Transport and Machine Size

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- Effect of iota profile variations on transport:

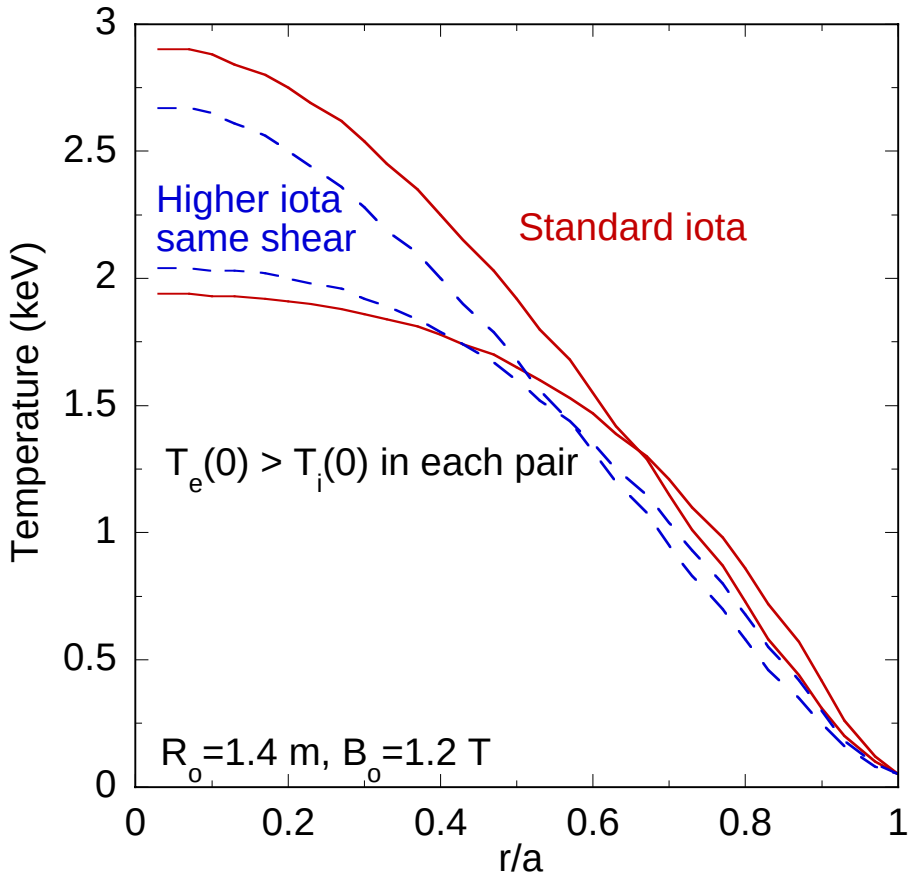
Higher iota → higher eff. I_p → more neocl. confinement → lower $H_{ITER\text{-}89P}$.
Anomalous transport raised to maintain $<\beta>=4\%$, more peaked T profiles.
Higher density to maintain $\nu^*=0.25$ @r=a/2 → lower $H_{ISS\text{-}95}$.

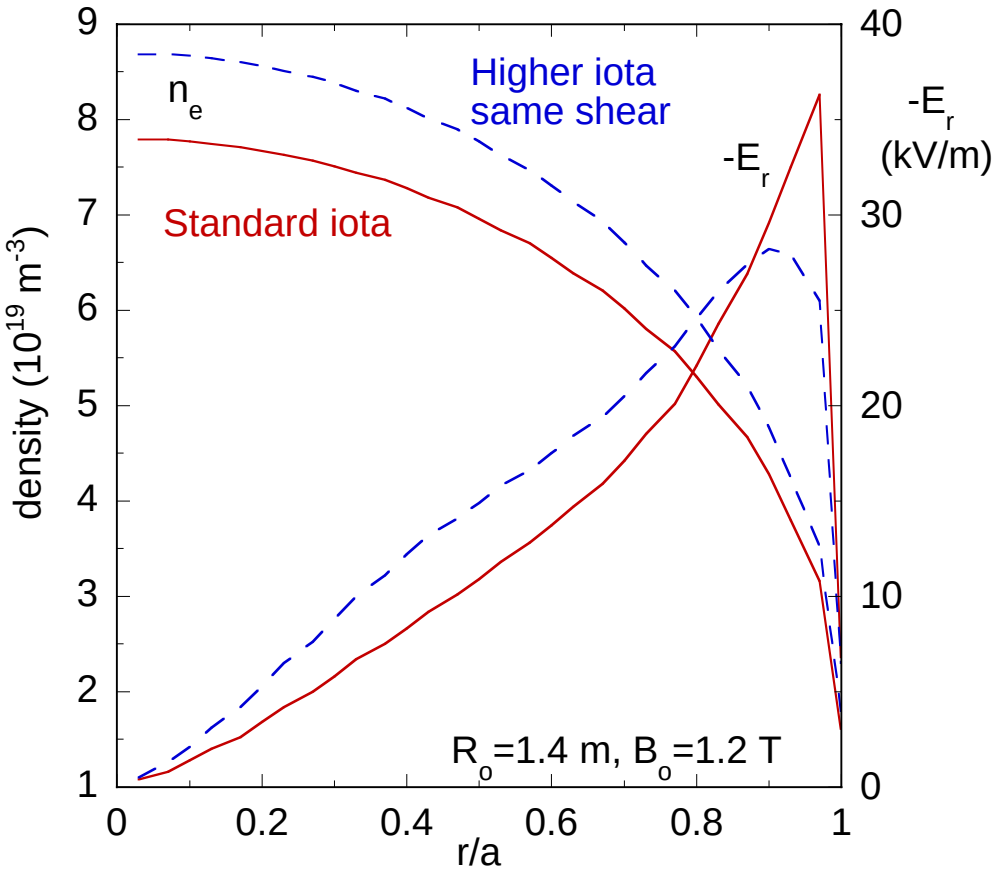
- Neutral beam losses depend on B_o; assume 2 co and 2 counter:

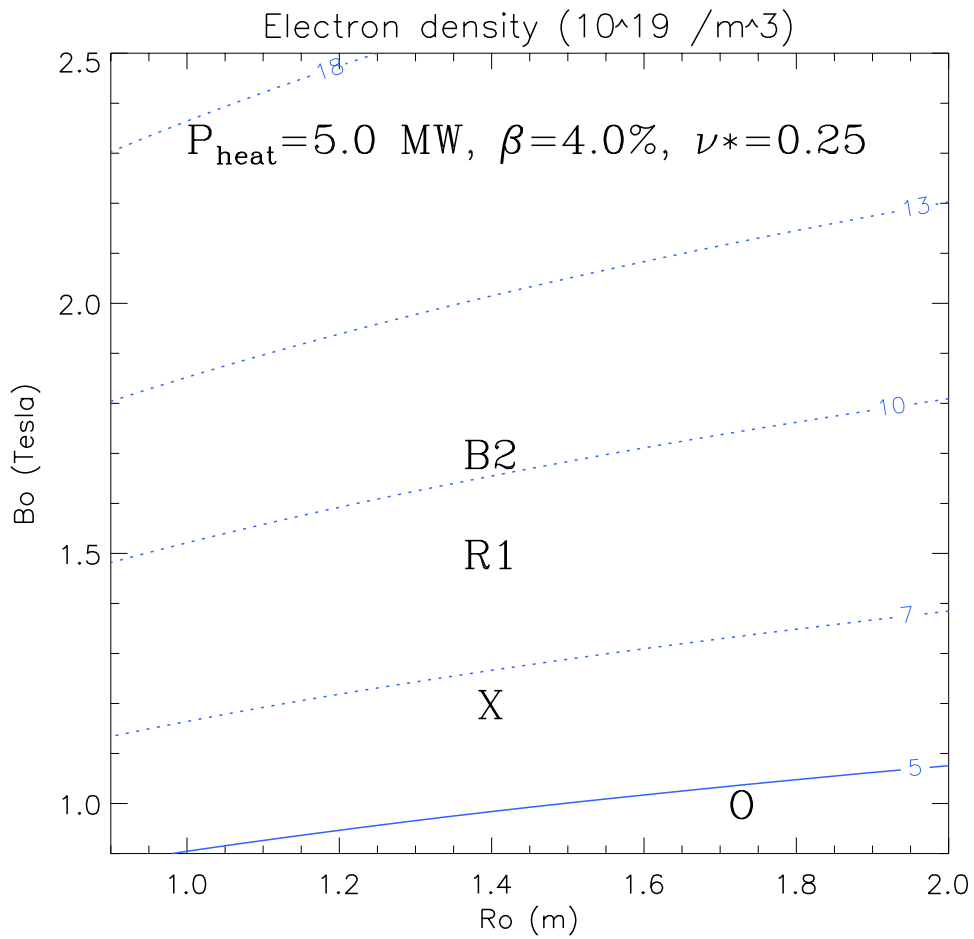
Nominal H^o power into the vessel assumed to be 5.6 MW.
Spong's losses for R_o=1.4 m and B_o=1.2 T: co: 15%, counter: 30%.
Scale losses to other B_o with Spong's B_o scan at R_o=1.7 m.
P_{heat} previously assumed to be 5 MW; now 4.3 MW @1.2 T, 4.6 MW @1.7 T.
Lower P_{heat} implies higher $H_{ISS\text{-}95}$, was 2.7 & 3.3, now 2.8 @1.2 T & 3.4 @1.7 T.
Lower P_{heat} implies slightly higher $H_{ITER\text{-}89P}$, 1.2 @1.2 T & 1.6 @1.7 T.
$<\beta>=4\%$ is neoclassically inaccessible for B_o > 2.3 T.

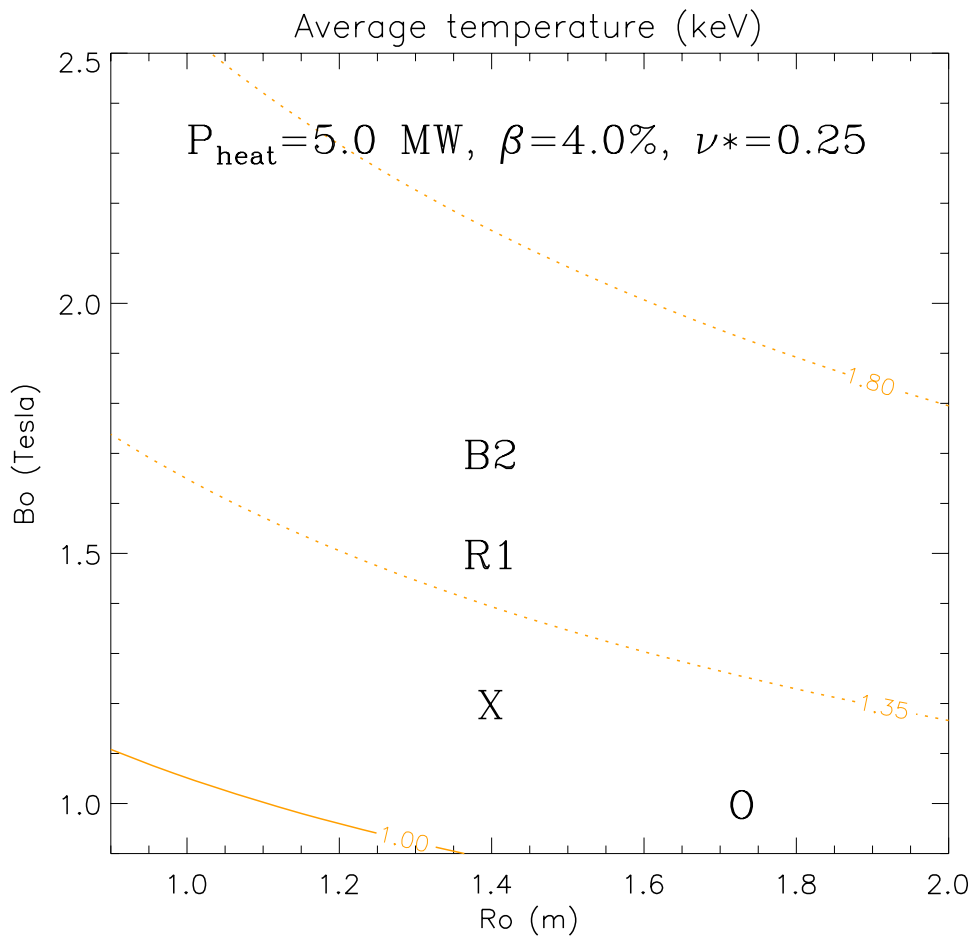
Temperature slightly more peaked with higher iota

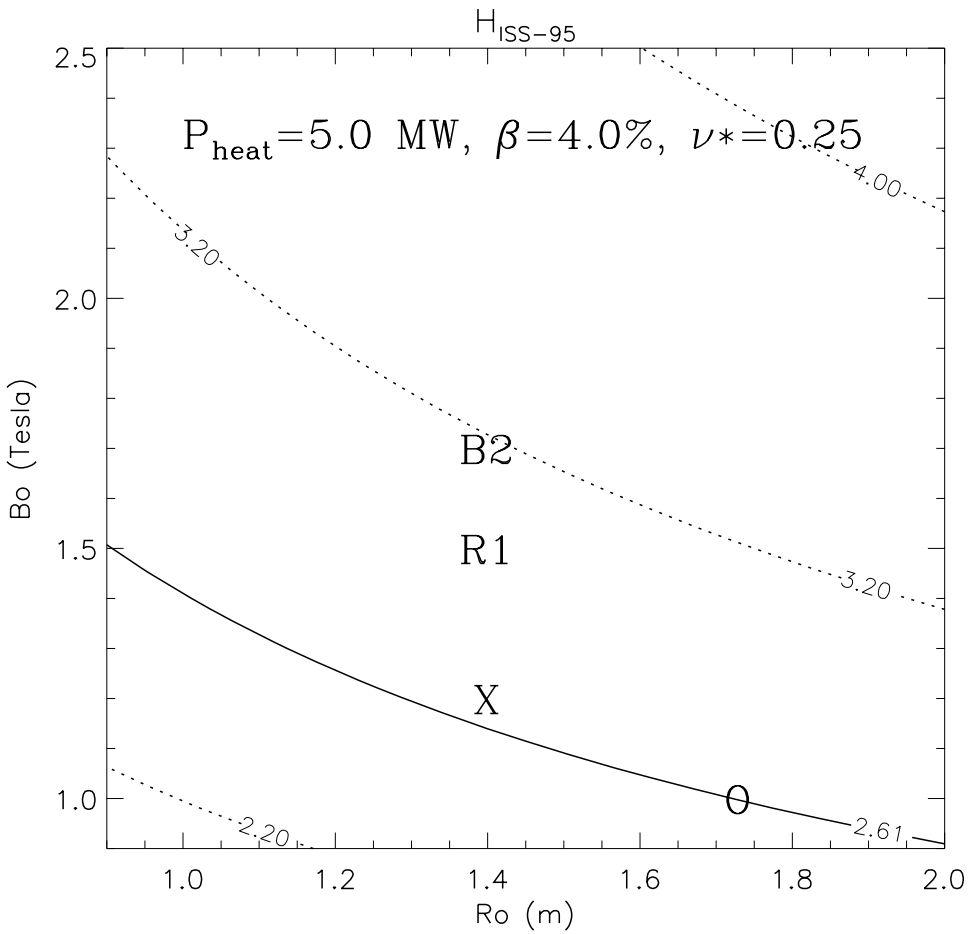
$<\beta>=4\%$, $P_{heat}=5$ MW, $\nu^*(a/2)=0.25$

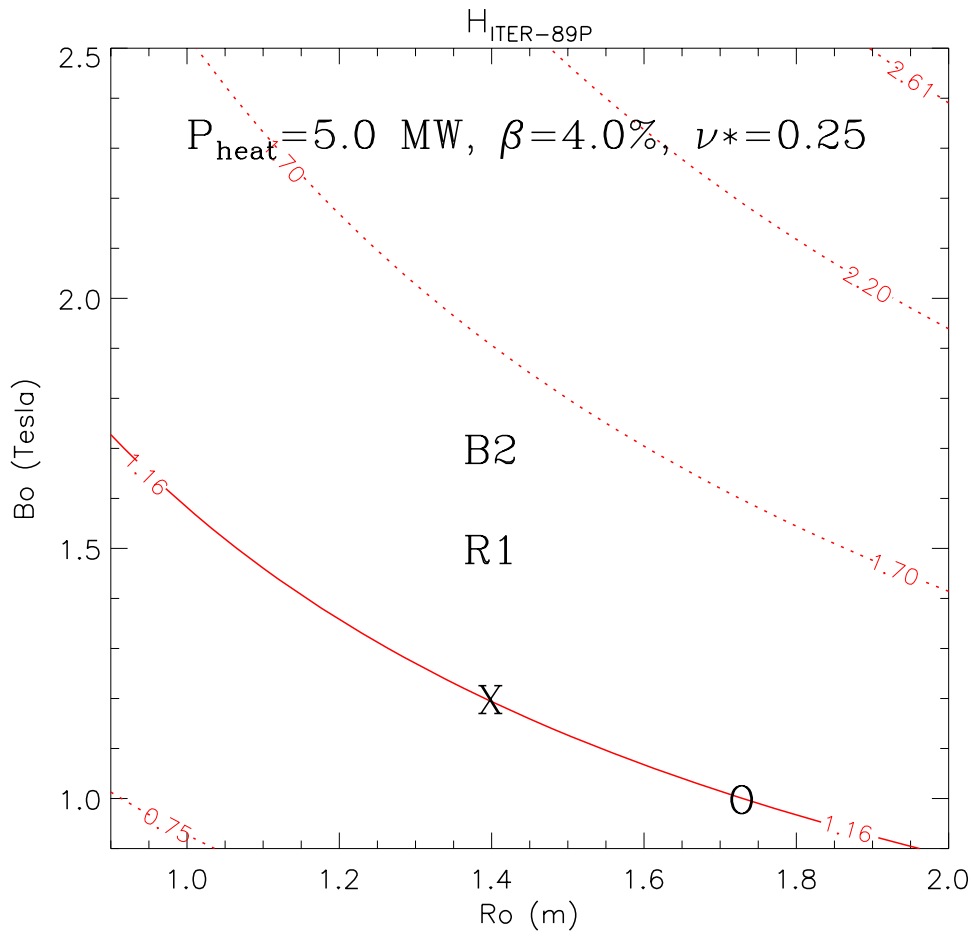





Electron density (10^19 /m^3)
P_{heat}=5.0 MW, β=4.0%, $\nu*$=0.25
18
13
10
7
5
B2
R1
X
O
Bo (Tesla)
Ro (m)
2.5
2.0
1.5
1.0
1.0
1.2
1.4
1.6
1.8
2.0


Average temperature (keV)
P_{heat}=5.0 MW, β=4.0%, $\nu*$=0.25
1.80
1.35
1.00
B2
R1
X
O
Bo (Tesla)
Ro (m)
2.5
2.0
1.5
1.0
1.0
1.2
1.4
1.6
1.8
2.0


H_ISS-95
P_heat=5.0 MW, β=4.0%, ν*=0.25
4.00
3.20
3.20
2.20
2.61
B2
R1
X
O
Bo (Tesla)
Ro (m)
2.5
2.0
1.5
1.0
1.0
1.2
1.4
1.6
1.8
2.0


H_ITER-89P
P_heat=5.0 MW, β=4.0%, ν*=0.25
2.61
2.70
2.20
1.16
1.70
0.75
1.16
B2
R1
X
O
Bo (Tesla)
Ro (m)
2.5
2.0
1.5
1.0
1.0
1.2
1.4
1.6
1.8
2.0

RF Heated Simulations

Assume 6 MW launched, all is absorbed; 90% heats electrons, 10% to ions.
Higher heating power lowers the implied H_{ISS-95} and $H_{ITER-89P}$.

With a fixed RF frequency, B_o determines the heating location.
Higher B_o raises the implied H_{ISS-95} $H_{ITER-89P}$ and (for NBI or RF).

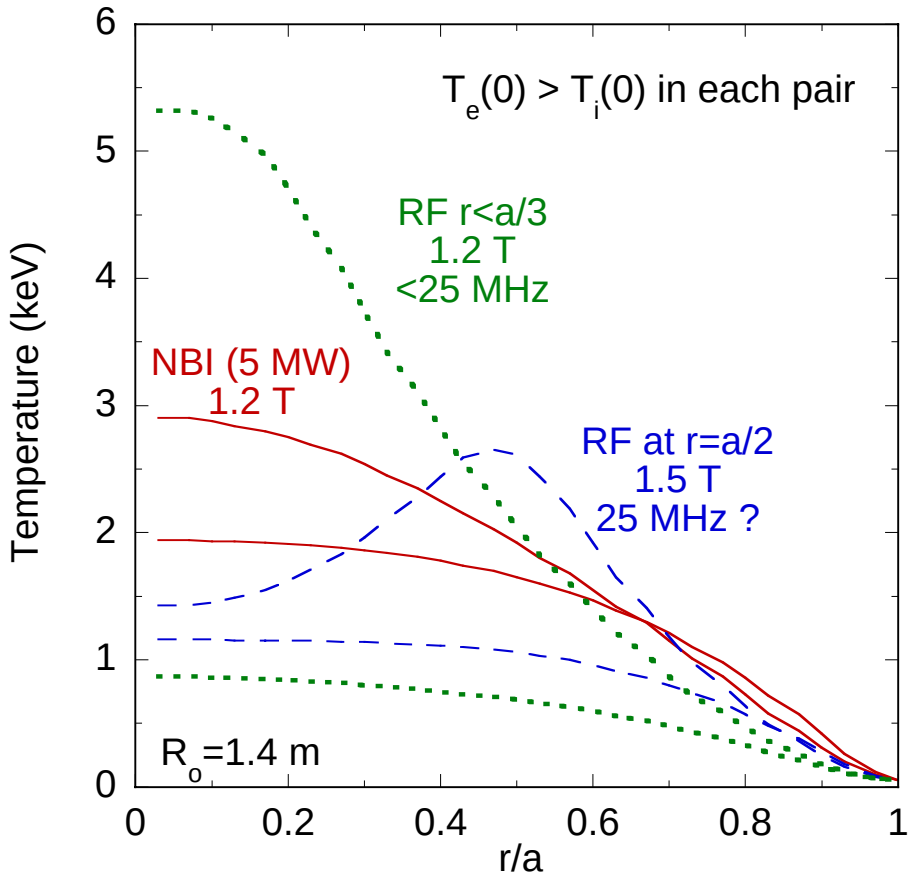
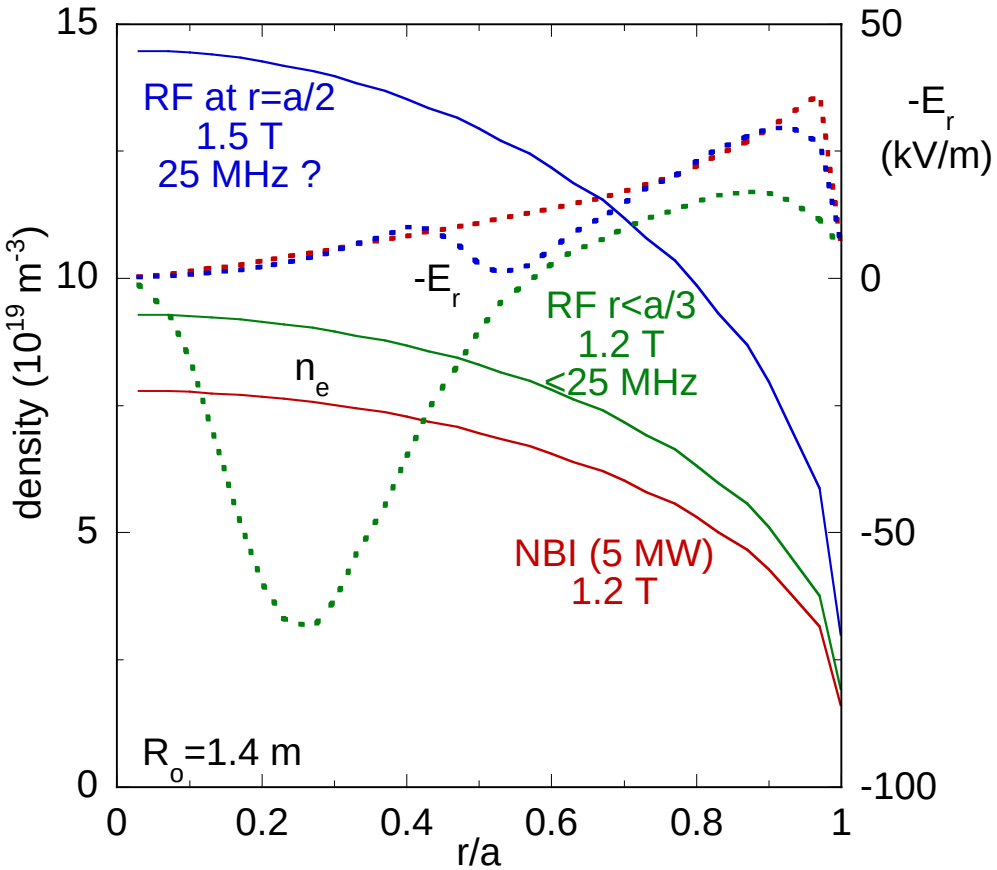
Assume two heating profiles:
Mid-radius deposition near r=a/2 (possible with 25 MHz at B_o=1.5 T?).
Central deposition; implies frequency<25 MHz at lower B_o (< 1.7 T?).

With higher power, $<\beta>$=4% is accessible with more anomalous transport.
H_{ISS-95} drops to 2.1–2.3 for B_o=1.2 T, and 2.4–2.6 for B_o=1.5 T
$H_{ITER-89P}$ drops to 1.0 for B_o=1.2 T, and 1.25 for B_o=1.5 T

Mid-radius scenario has big 'step' in T_e profile.
These temperature profiles are much broader, so for fixed $<\beta>$ and ν^*:
Temperatures at r=a/2 are higher than for central heating, so
Density must be higher, so H_{ISS-95} is lower for mid-radius scenario.

Expect high central T_e with central heating; code finds electron root.

Temperature profile shapes change with RF heating

Central RF heating produces electron root

$\langle\beta\rangle$=4%, P_{heat}=5 MW, $\nu^*(a/2)$=0.25