# Density Limit Mechanisms in NSTX NBI Heated Discharges

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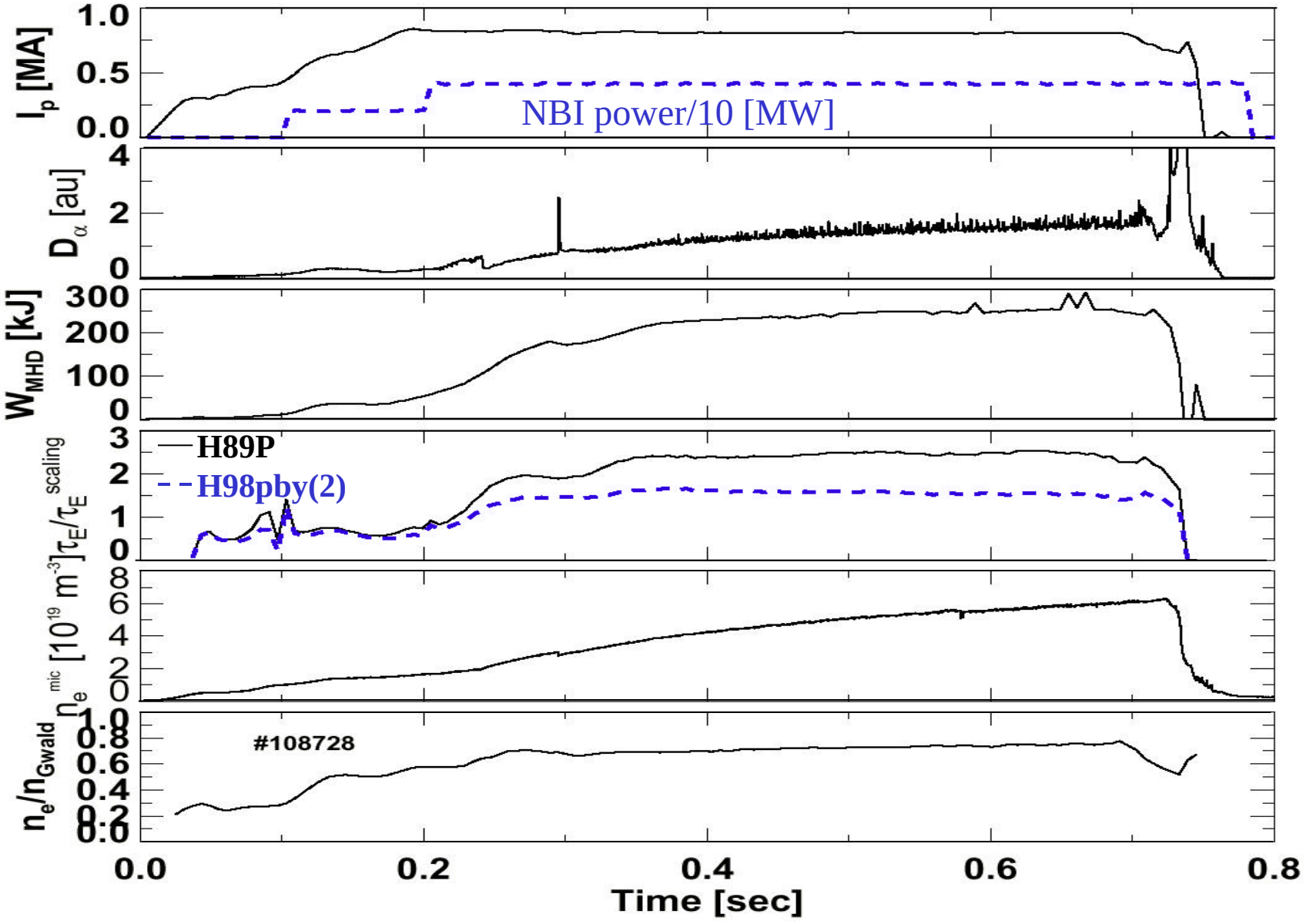
Transport Group Session
NSTX Research Forum FY 2003
Princeton, NJ
Sept. 11-12, 2002

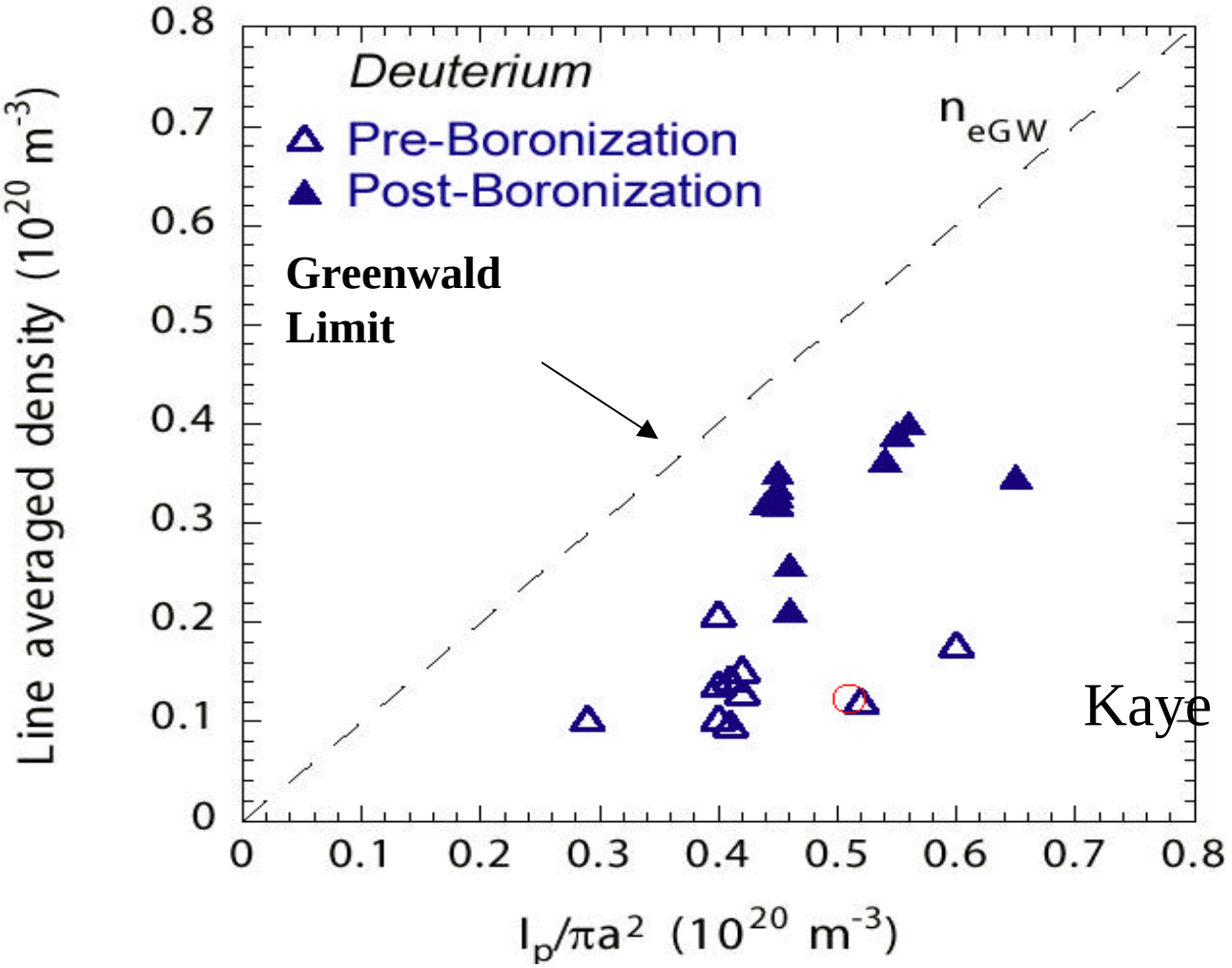
# Many processes can impose limit on plasma density

- Confinement in NSTX tends to increase with density
  - understanding processes can have big payoff
- Hughill/Greenwald empirical scaling is $n_e^{max} \sim I_p/(\pi a^2)$
- Proposal: identify processes which limit density in good performance NBI heated discharges
  - MARFE limit
  - MHD imposed limit (e.g. tearing modes)
  - Particle confinement limit
  - Fueling limit
  - Radiative collapse limit

# High $n/n_{GW}$ Achieved with Good Performance in Long Pulse H-modes



# NBI density limit study can proceed because ohmic density limits have been established




Example of ohmic density limit study from FY 01

# DIII-D density limit study resulted in H-mode discharges ~ 50% above Greenwald "limit"

- **Divertor detachment sequence: caused transition back to L-mode and subsequent disruption (cryopump on)**
- **Pellet particle confinement time: increased non-linearly with $I_p$ (high $I_p$)**
- **Fueling limit: pellet efficiency increased with decreasing NBI power; near $P_{heat} \sim P_{LH}$ pellets caused H-L mode transitions (low $P_{NBI}$, low $B_t$ for margin over $P_{LH}$)**
- **MARFE: restricts $n_{edge}*q_{95}$ (pumping, low q)**
- **Tearing modes: observed over wide NBI range and sometimes triggered by pellets (n=1 modes avoided for $P_{heat} < 3MW$)**