

Integration of Enhanced Stability and Limiter Power Handling in TFTR

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S. Sabbagh - [TFTR](#)



Columbia U. - PPPL
Collaboration



High ℓ_i operation combined with a radiative mantle and recycling control

■ Motivation

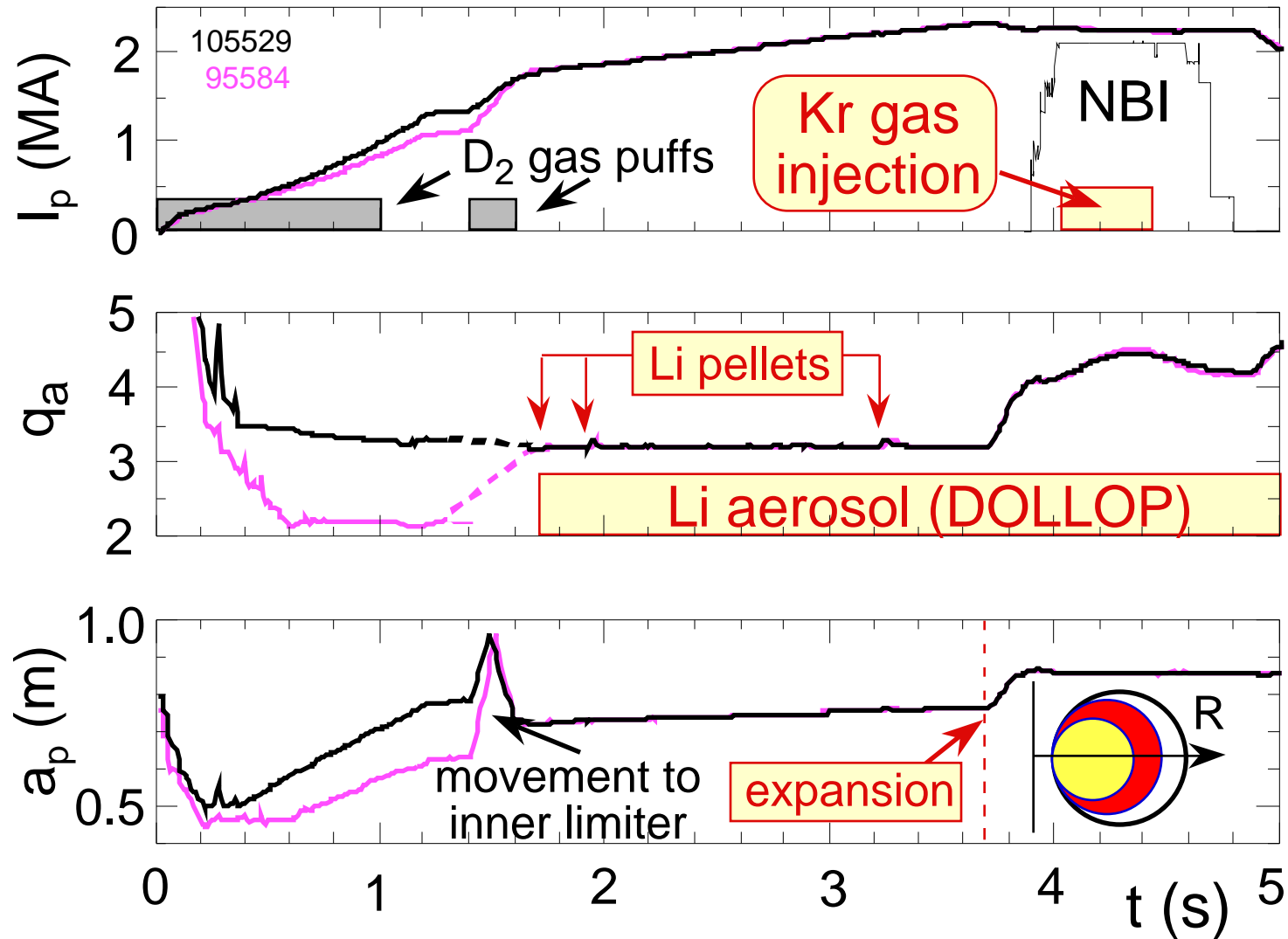
- Alleviate limiter power handling constraint:
 - stability limit improves as ℓ_i is increased
 - rapid edge density influx (bloom) limits performance, **not stability**

■ Final Experiments

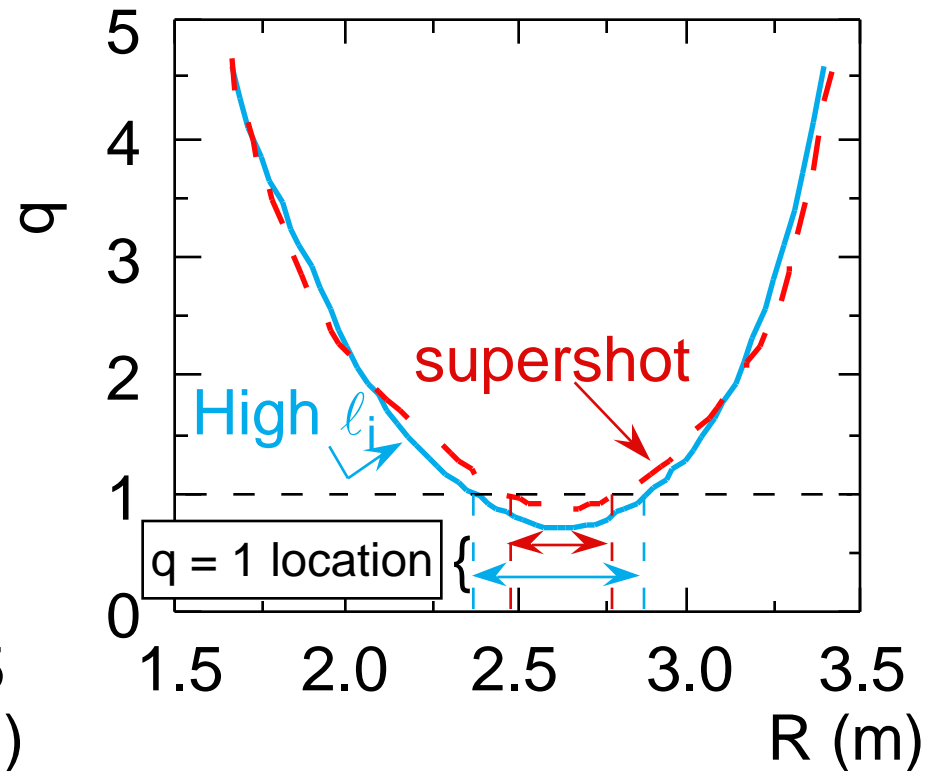
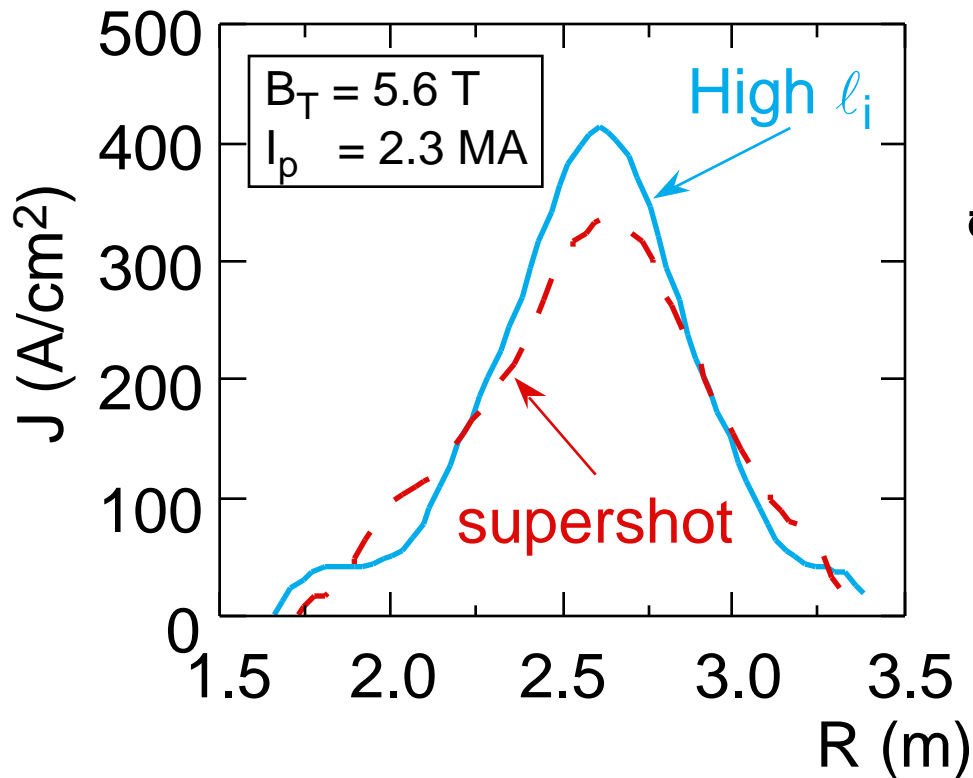
- Incorporate Kr radiative mantle to eliminate blooms
- Increase ϵ_E by utilizing recycling control with Li conditioning
- Operate high ℓ_i plasma at high $I_p = 2.3$ MA and $B_T = 5.6$ T



Kr Radiative Mantle added to High ℓ_i startup



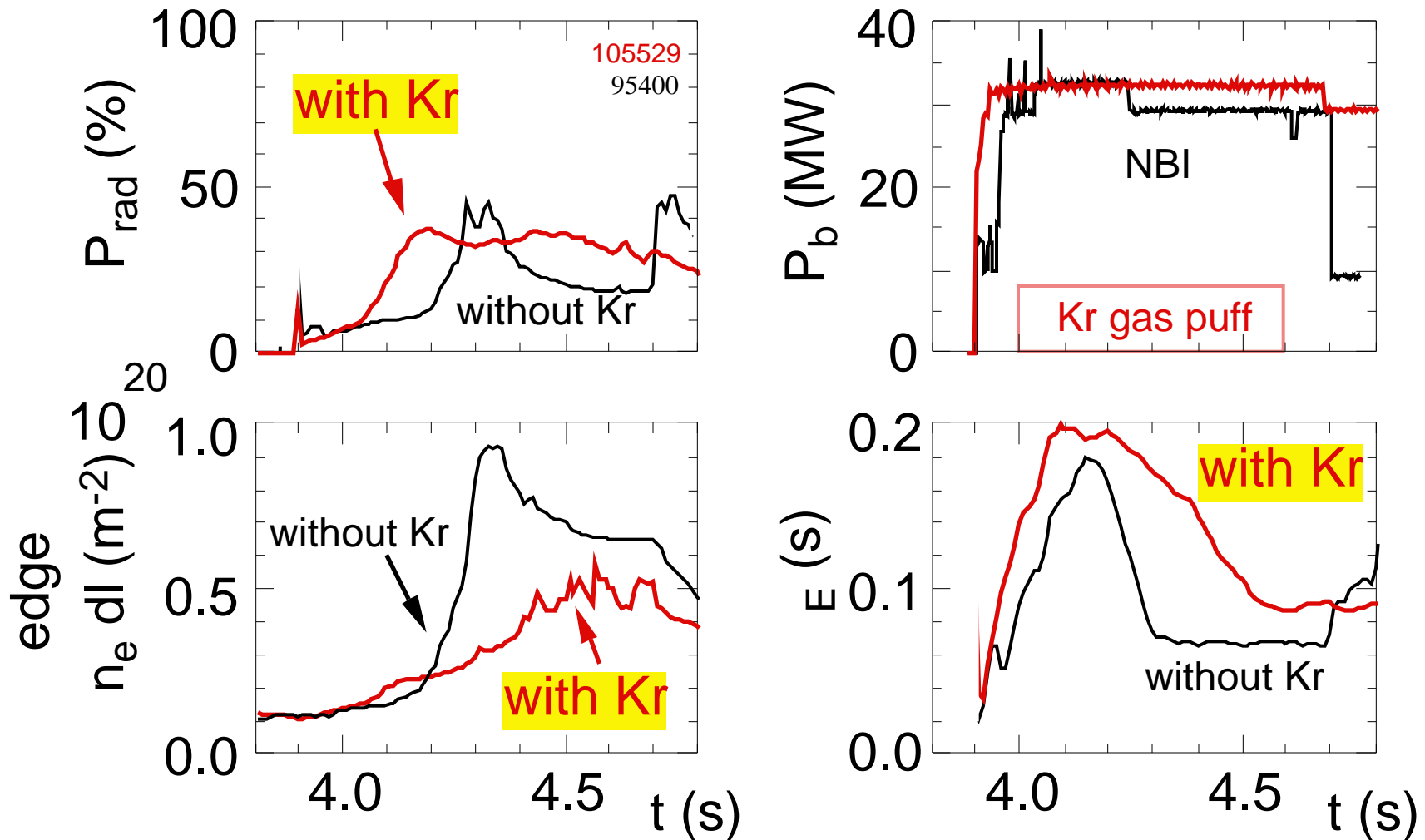
Increased core current results from low q_a startup



S. H. Batha
FP&T

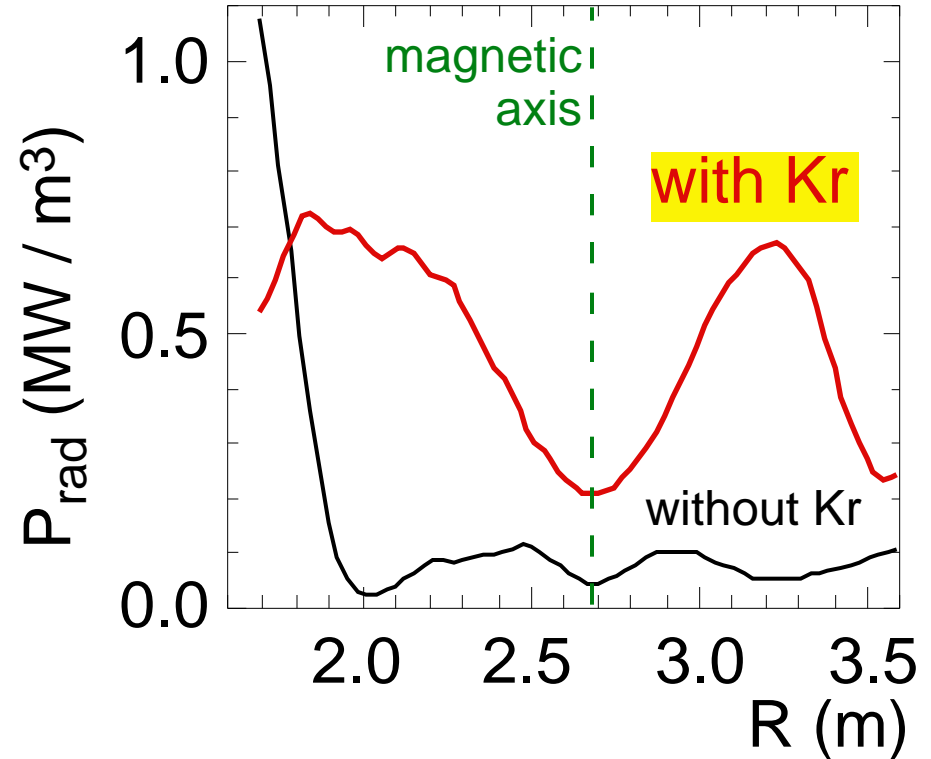
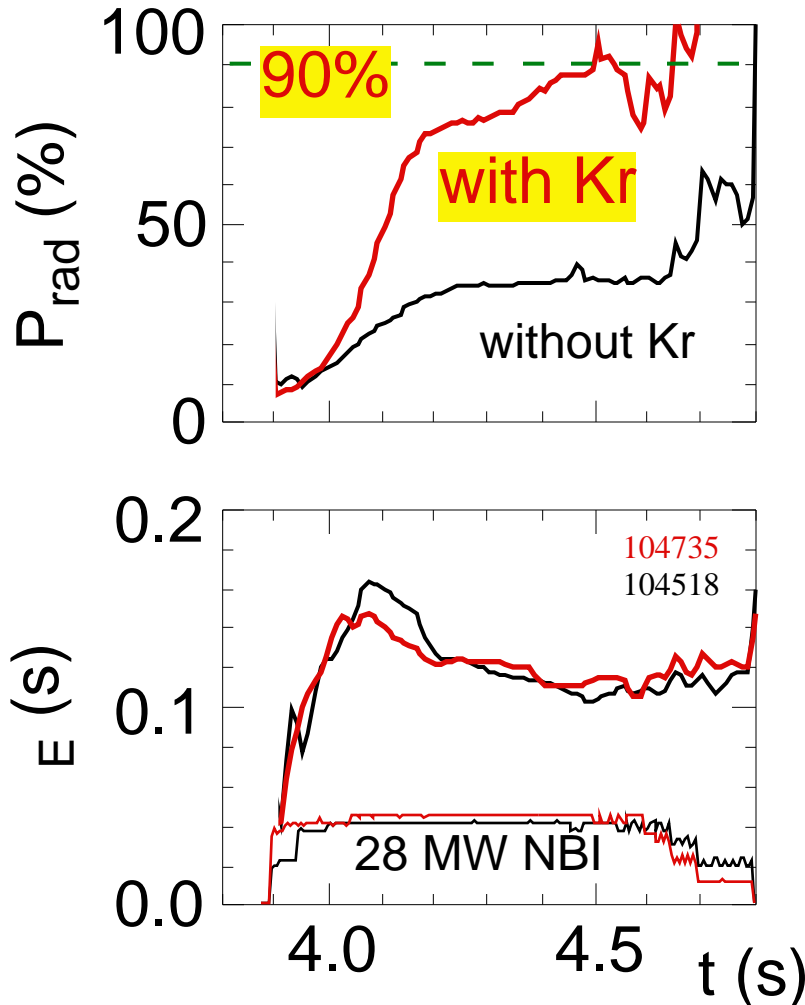
- VMEC equilibrium using 21 channel MSE diagnostic
- Increased sawtooth inversion radius verified by ECE T_e measurements

Higher E , maintained for longer interval with Kr



■ Rapid edge density influx suppressed by Kr mantle

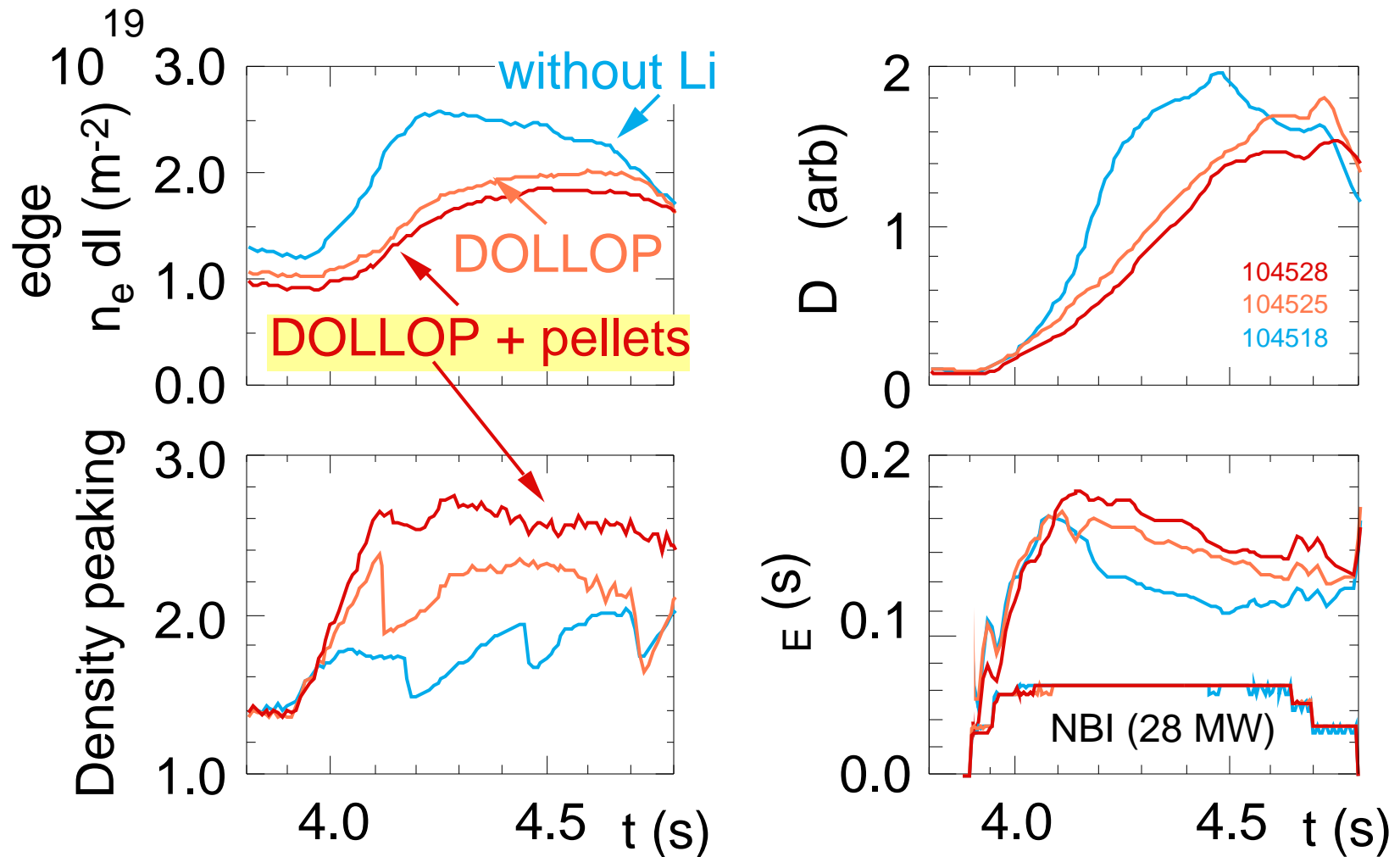
Radiated power 90% with no reduction in E



■ Significant core radiation

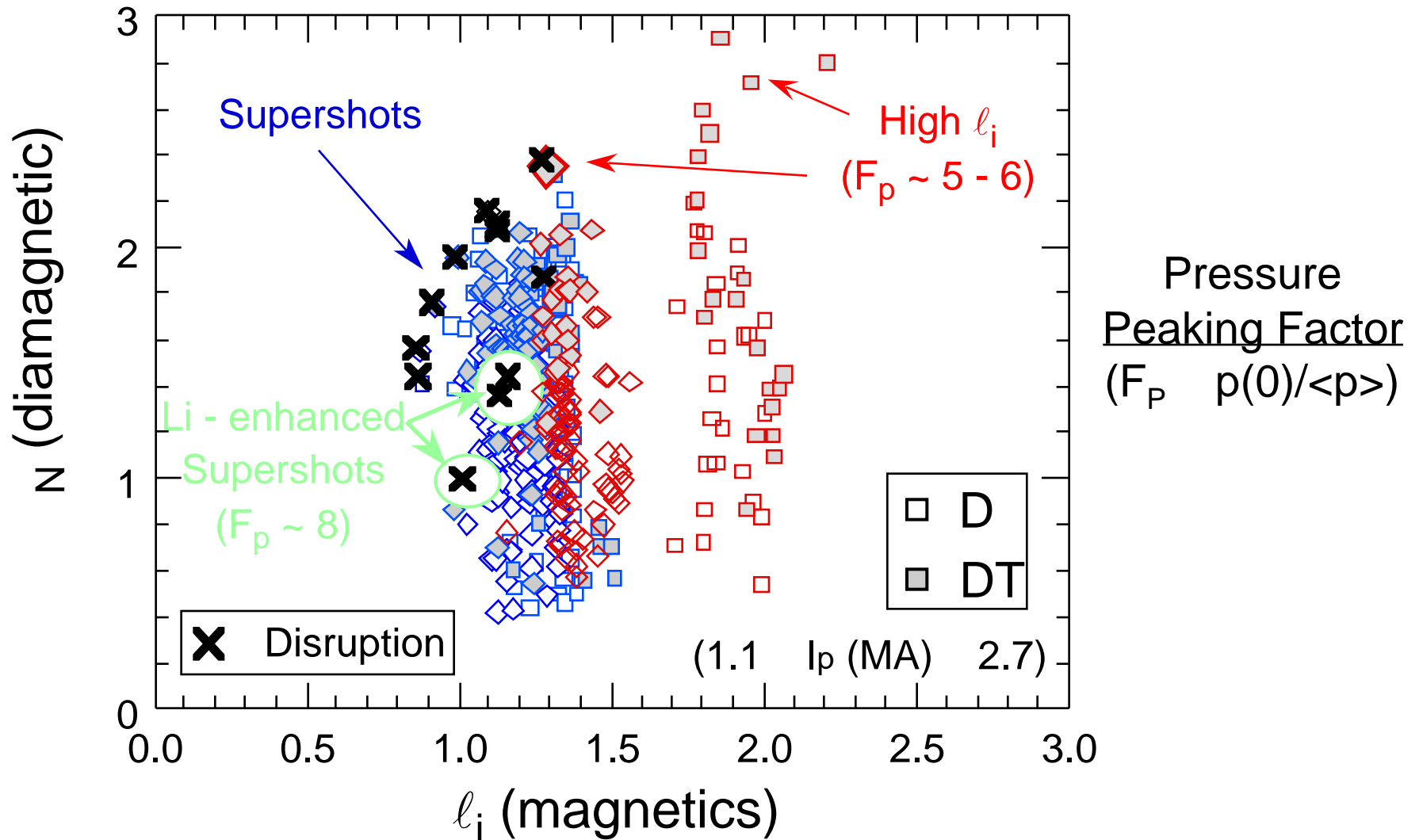
■ Feedback control required to prevent thermal collapse (Hill, oThal1.05)

Recycling control (with Lithium) increases E

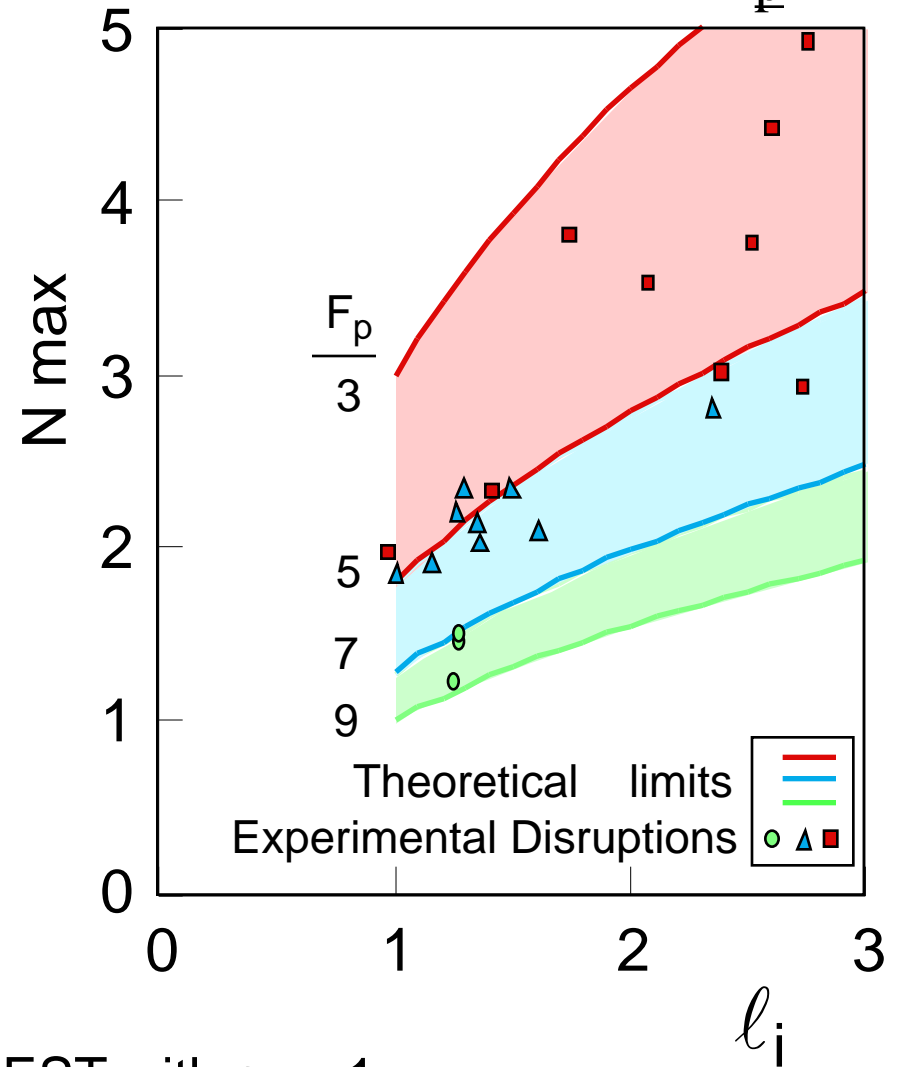
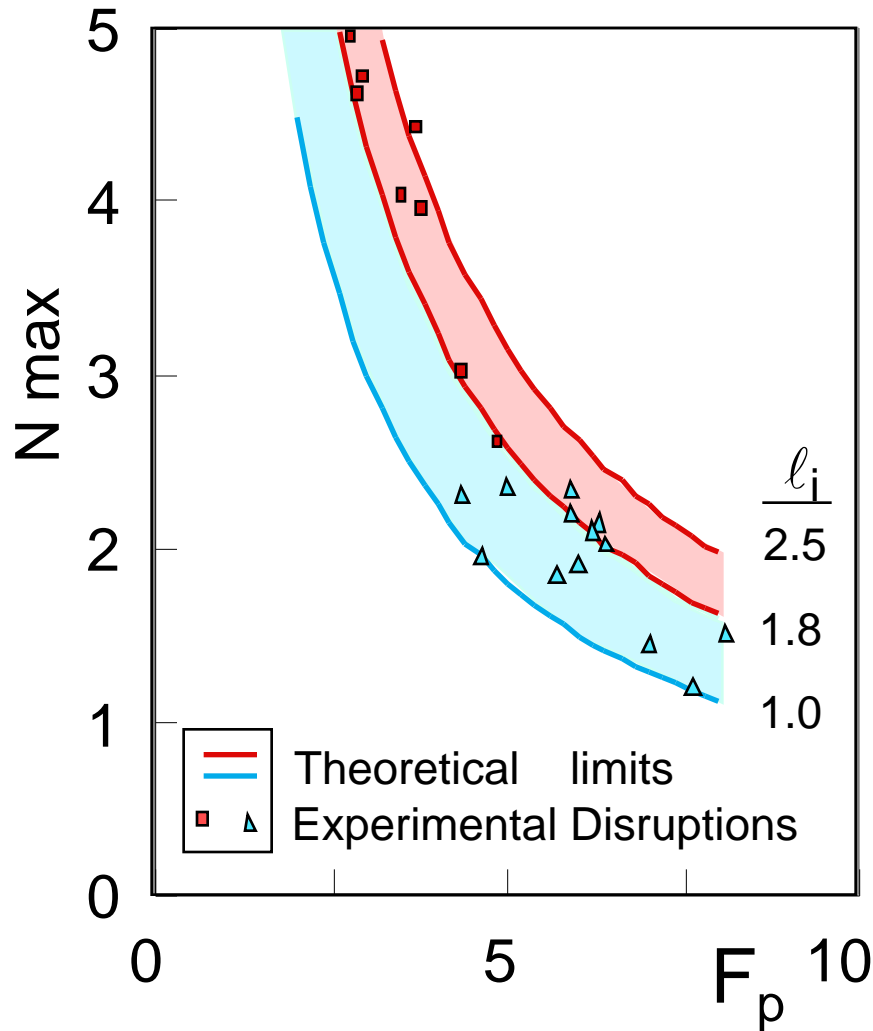


■ Sawteeth stabilized; E increased by 30%

Achieved N generally increases with l_i

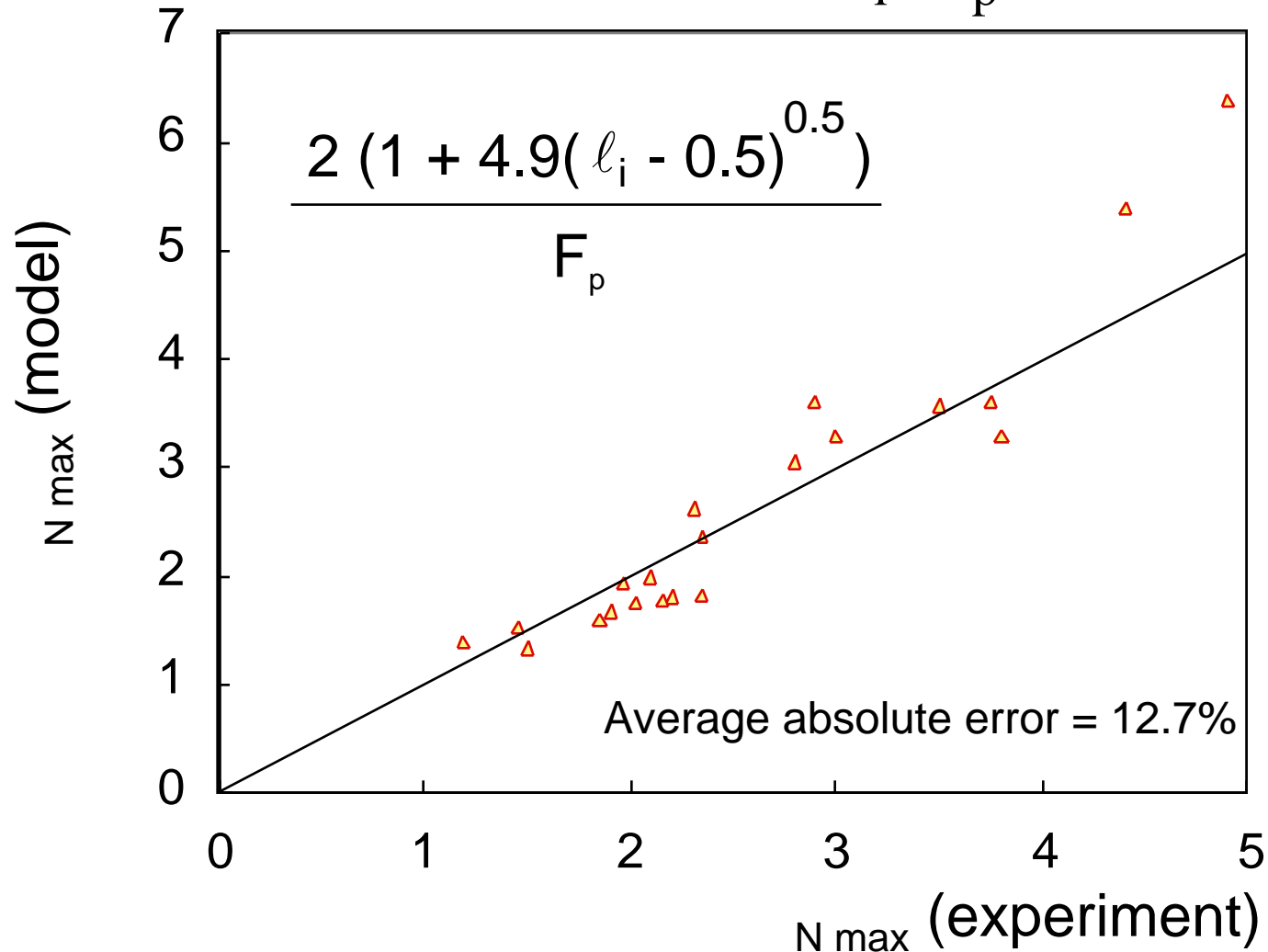


MHD limit increases with l_i , decreases with F_p



■ Theoretical limits computed from PEST with $q_0 = 1$

Theoretical beta limit model $f(\ell_i, F_p)$ fits data well



- Inclusion of F_p in scaling suggests a non-linear dependence on ℓ_i

Final TFTR Experiments Integrated 3 Improvements

- Reduced limiter power load with Kr radiative mantle:
 - Rapid edge density influx (bloom) suppressed
 - Up to 90% radiated power with no reduction in ϵ_E
- Improved recycling control with Li deposition:
 - Maximum ϵ_E attained through edge recycling control
 - Li aerosol (DOLLOP) system to provide continuous Li injection
- Increased stability limit with high l_i operation:
 - Operation at high I_p 2.3MA, B_T 5.6 T ($q^*=3.5$)
 - Yielded high ϵ_E and fusion power (P_f 8.7 MW)



Supporting Presentations at this meeting

- D. Mansfield, et al., **Oral** (IWepO1.10) Wednesday
“DOLLOP: Improved plasma performance using a new concept for mitigating the plasma-wall interaction in fusion devices”
- K. Hill, et al., **Invited paper** (oTha11.05) Thursday
“Tests of Transport Theory and Reduced Impurity Influx with Highly Radiative Plasmas in TFTR”

