EFDA EUROPEAN FUSION DEVELOPMENT AGREEMENT JET

Comparison of RF-heated with NBI-heated ELMy H-mode plasmas in JET

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Outline

Motivation

Experiment

Modeling and Results

Discussion and Future Plans

Motivation

ICRH – heated ELMy plasmas are suggested for reactor startup

But NB-heated ELMy plasmas have better diagnostics and better performance in present-day experiments

To what extent are NB and ICRH ELMy's comparable?

Goals

Compare global and local parameters for ICRH and NBI ELMy's

Compare results with Ion Temperature Gradient theory

Results from experiment

Matched pair of ICRH and NBI heated ELMy plasmas

Heating power lower than desired (close to L-mode)

V_{Tor} for RF in Co-I_p direction, similar in shape to that of NBI, but 15% magnitude

Power deposition in ICRH more central, similar to that expected by alpha heating

Higher central Z_{eff} with ICRH

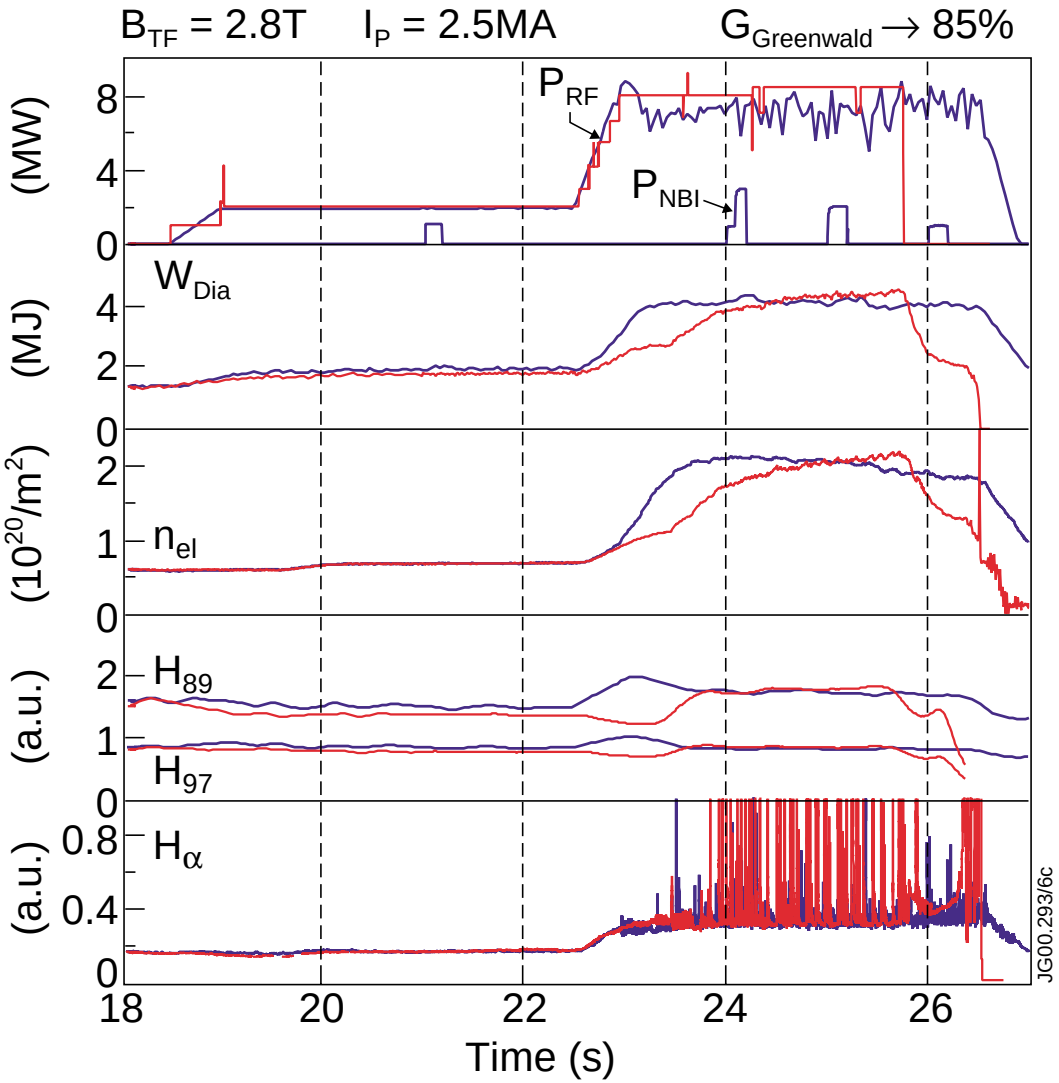
Results from theory

Near the mid-radius, R/L_{Ti} close to R/L_{crit} for ICRH and NBI

Peak γ_{lin} similar for ICRH and NBI

Peak ω_{ExB} and $\omega_{ExB} / \gamma_{lin}$ smaller for ICRH

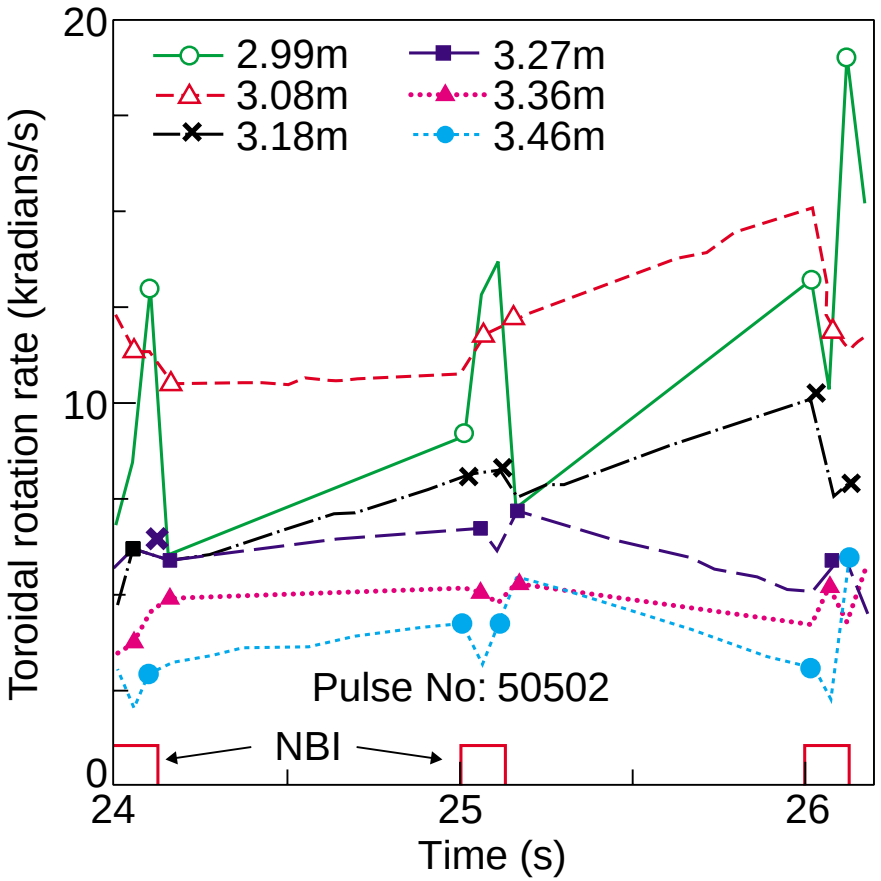
Matched pair of plasmas:

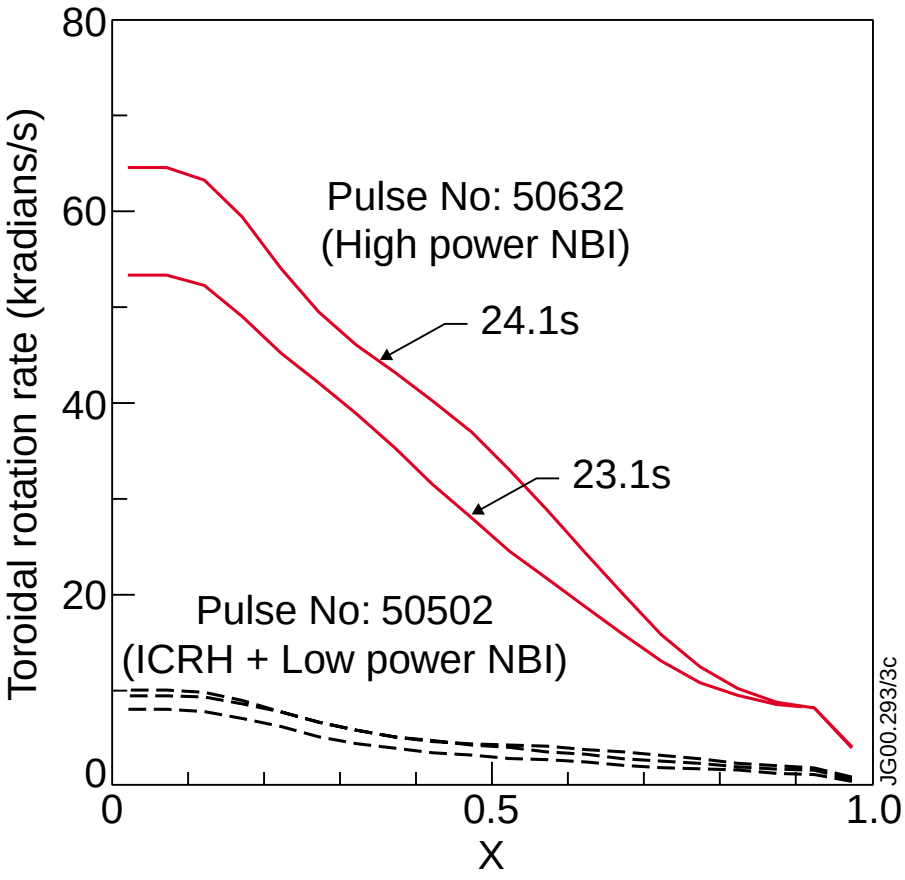


Pulse No: 50502 with ICRH

Pulse No: 50632 with NBI

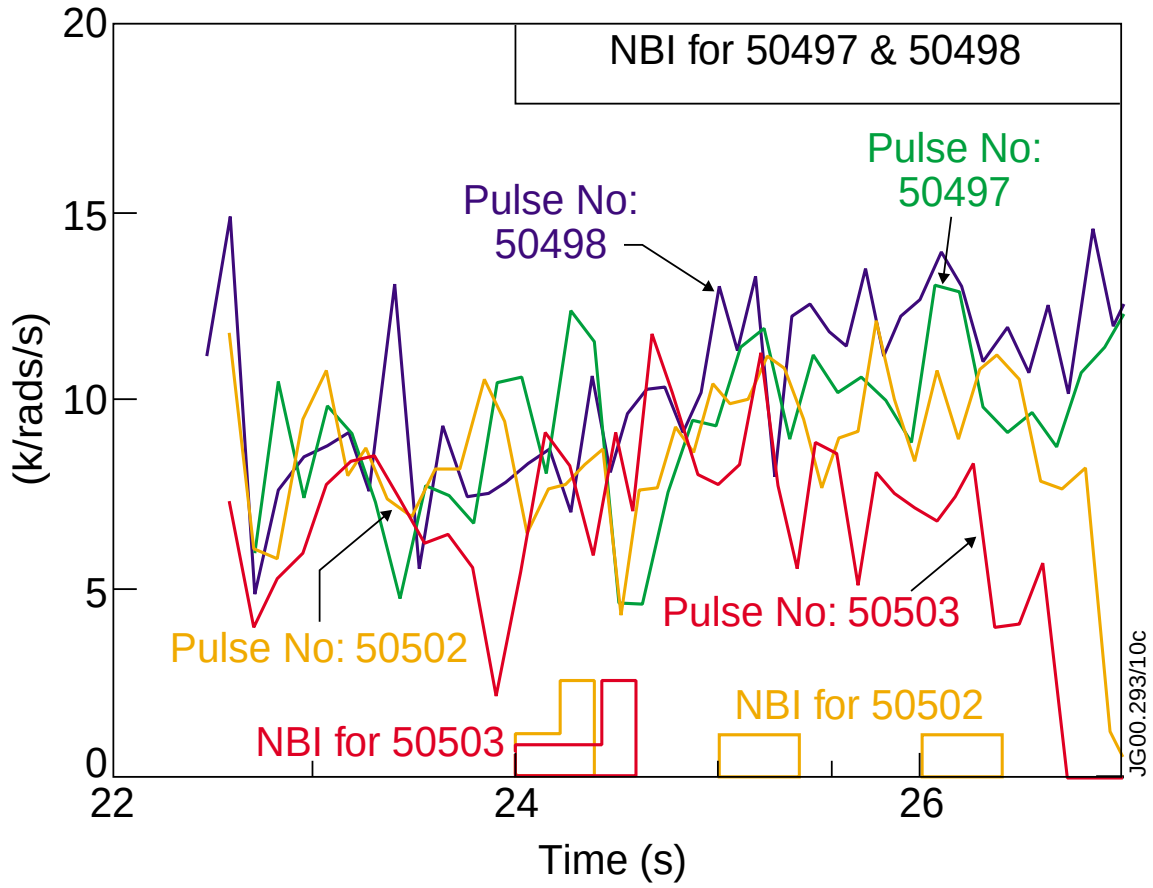
Measured toroidal rotation rate from CX



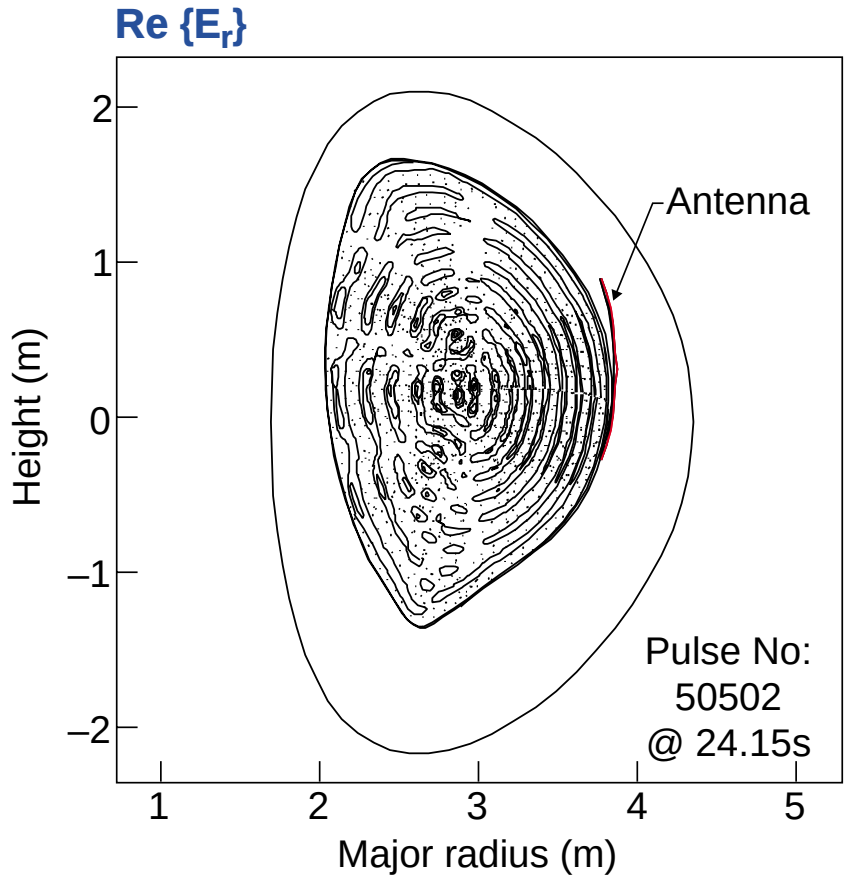


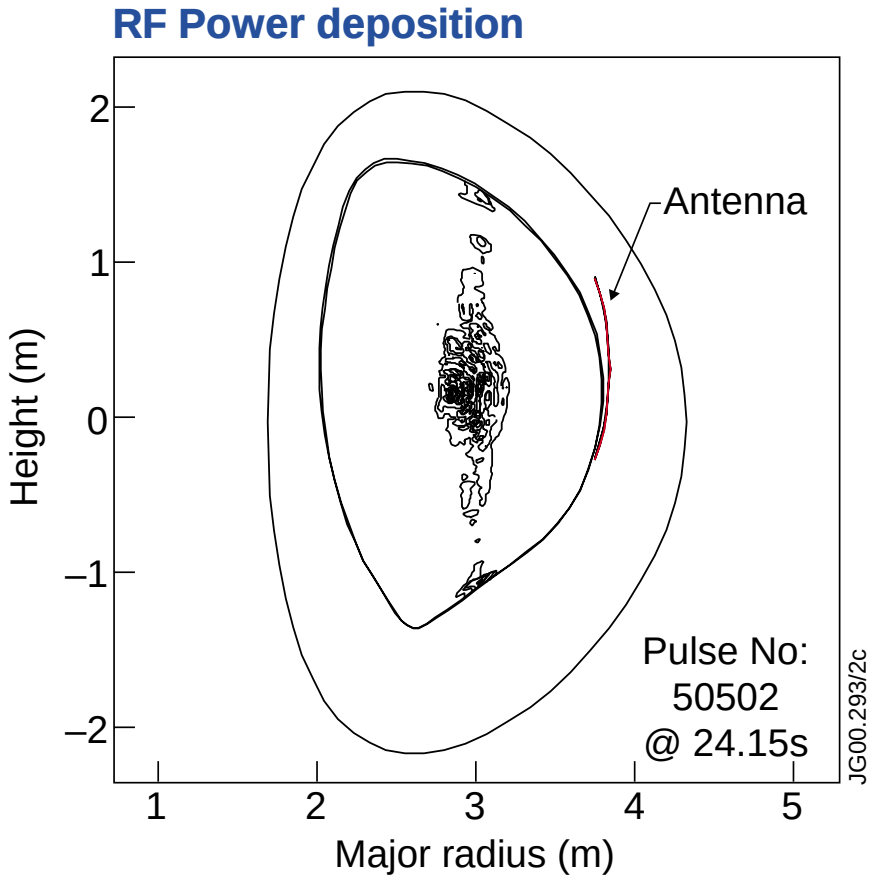
Rotation factor of 6 lower with ICRF

Toroidal rotation rate measurements of Ni27 consistent with CX measurements



2D contours from TRANSP using SPRUCE ICRH model

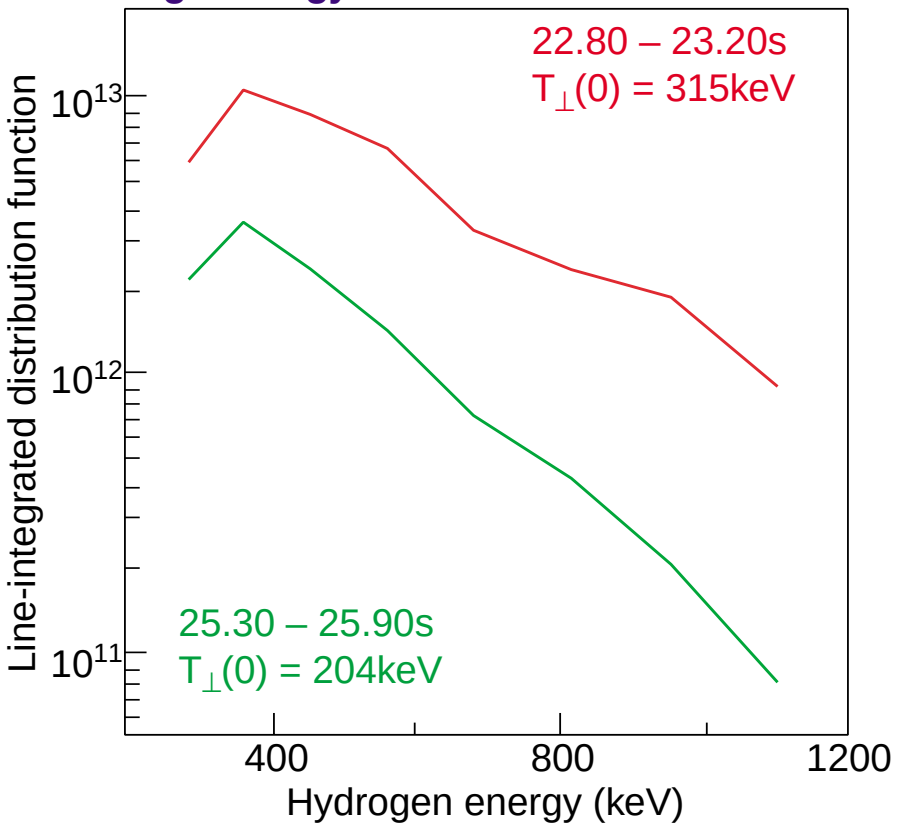




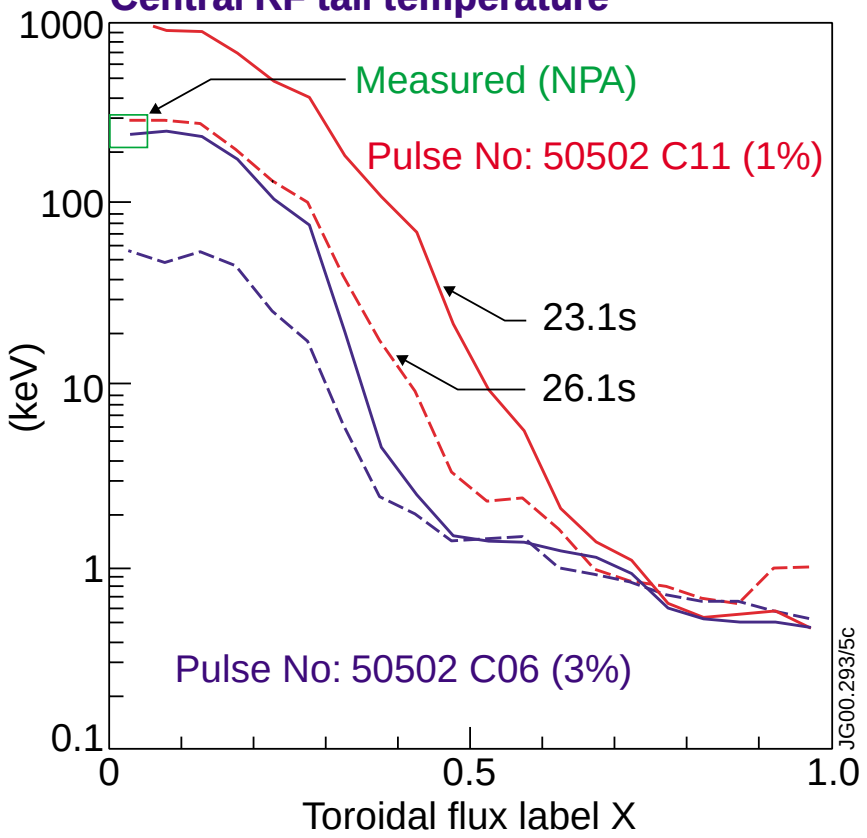
Well focused heating on resonance rear axis

Distribution function of hydrogen minority in Pulse No: 50502

High Energy NPA measurements

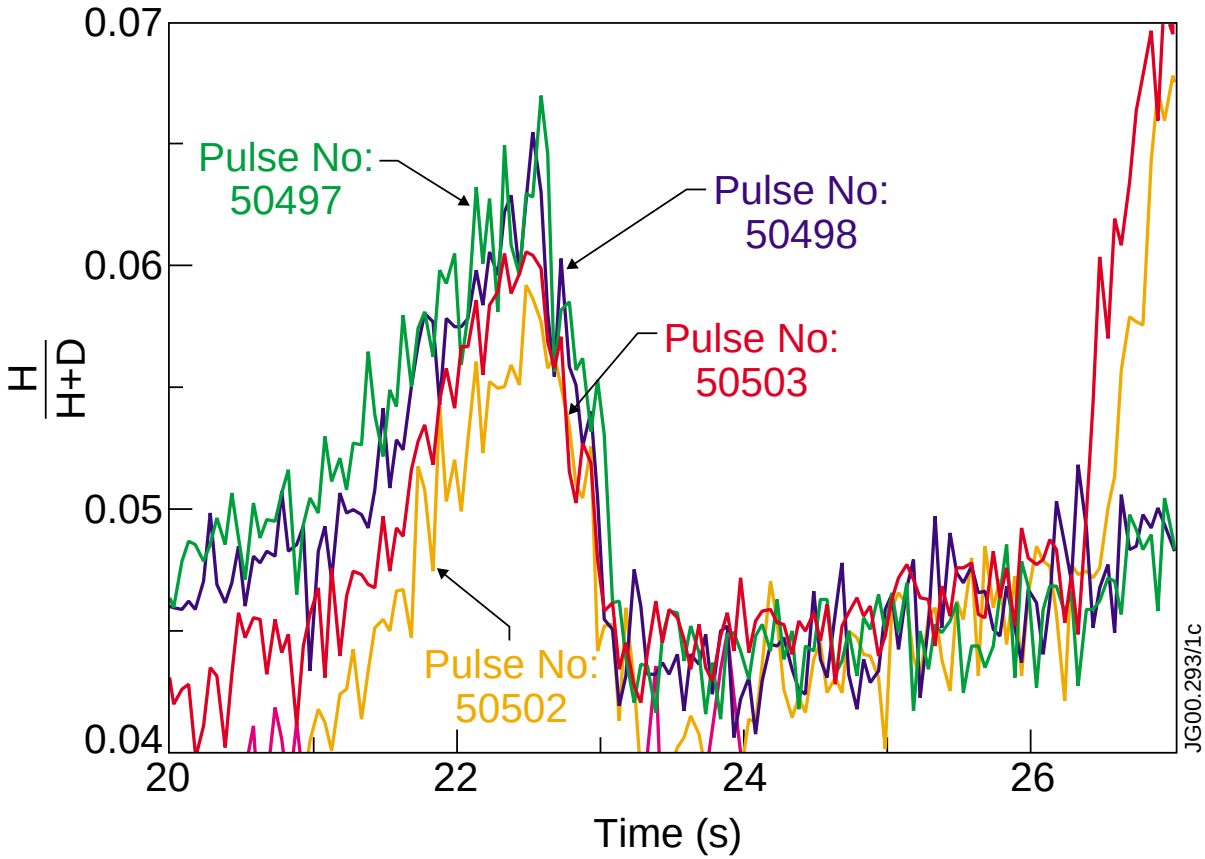


Central RF tail temperature

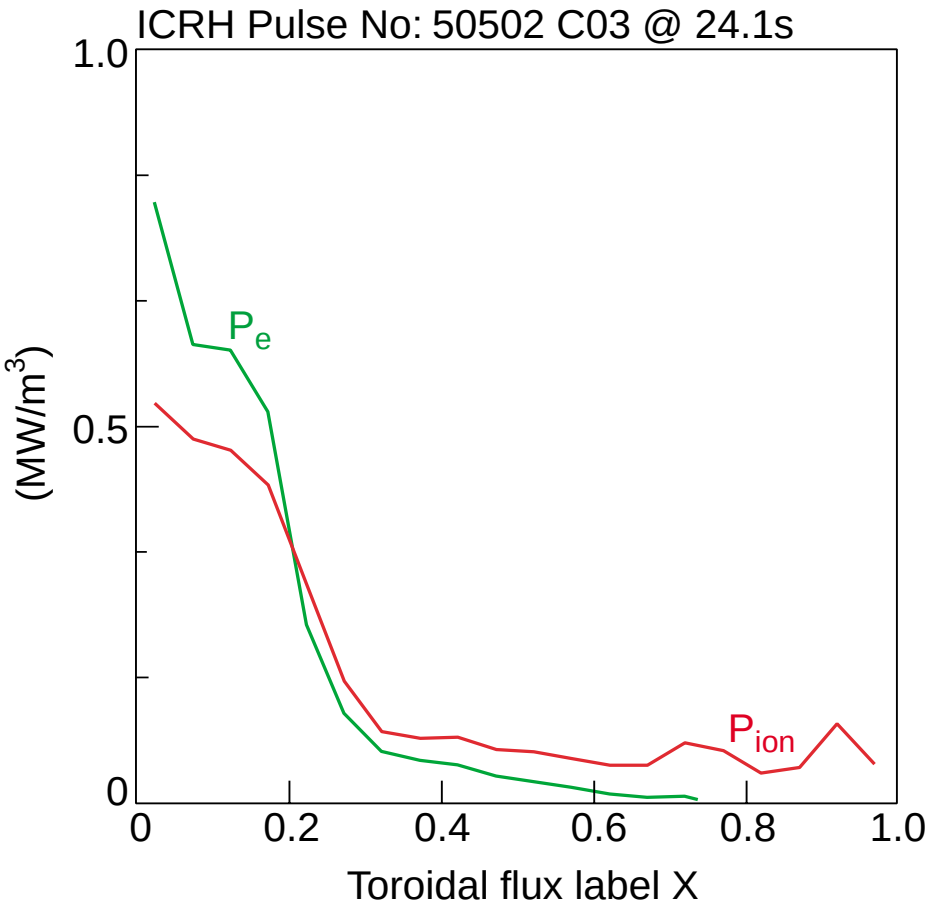


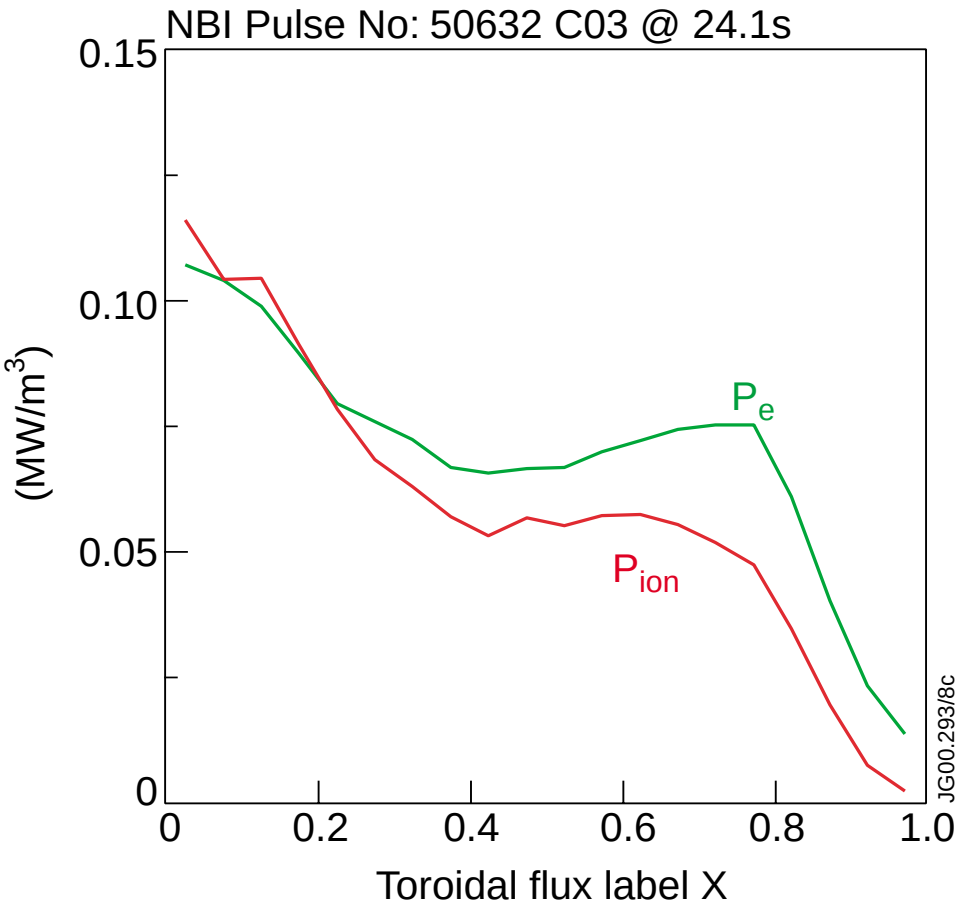
$n_H/n_e \approx$ 1-2% in approximate agreement with measurements

H Concentration in the edge increases in time

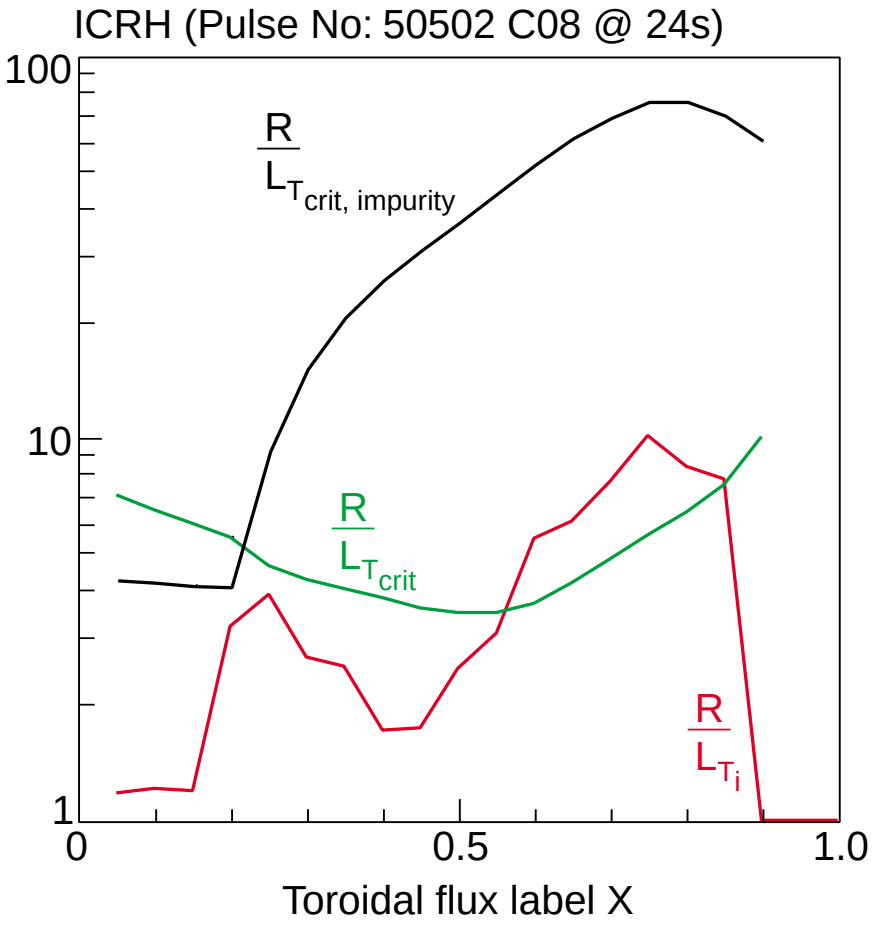


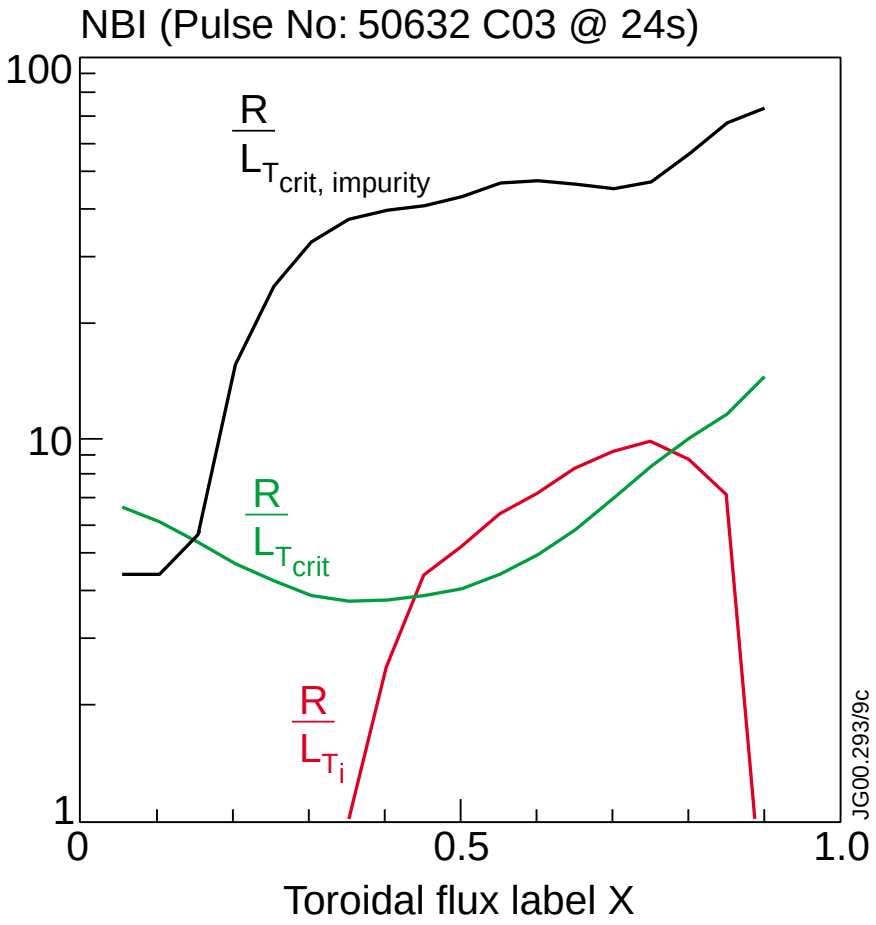
ICRH Heating power deposition to thermal plasma can simulate alpha heating



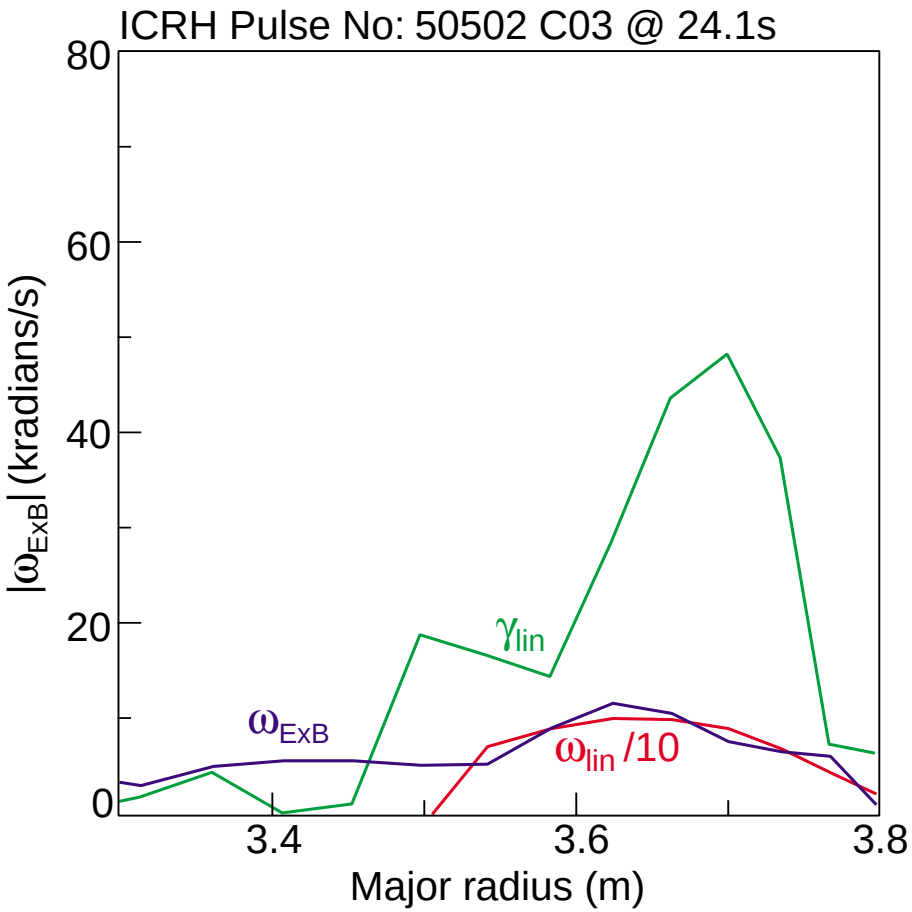


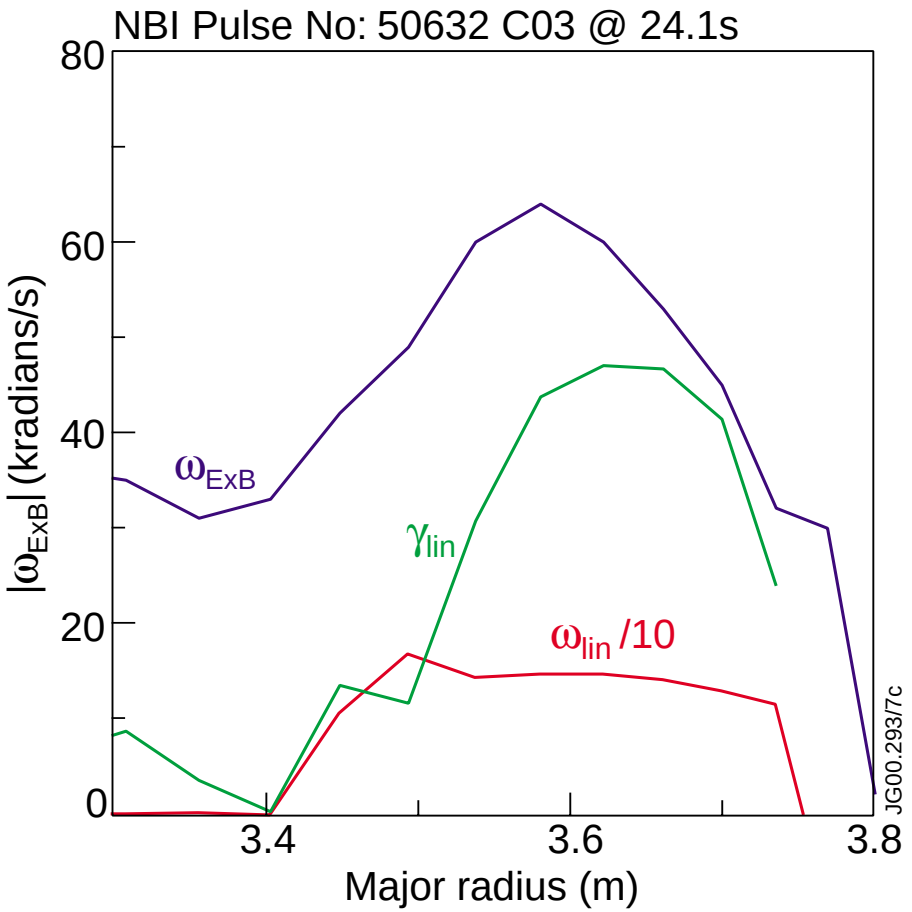
Ion temperature gradient near the critical value at mid radius





Microturbulence growth rate, frequency and flow rate





Turbulence suppression ratio $\omega_{ExB} / \gamma_{lin}$ small for ICRH, large for NBI

Discussion

The turbulence suppression ratio $\omega_{ExB} / \gamma_{lin}$ appears to be paradoxically small for ICRH plasmas

Candidate explanations:

- $\omega_{ExB} / \gamma_{lin}$ is not a good indicator of microturbulence and transport suppression
- V_{Pol} is larger than $V_{neoclassical}$ and thus ω_{ExB} is larger
- γ_{lin} is not a good indicator of the amount of microturbulence and transport

Future plans

Improve the ITG analysis to include non-linear effects, TEM branch, etc

Continue the experiment at higher heating power to produce plasmas with more reactor relevant conditions and lower torque from the diagnostic NBI

Apply theories of ICRH-induced rotation