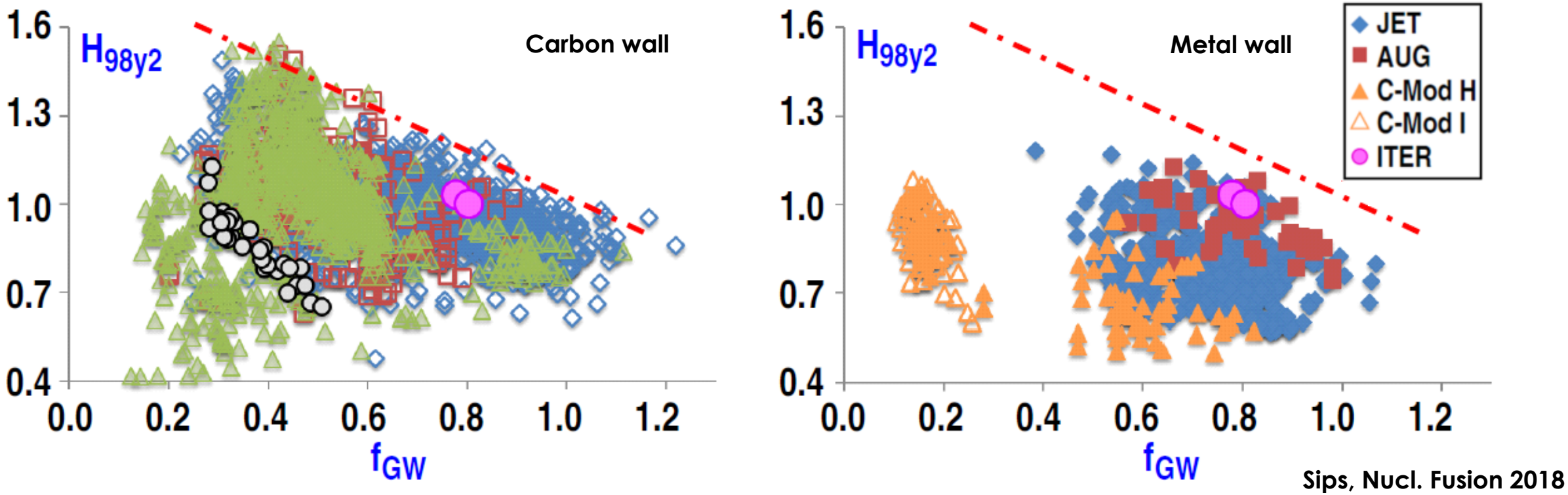
An AT Scenario Potentially Compatible with Tungsten Wall Material

Siye Ding for the Integrated High β_P Scenario Task Force

Presented at
DIII-D Community Workshop on First Wall Material Change out

June 12-13, 2024

High-Z Metal Wall Reduces Confinement Quality in H-mode Plasmas



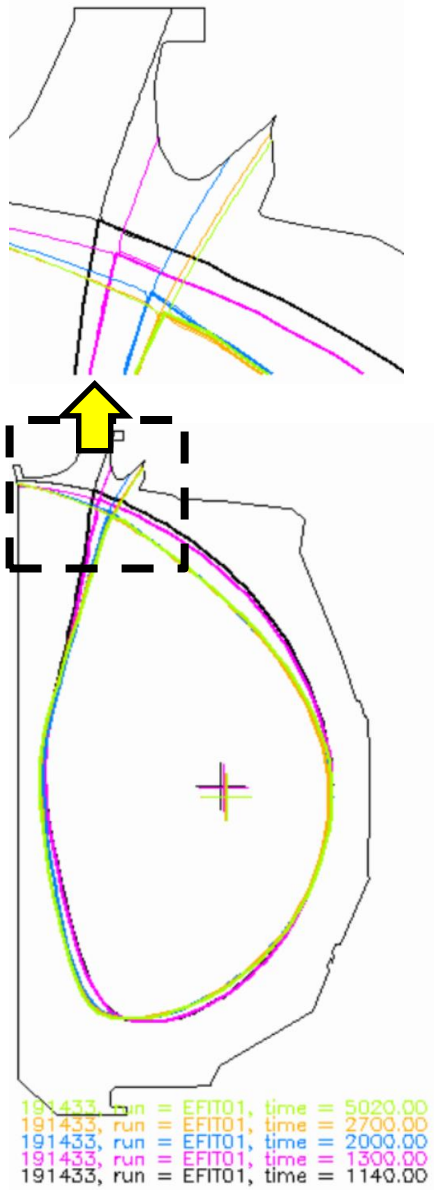
Sips, Nucl. Fusion 2018

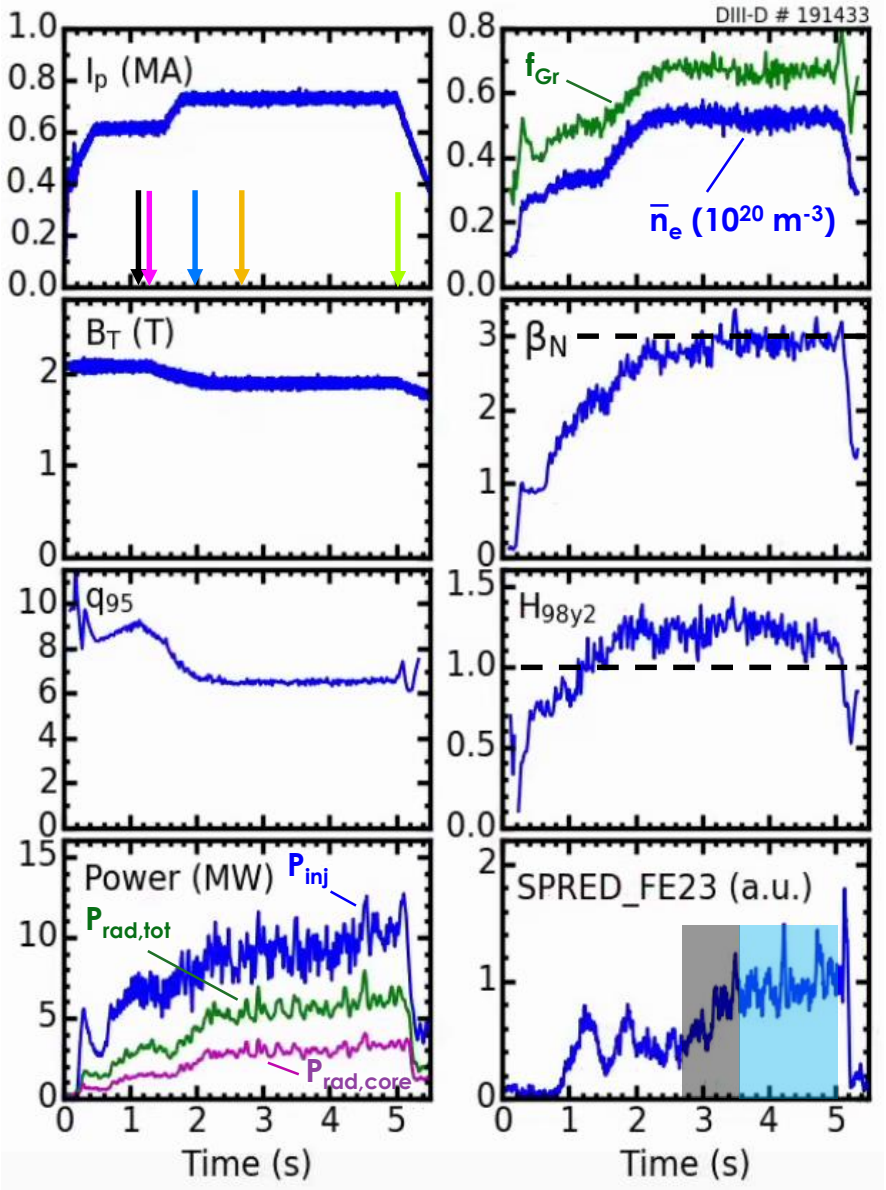
- **ITPA database for ITER Q=10 H-mode q_{95}=2.7-3.3**
  - No constraints on toroidal rotation/injected torque
- **AT scenarios are usually vulnerable to high-Z metal wall due to relatively low density**

DIII-D NATIONAL FUSION FACILITY

Sustained β_N~3.0 and H_{98y2}~1.25 in High β_P Experiments with Tungsten Ring

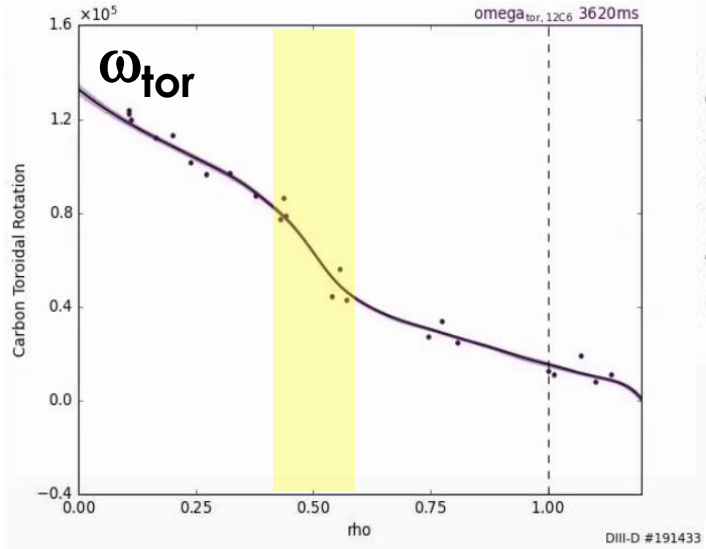
- **Well-controlled strike point at tungsten ring from 2.7 s to 5 s**
  - $2.3 \times \tau_R$
- **SPRED signal first increases, then stay constant**
- **P_{inj}~9 MW, $P_{rad,tot}/P_{inj}$~61%, $P_{rad,core}/P_{inj}$~33%**
- **f_{Gr}~70%**
  - Lower than usual high β_P discharges with good ITB
- **q_{95}~6.5**

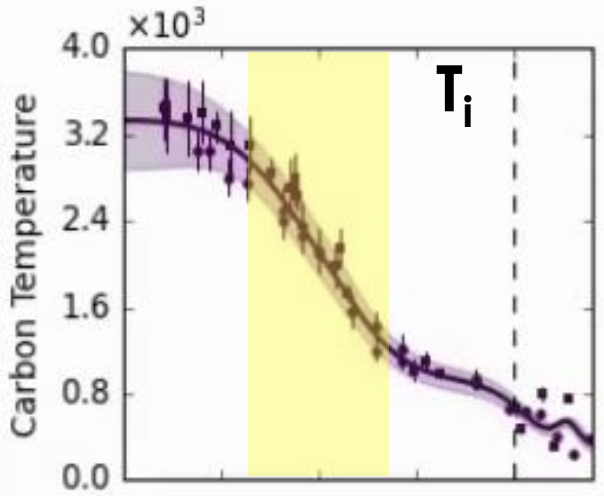


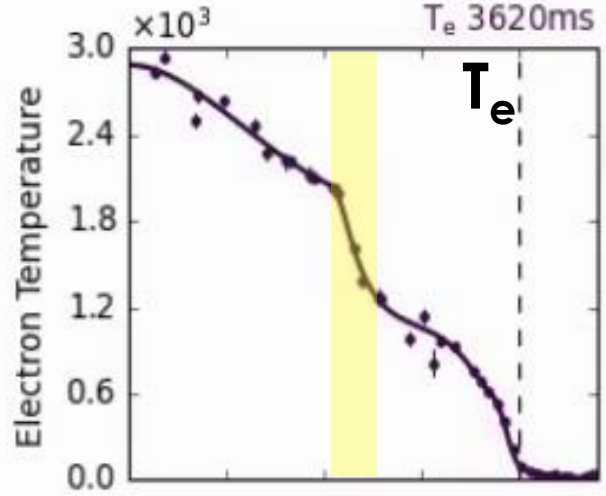


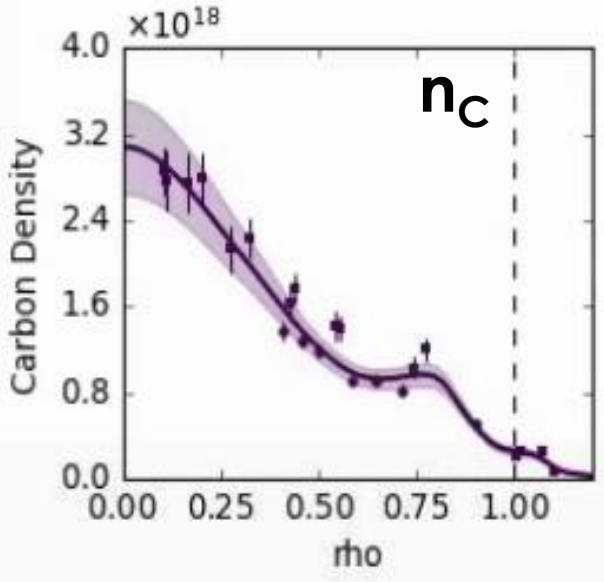
Clear ITB at Large Radius in Temperature and Toroidal Rotation Profiles

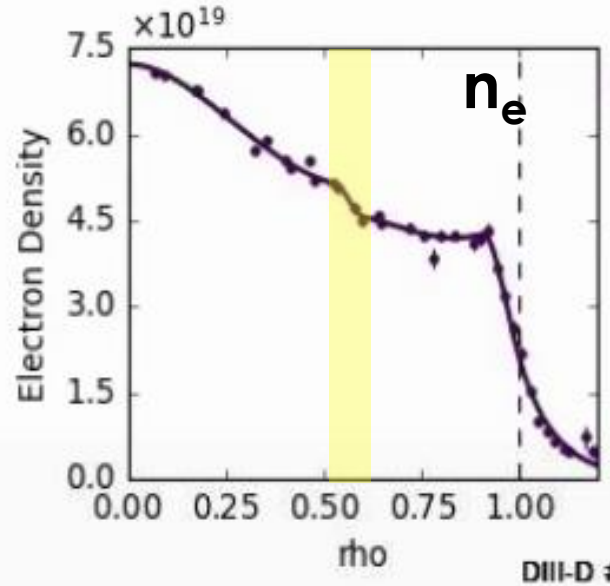
- **ITB foot location: ρ~0.6-0.7**
- **Wider ITB in T_i**
- **Small ITB in n_e**
  - Need further optimization
- **ITB in n_C?**
- **Impurity analysis is being performed**











Summary and Outlook

- Sustained high β_P plasma with β_N~3.0 and H_{98y2}~1.25 achieved with tungsten ring for 2.3 × τ_R
- No sign of serious radiation issue (induced by high-Z impurity accumulation) at high injected power in the experiment
- Clear ITBs at large radius in temperature and toroidal rotation channels
- Analysis underway
- Need experiments, perhaps on full metal wall, to confirm the compatibility

Thank you !