Electron Power Deposition During ICRF Heating on C-Mod

G. Taylor, B. LeBlanc, C.K. Phillips, G. Schilling, J.R. Wilson
Plasma Physics Laboratory, Princeton U.

A. Hubbard, Y. In, P. Bonoli, R. Boivin, E. Nelson-Melby, S.J. Wukitch
Plasma Science and Fusion Center, M.I.T.

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New ECE Polychromator Adds Improved $T_e(R,t)$ Coverage for C-Mod Electron Power Deposition

- Prior to 1998, ECE diagnostics installed on C-Mod included:
  - absolutely calibrated Michelson interferometer
  - 9-channel grating polychromator (GPC)

- New GPC added in late 1997:
  - up to 27 radial channels of T_e data, including original GPC

T_e Data Acquired with Two GPC's for ICRF-Heated, D(H) Plasmas

- 2-3 MW, 80 MHz RF power, amplitude modulated to study RF Power deposition
- $n_H/(n_H+n_D)$, measured by neutral particle analysis, varied from 2% to 30%
- Two dipole antennas using 0,π phasing
- "Break-in-slope" deposition analysis of $T_e(R,t)$ data to determine direct RF power flow to electrons

Electron Power Deposition Measurements are Challenging in C-Mod D(H) ICRF Heating Regime

- Frequent sawtooth crashes often close to RF power transitions:

  - sometimes locked to RF power transitions

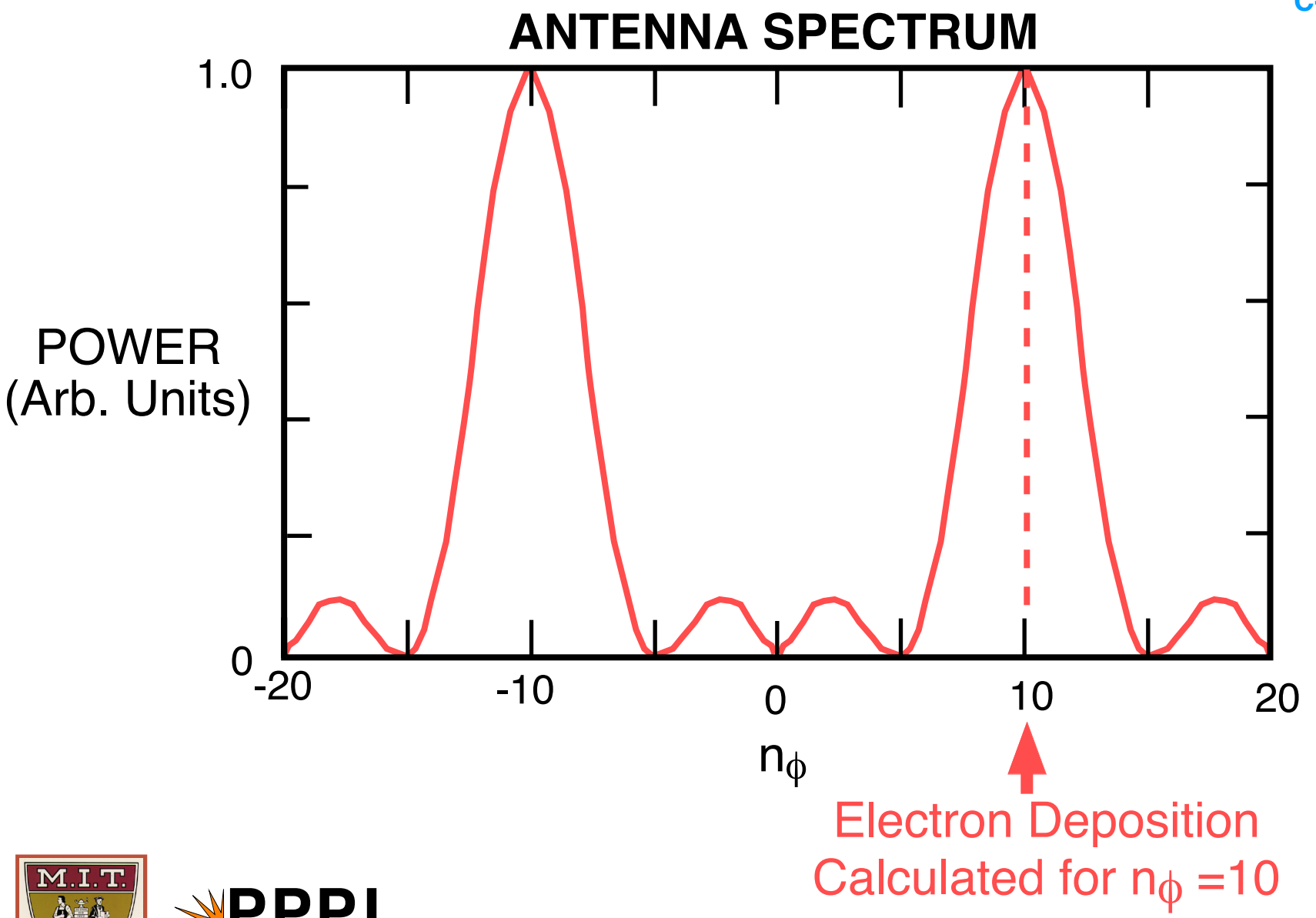
- Weak RF power deposition to electrons in D(H) ICRF-heating regime, 80% to 90% deposition predicted to ions

RF Power Deposition Measurements Compared to TORIC & METS RF Codes

- Measurements in D(H) ICRF-heated plasmas compared to RF codes:
  - TORIC, 2-D, FLR full wave; includes poloidal geometry
  - METS, 1-D integral; full treatment of large $k_{perp}\rho_i$ effects
- TORIC now has more complete treatment of mode conversion:
  - includes large $k_{perp}\rho_i$ corrections to electron Landau damping of mode-converted ion Bernstein waves

Both Antennas had 0,π Phasing with Power Peaking at $n_\phi = \pm 10$

C-Mod



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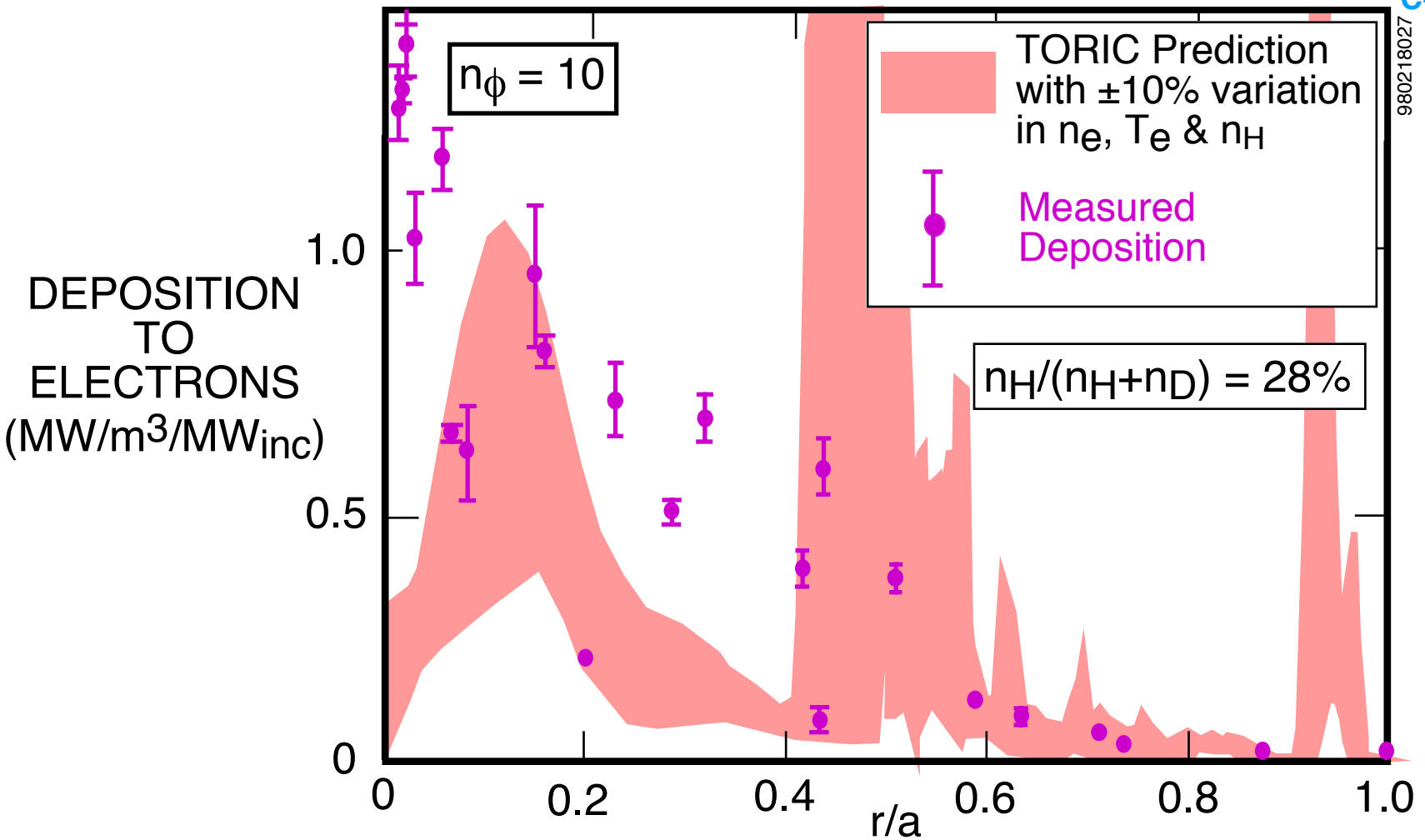
TORIC-Predicted Electron Deposition Very Sensitive to Small Changes in Plasma Parameters

C-Mod



- At $n_H/(n_H+n_D) = 28\%$, METS predicts 90% reflection from cutoff, so multiple pass absorption effects are expected to broaden deposition

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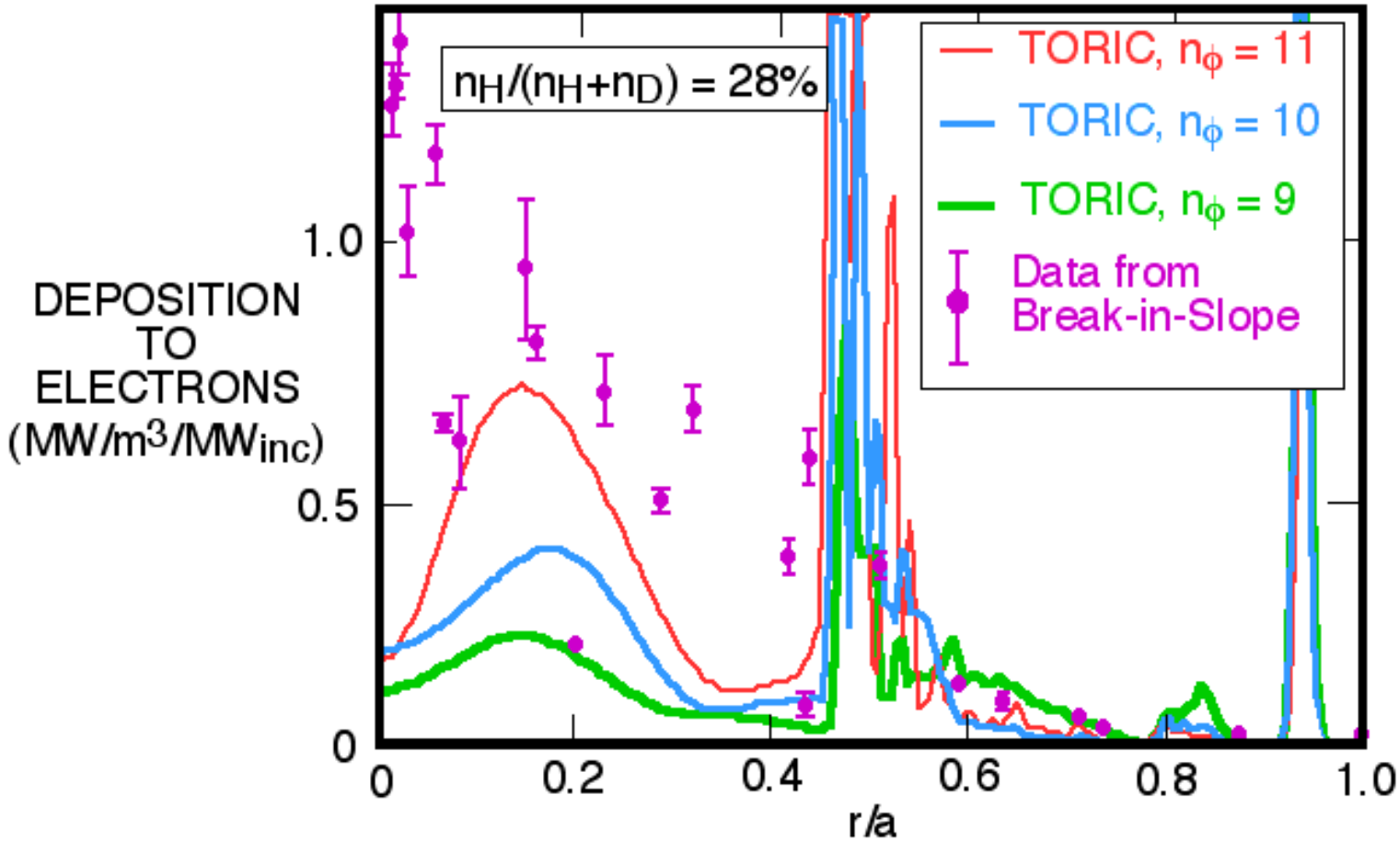
e_ebase.ps+hconc32

Electron Deposition Profile Depends on n_ϕ of Launched RF Power

980218027 C-Mod



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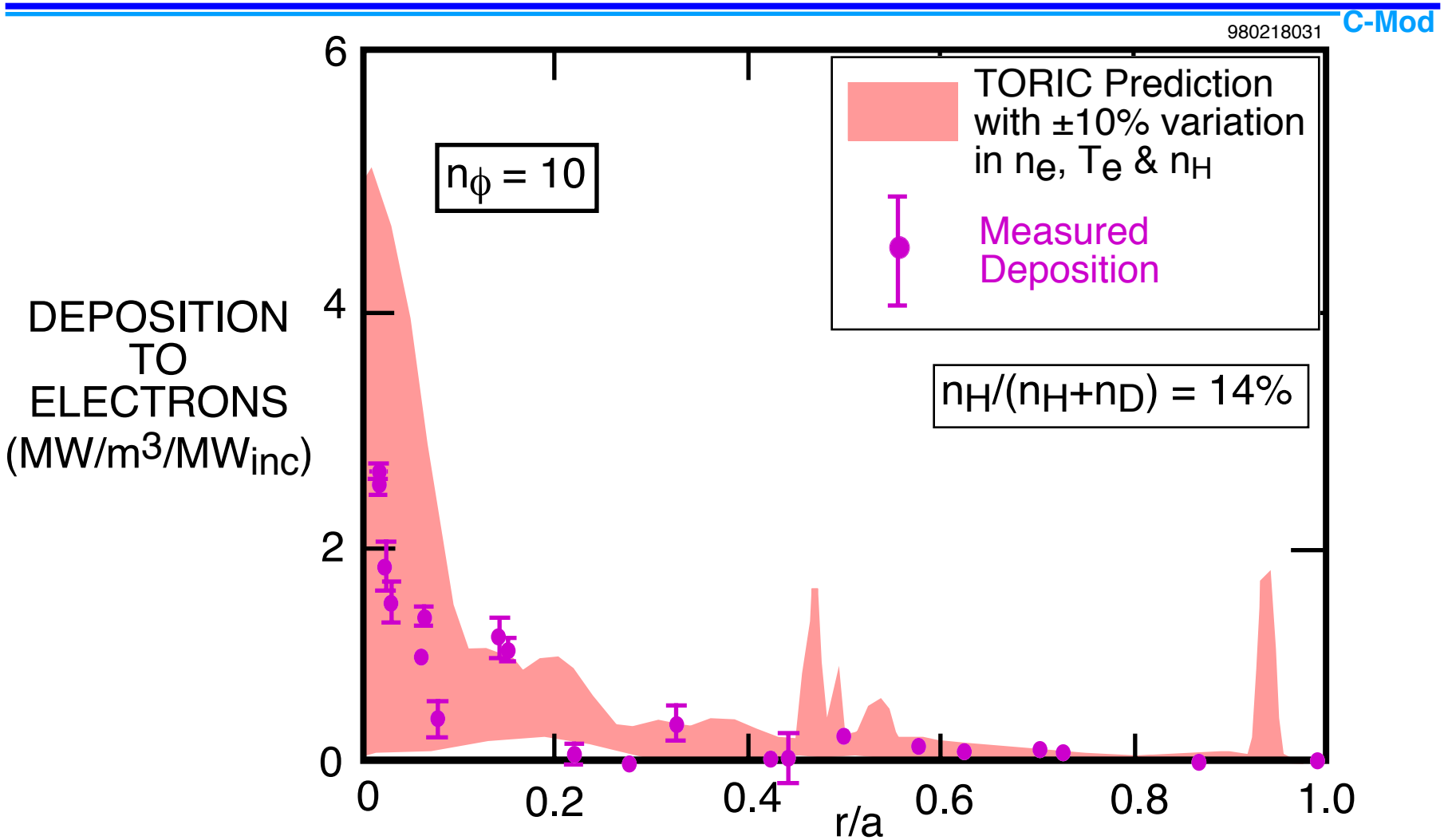
At $n_H/(n_H+n_D) < 28\%$ Measured Deposition Becomes More Peaked On Axis



- Core electron heating predicted by TORIC very sensitive to small variations in plasma parameters

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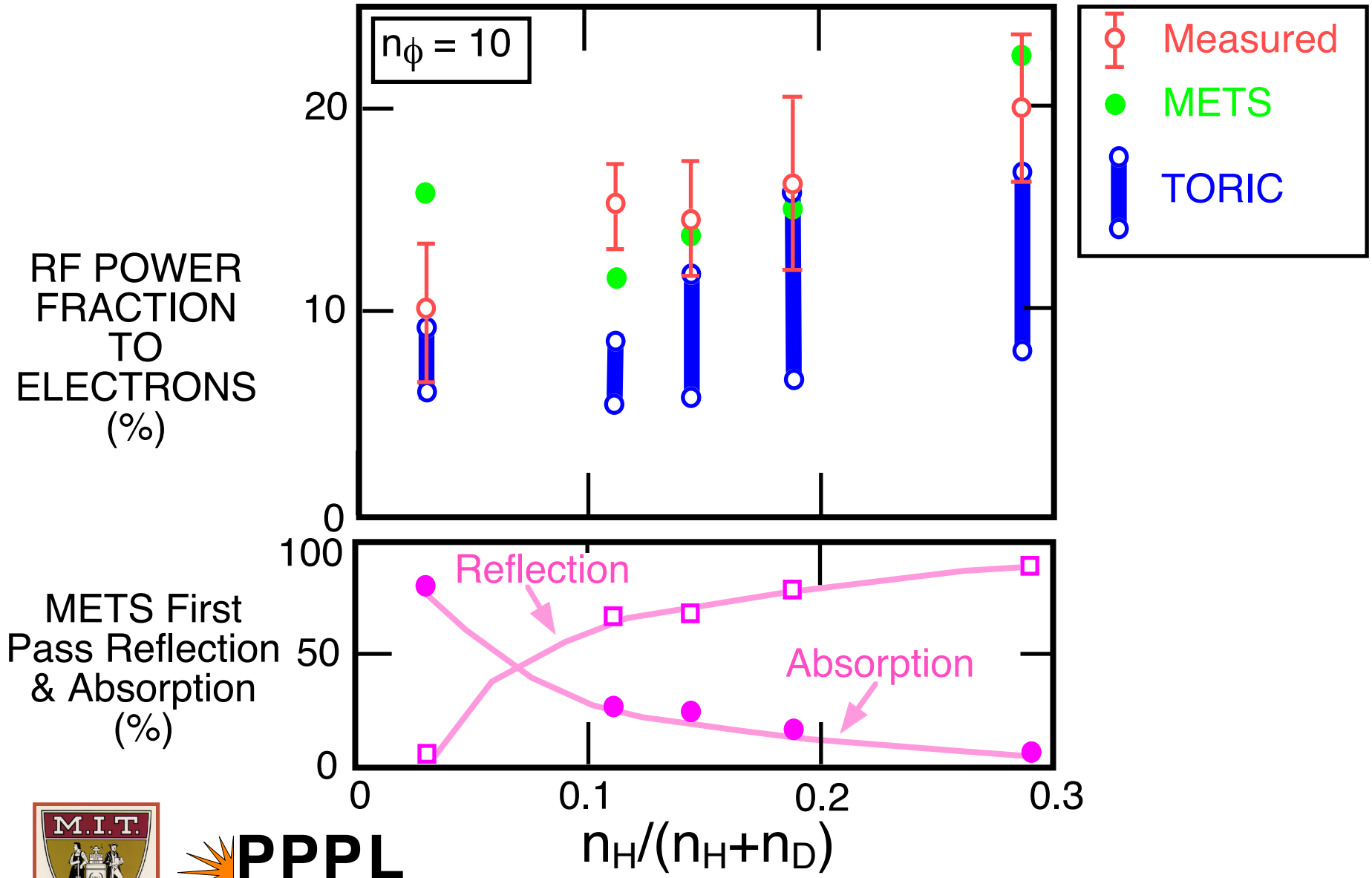
Measured RF Power to Electrons Increases from 10% to 20% as $n_H/(n_H+n_D)$ Increases from 2.5% to 28%

C-Mod



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Summary

- New ECE polychromator improves $T_e(R)$ coverage for electron power deposition studies in C-Mod
- Benchmarking electron deposition from TORIC in D(H) regime difficult due to model sensitivity to small (±10%) changes in plasma parameters
- In D(H) regime < 20% of RF measured and predicted to go to electrons, remaining power goes to ions
- In future, studies with improved $T_e(R)$ coverage in D(^{3}He), where mode conversion electron heating is much stronger