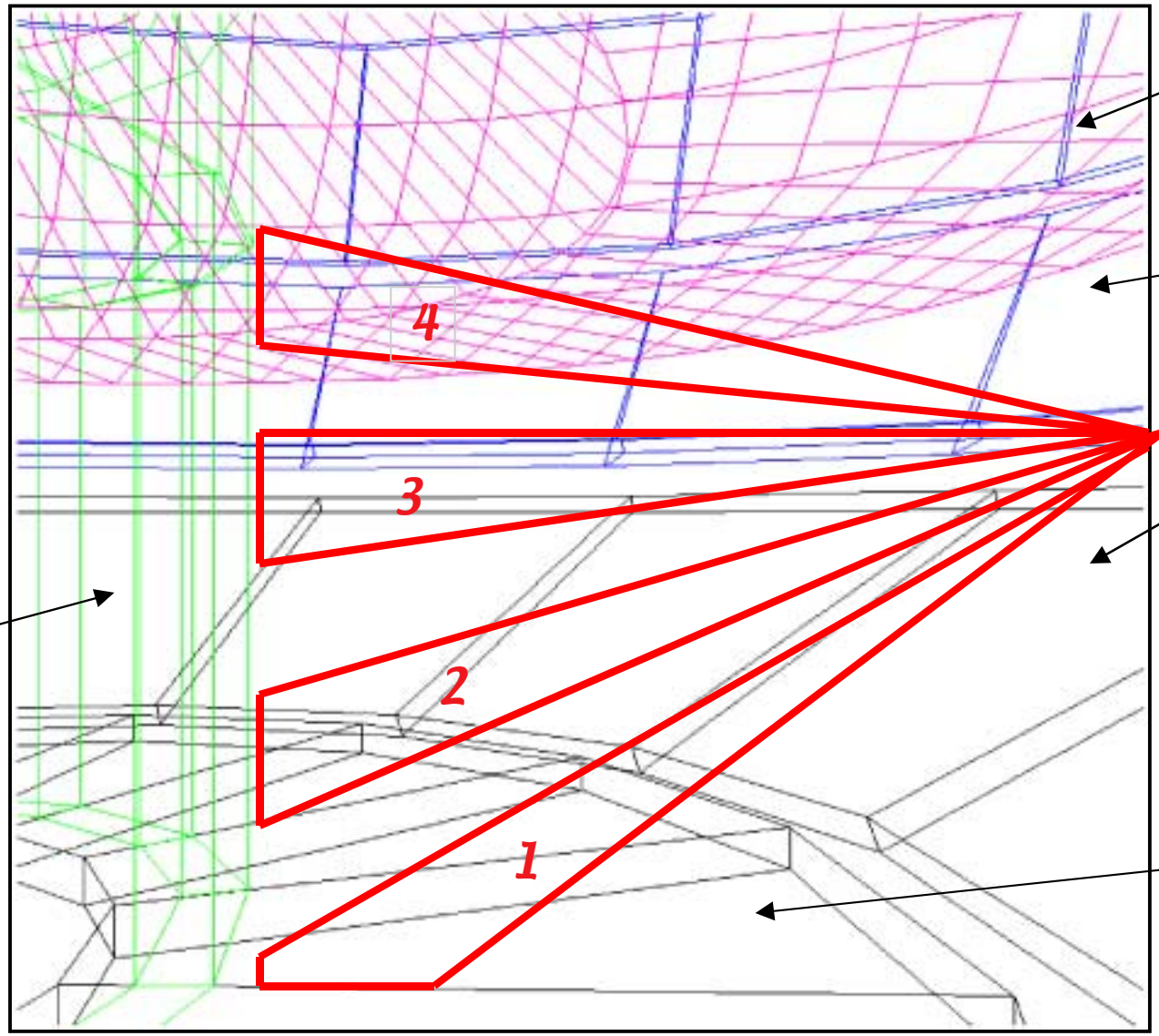
IR camera view allows radial profile measurements

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

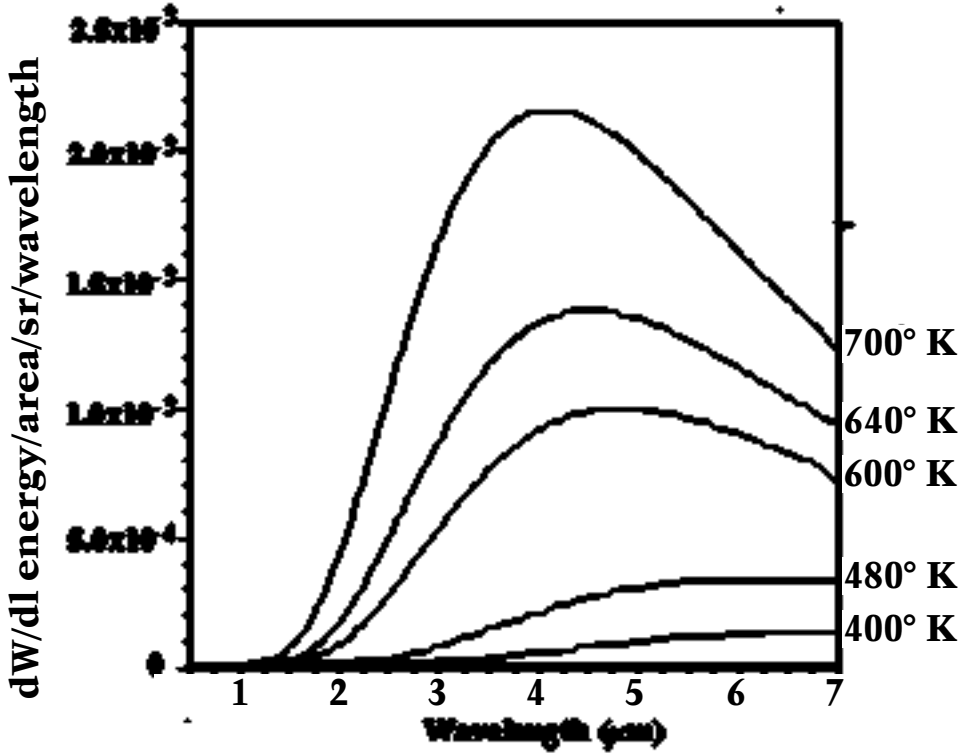
Outer strike plate

Center Stack Pedestal

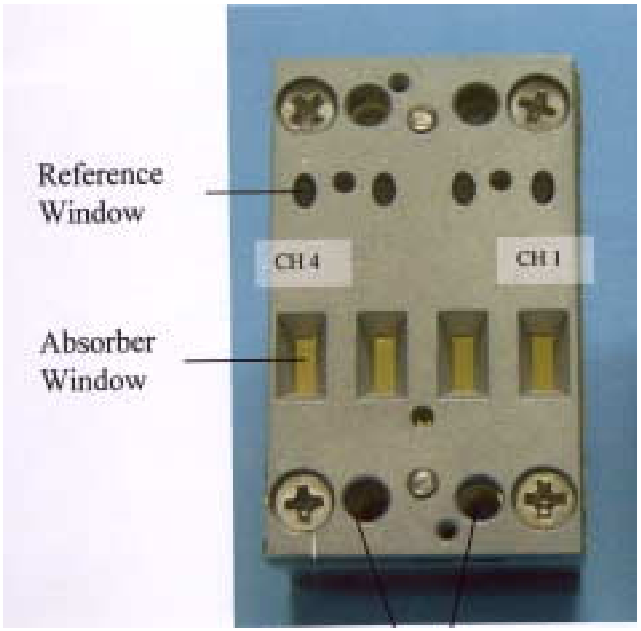
Inner strike plate

Bolometer has gold foil face, reflects above .5 μm

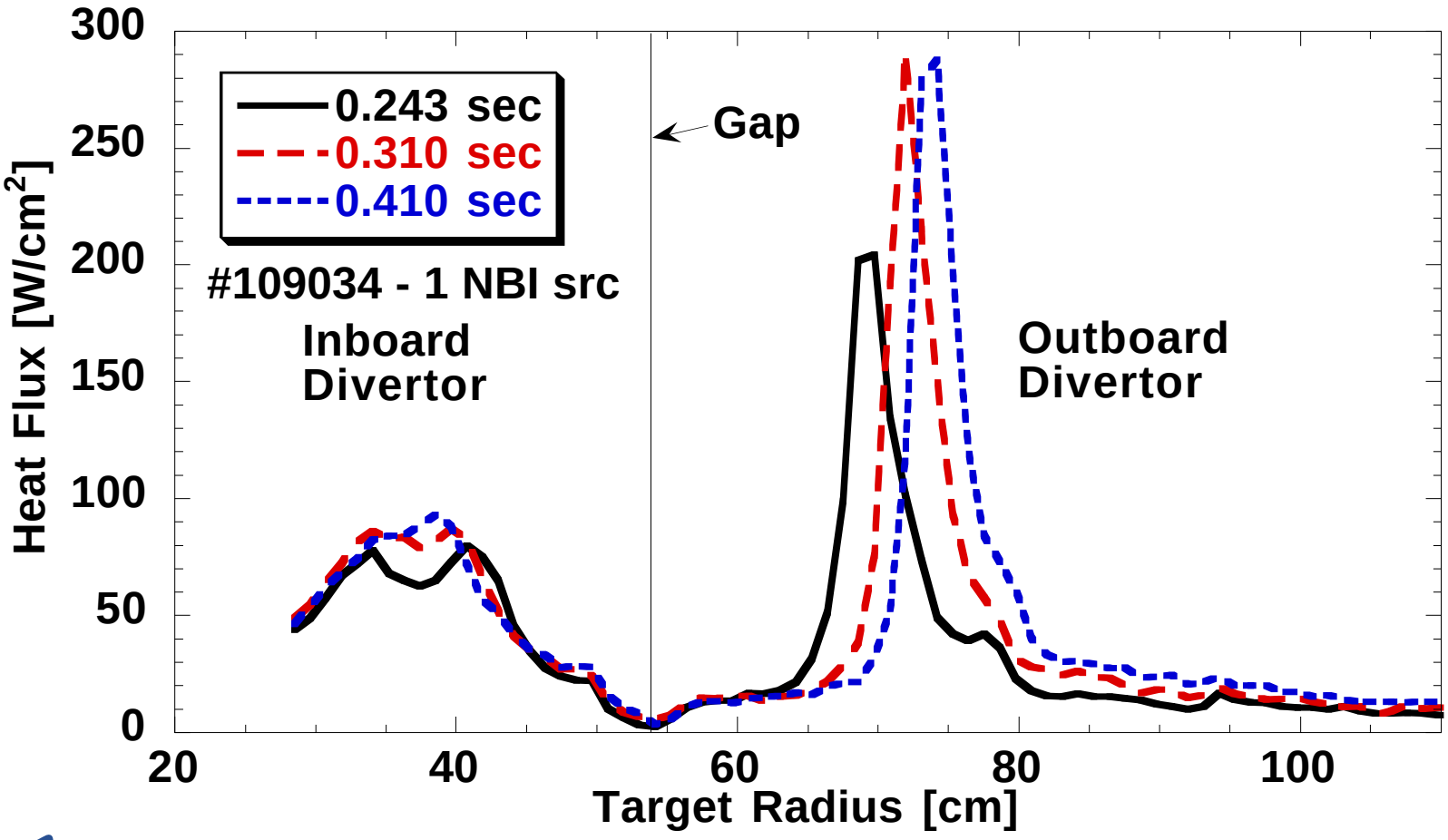
Tile blackbody radiation > 1 μm



Divertor bolometer sensor



Heat flux profile in 1 src. NBI shot comes into equilibrium



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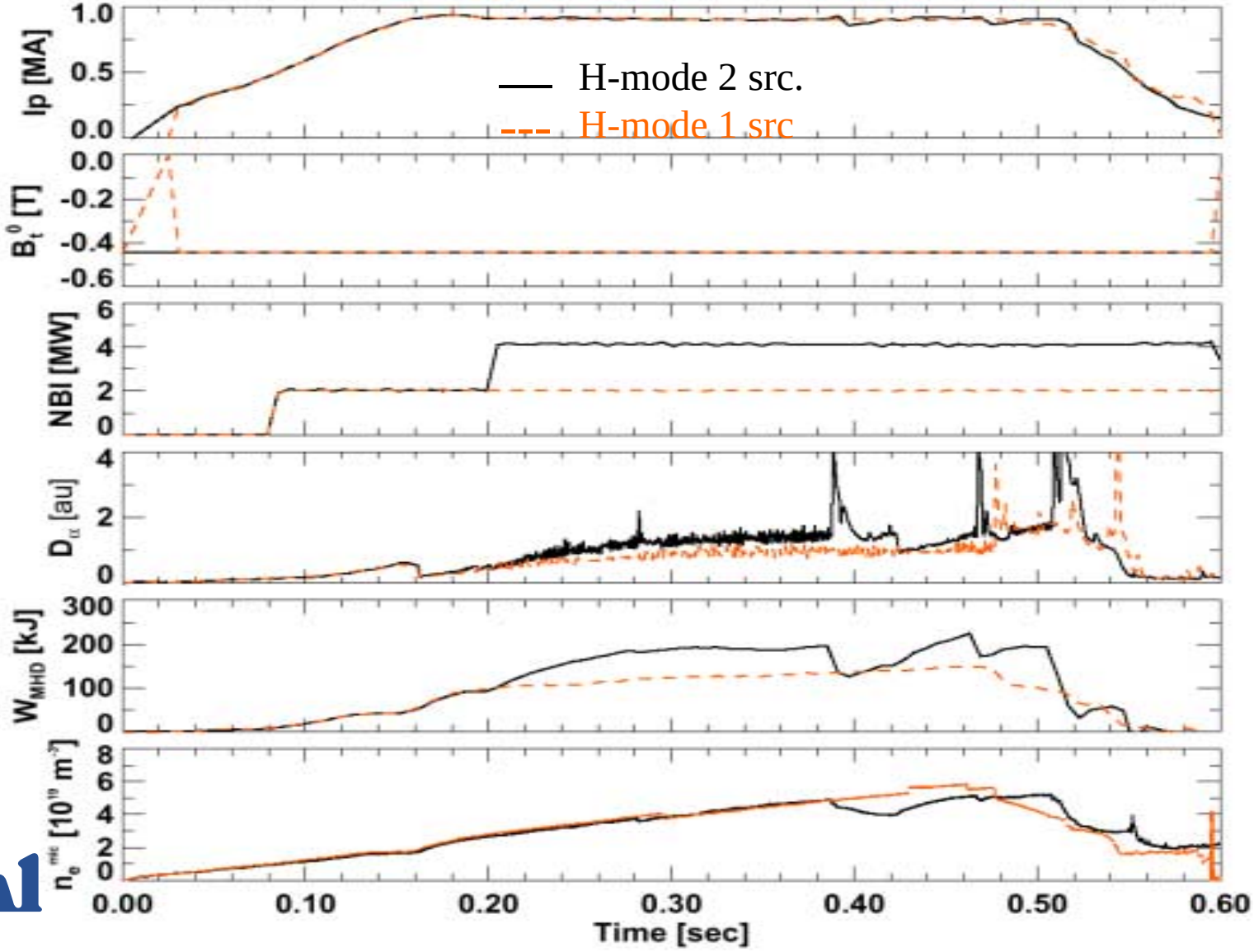
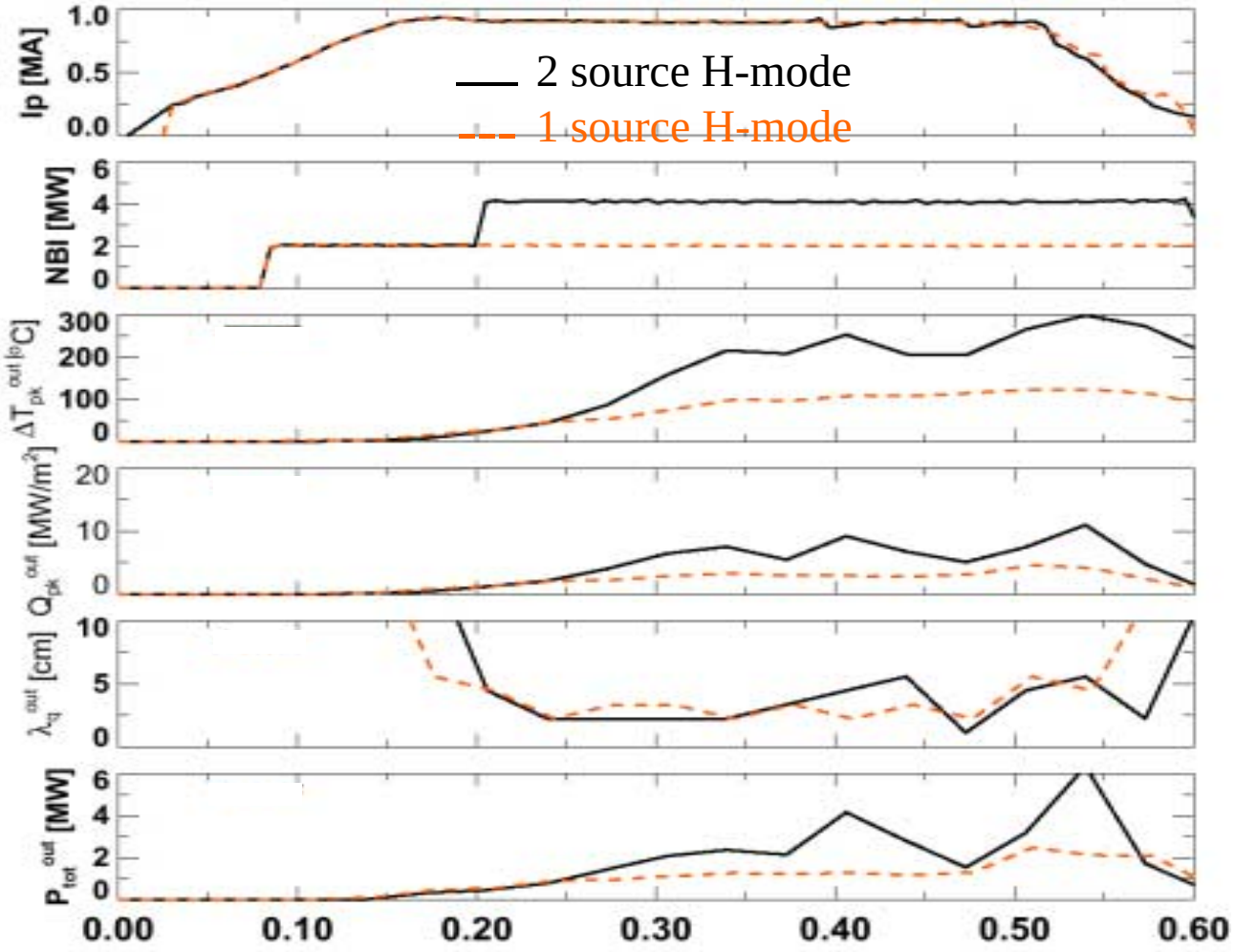
H-mode power scan: 2 src shot has higher W_{st} and longer H-mode



Outer strike plate: Higher heat flux -> higher wall temp. narrow width of strikepoint independent of P_{NBI}



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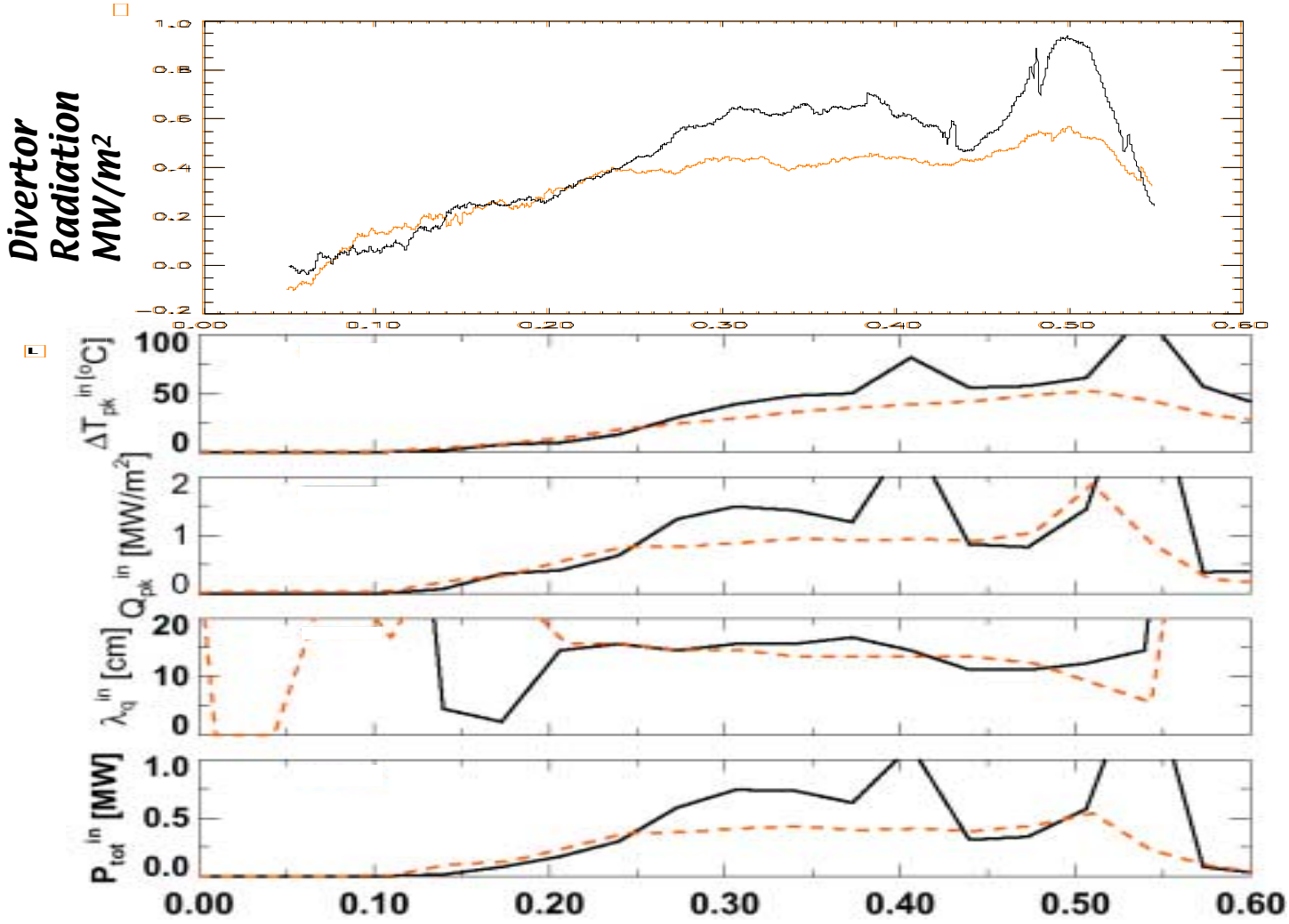
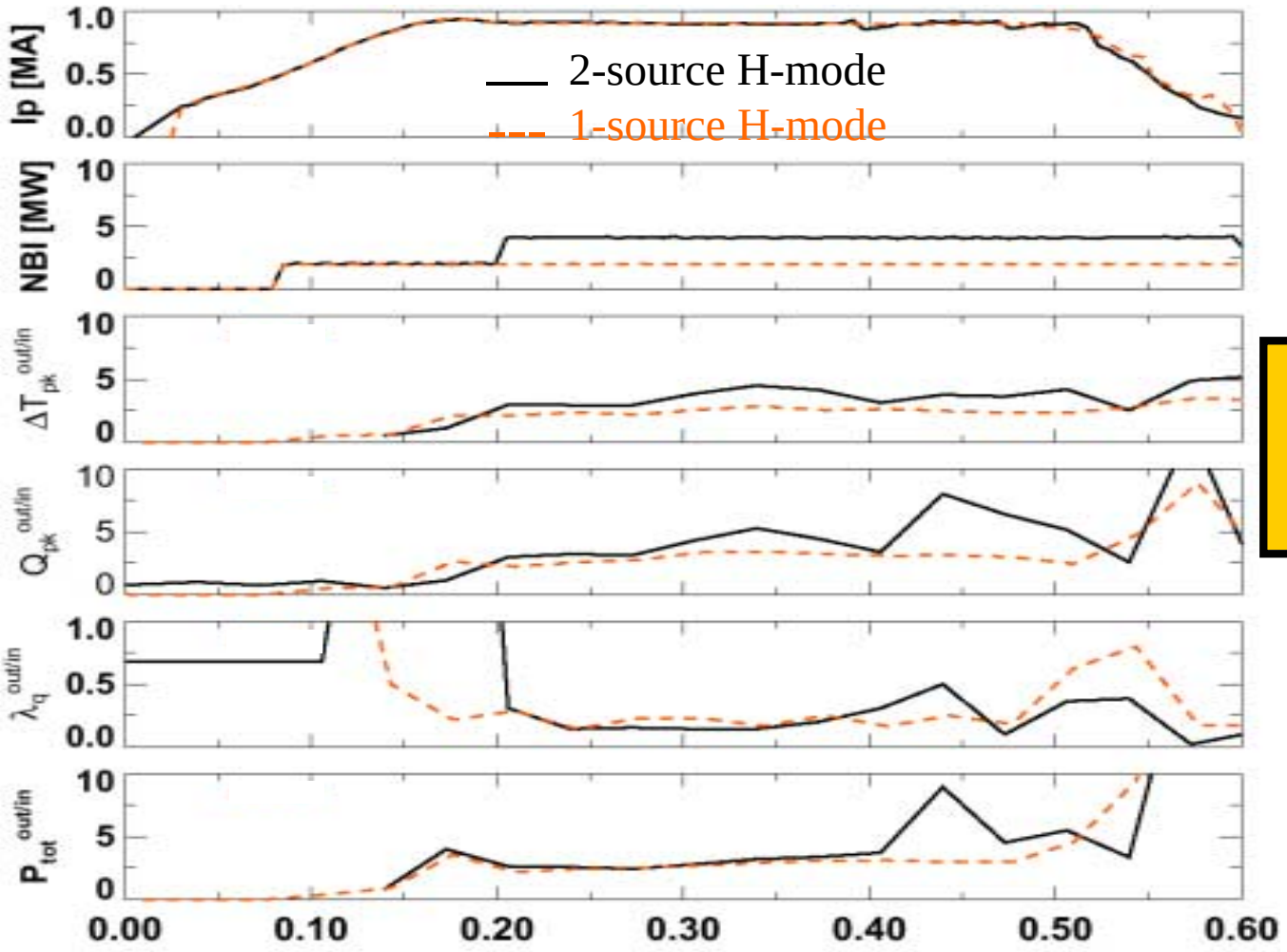
Inner strike plate: Higher heat flux -> higher wall temp. wide width of strikepoint independent of P_{NBI}



2-source H-mode

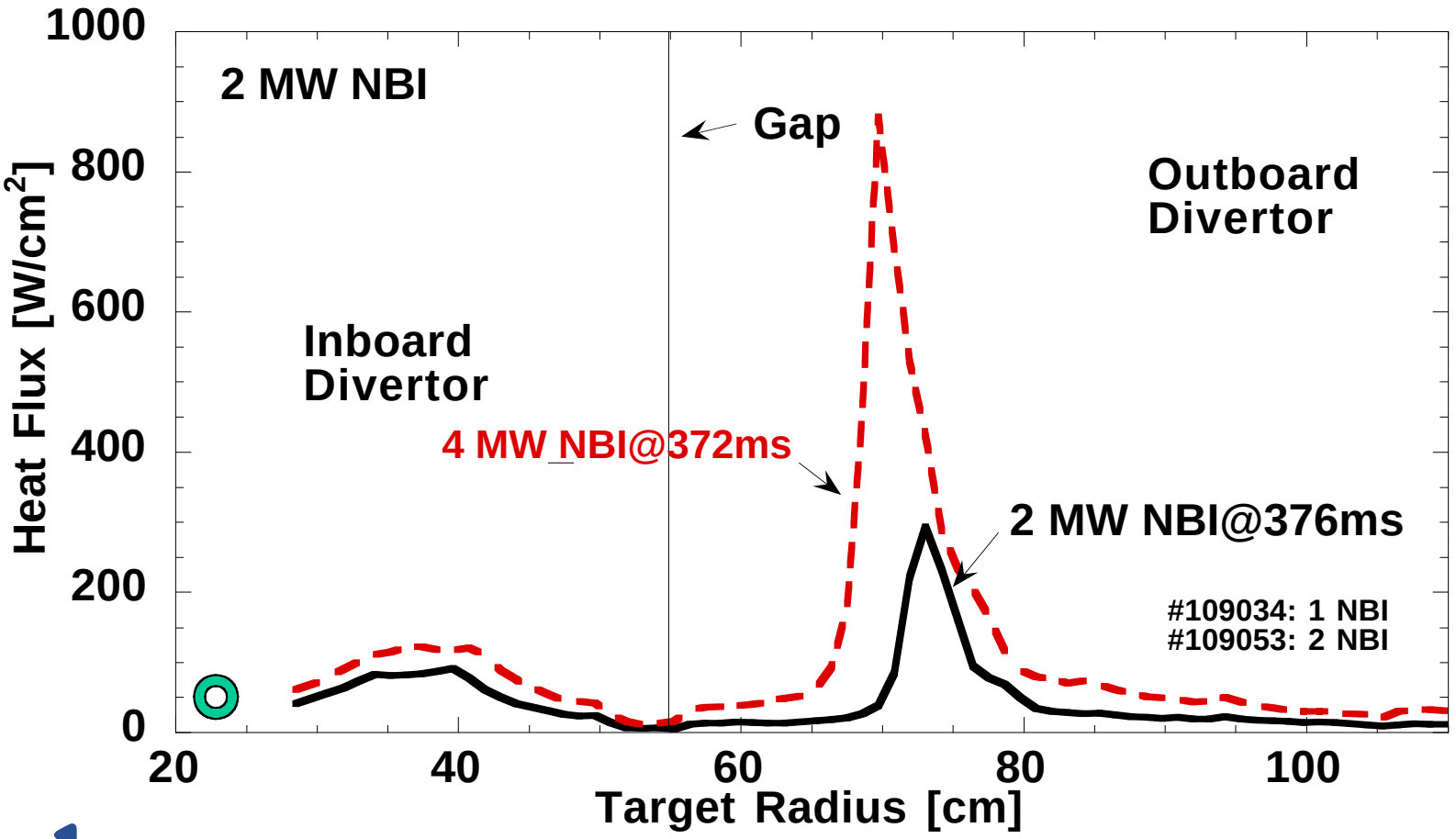
1-source H-mode

In/out ratio: footprint and power not dependent on P_{NBI}



But neither peak temperature rise nor peak heat flux.

Profile comparison at 3.7×10^{13} cm^{-3} higher flux, same foot print Radiated power flux is increases from 43 to 64 W/cm^2



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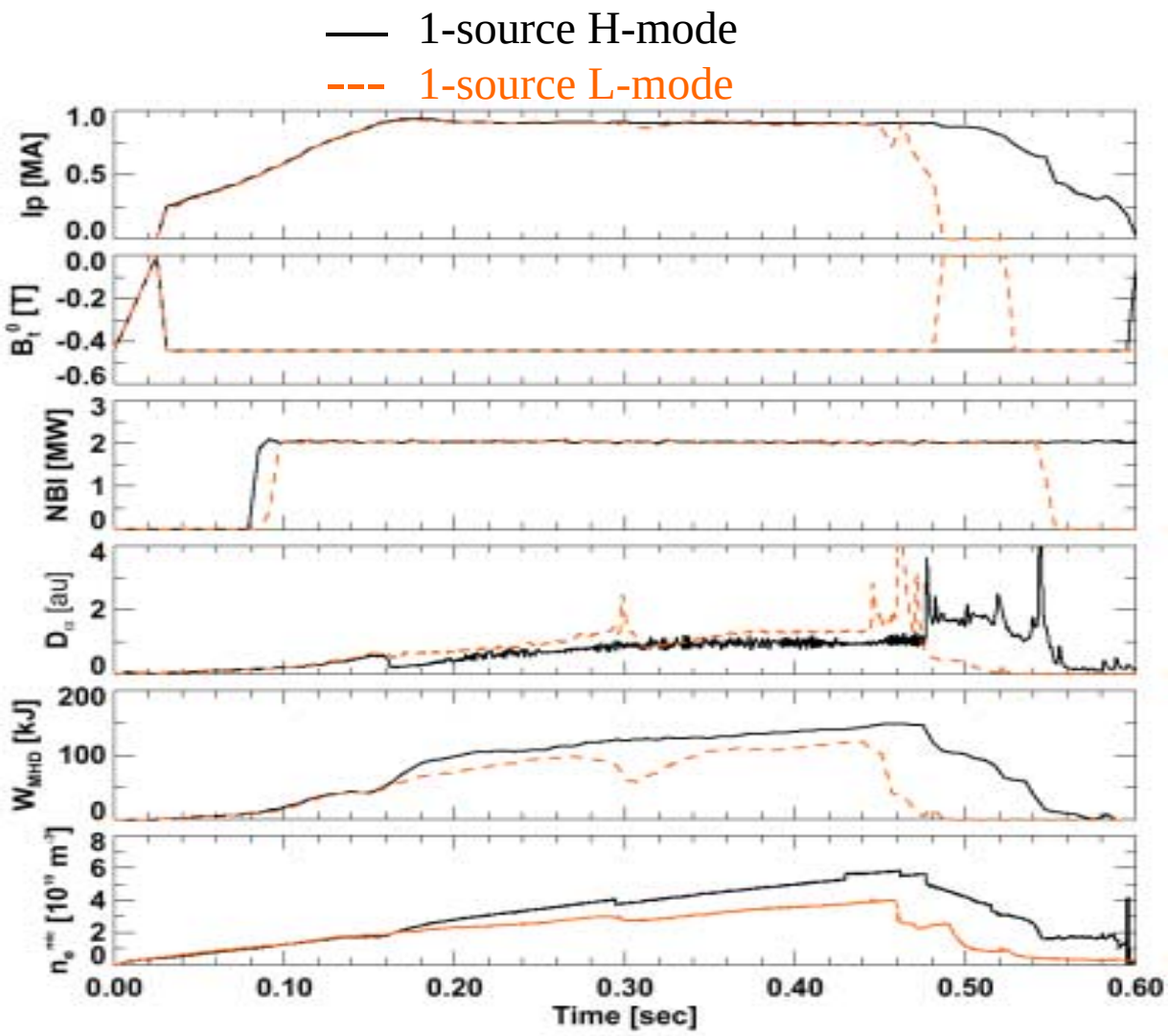
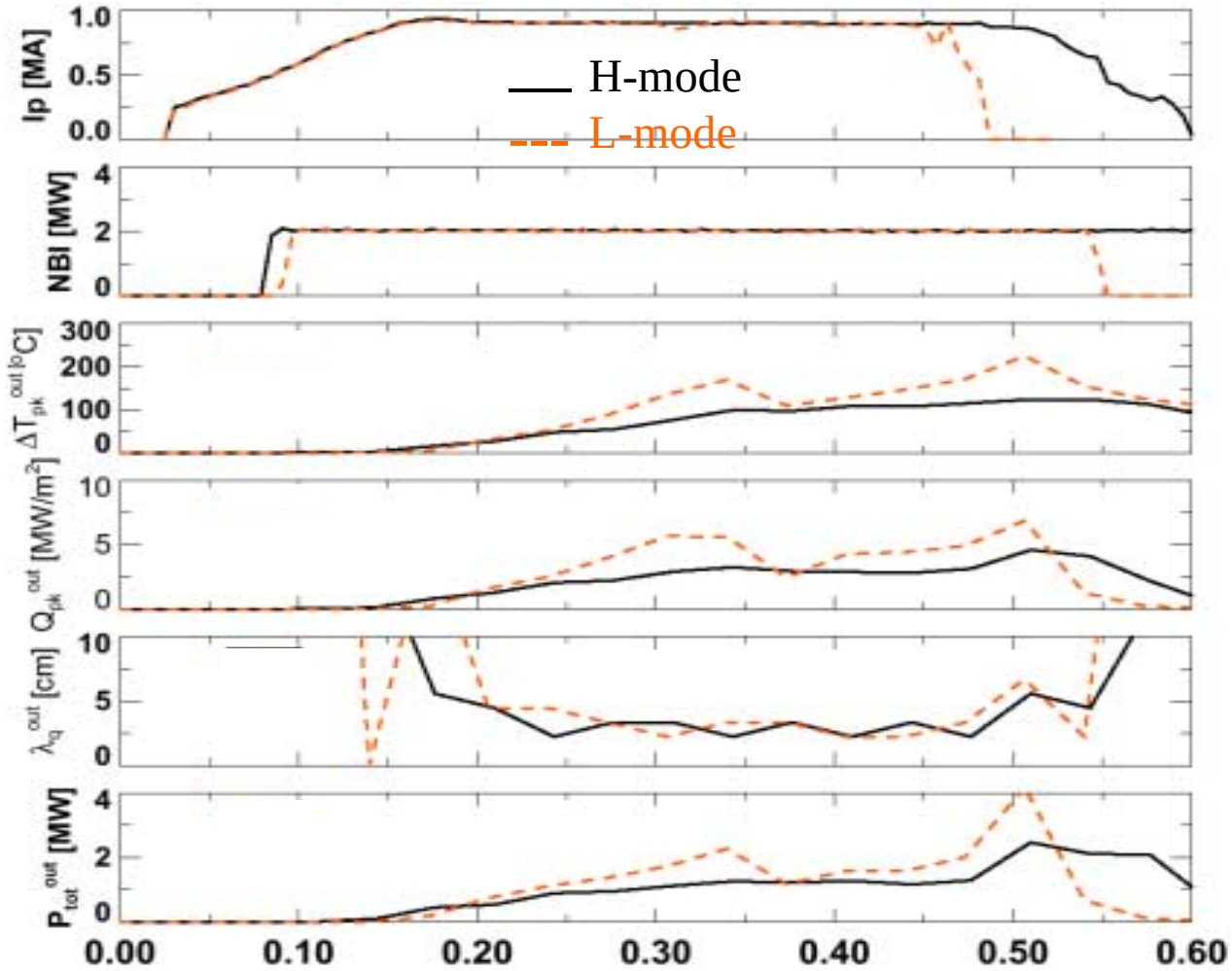
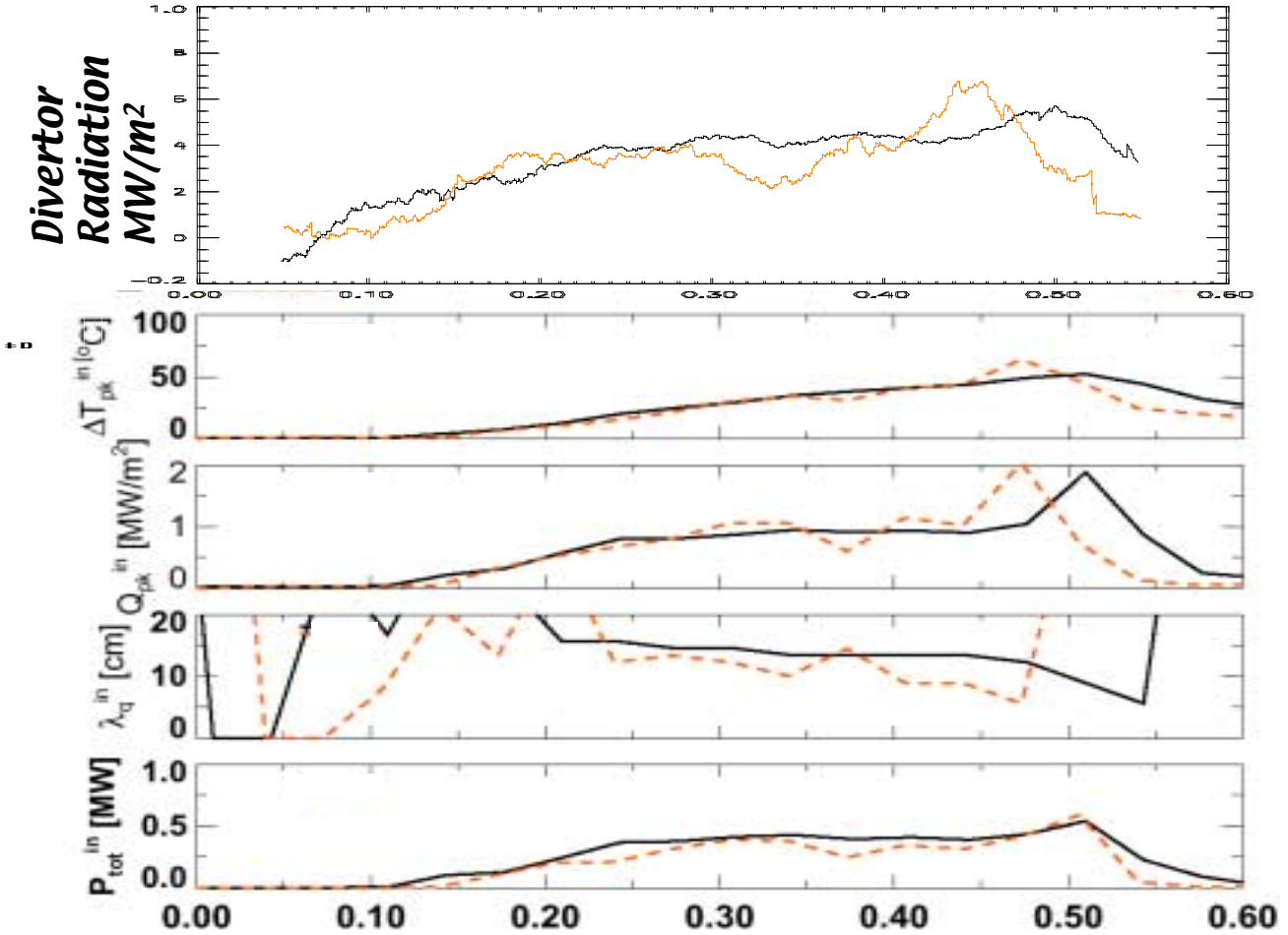
L-mode/H-mode comparison --1 NBI source



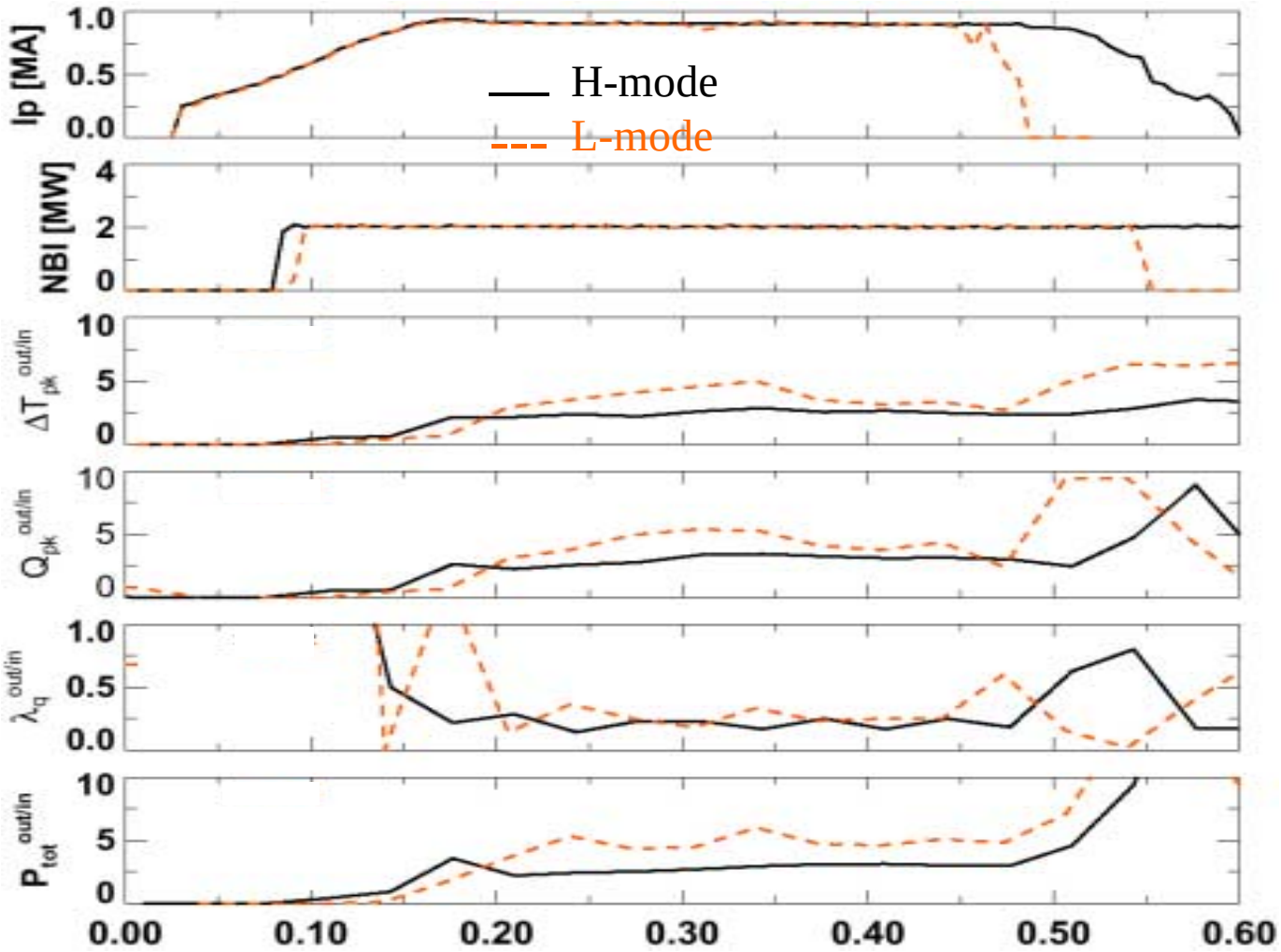
HIGHER heat flux on outer plate in L-mode



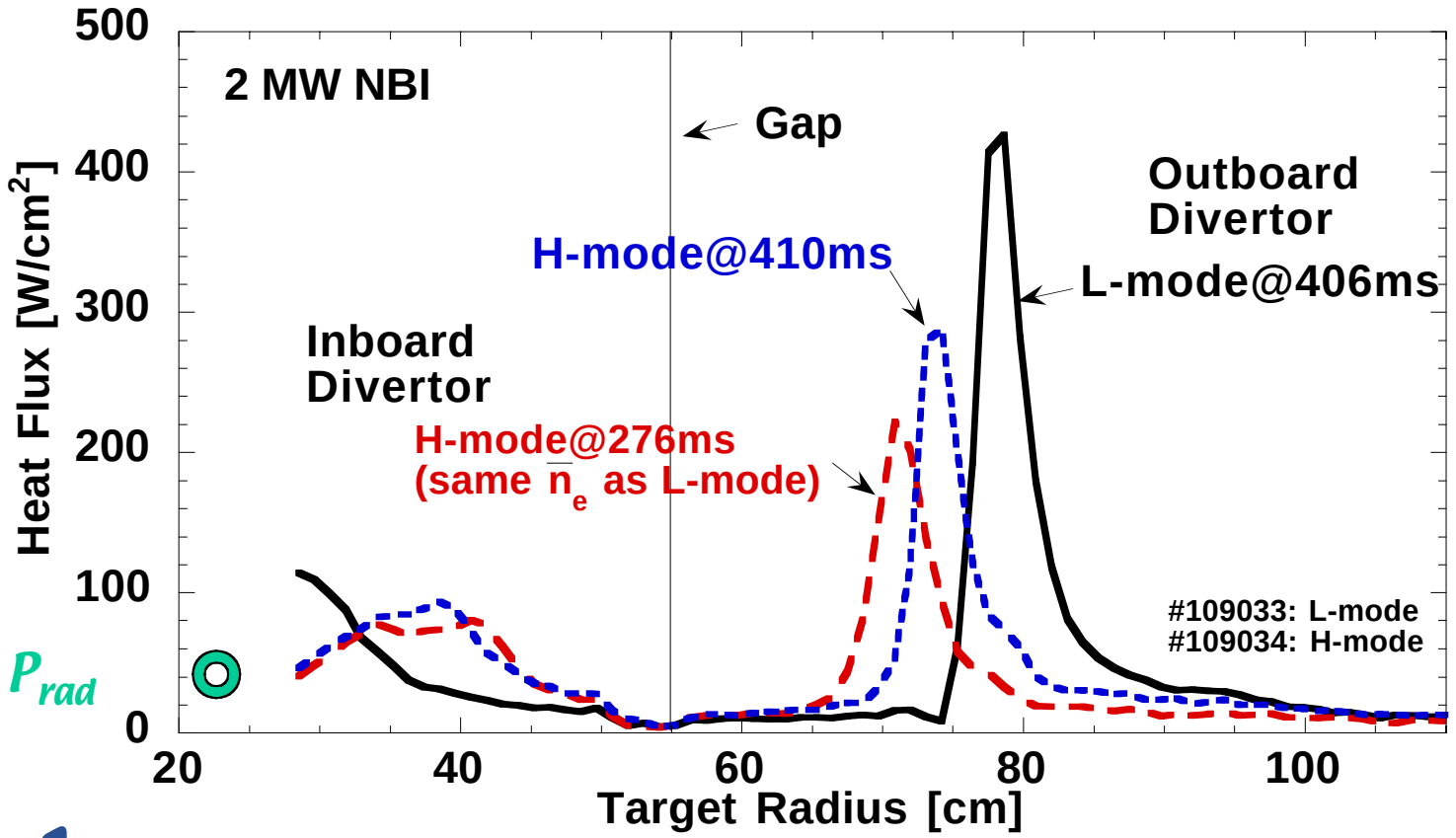
No change in heat flux on inner plate in L-mode



HIGHER heat flux on outer plate in L-mode



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



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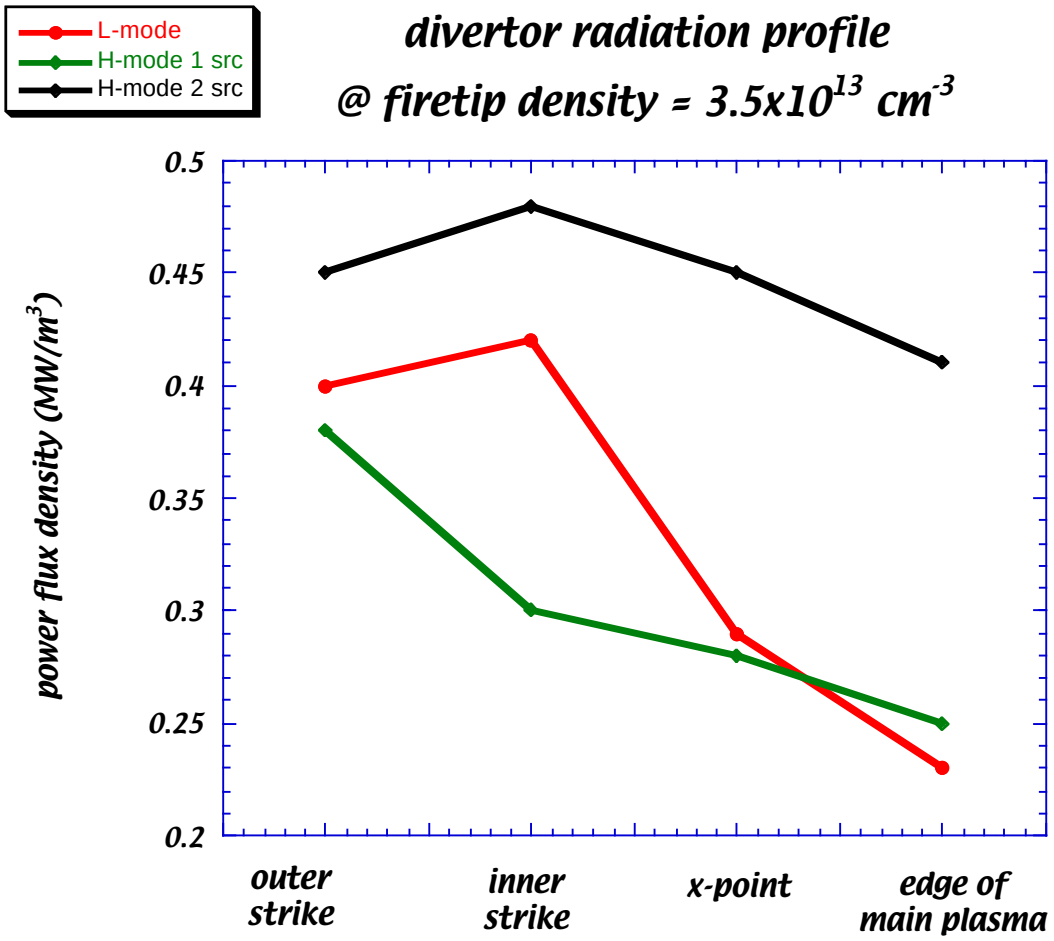

At same power level, divertor radiation is slightly higher in L-mode
At low power, vertical radiation profile concentrated towards strike plates.
Rough estimate of divertor radiated power up to 1 MW