XP 613:
Impurity transport in beam heated NSTX H-mode discharges using the multi-color "optical" soft X-ray arrays

L. F. Delgado-Aparicio, D. Stutman, K. Tritz, and M. Finkenthal
The Johns Hopkins University, The Plasma Spectroscopy Group

R. E. Bell, M. Bell, R. Kaita, S. Kaye, B. P. LeBlanc, S. Paul and L. Roquemore
Princeton Plasma Physics Laboratory

F. Levinton, H. Yuh
NOVA Photonics, Inc.

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Motivation and achievements

MOTIVATION

- Extend the impurity particle transport studies for the **H-mode**:
  a) **D_Z** & **v_Z**
  b) ρ^* scaling at fixed q-profile
  c) **Z** (C, Ne, Ar).

- Studies relevant for **NSTX**, the **next step ST** and **ITER** where screening of high-Z impurities is invoked to shield the plasma core.

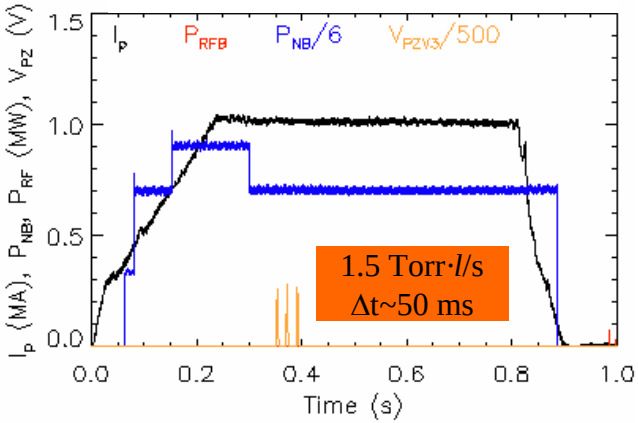
ACHIEVED

- Successfully performed Neon gas-puffs for study its penetration into NSTX core.
  a) Three injection times were also established.
  b) Neon penetrates to the core on tens to few hundred ms time scale.
  c) Late peaking of $n_{Ne} \Rightarrow$ an **inward convective (pinch) velocity**.
  d) A field scan (fixed q-profile) shows **slower penetration at higher field**.

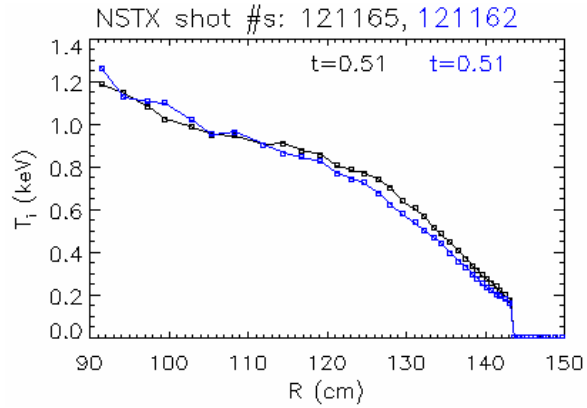
- CD_4 puff, vitreous C pellet injection for Z-scaling were unsuccessful.

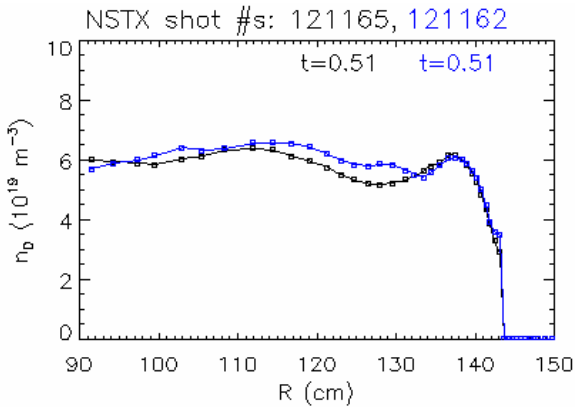
Neon injection didn't modify background shot

NSTX#s 121165 & 121162

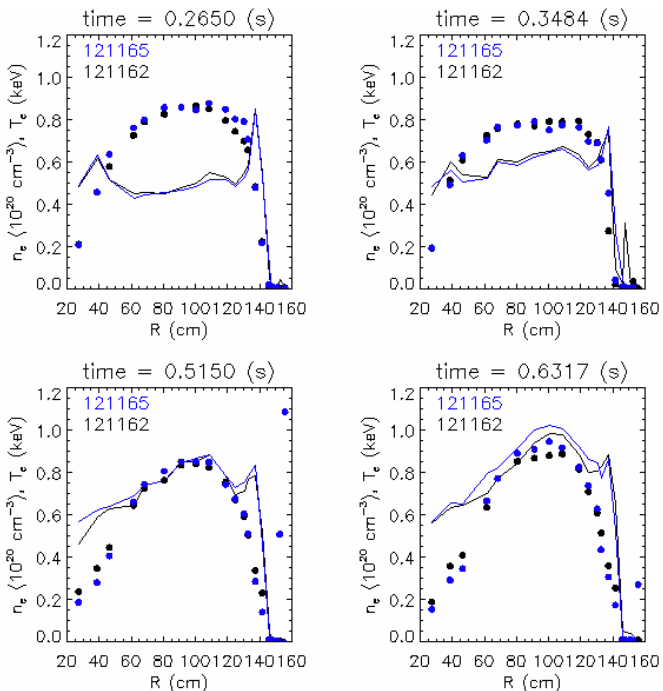


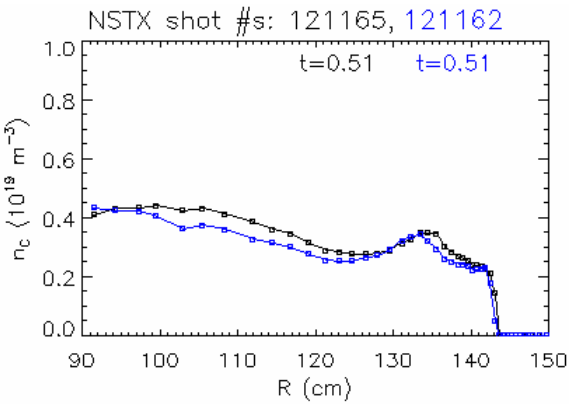
CHERS DATA (R. Bell, PPPL)





MPTS DATA (B. LeBlanc, PPPL)





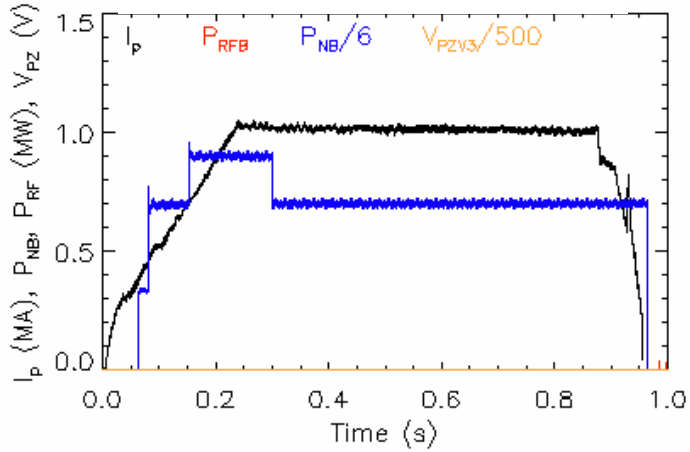
Background shot

Neon shot

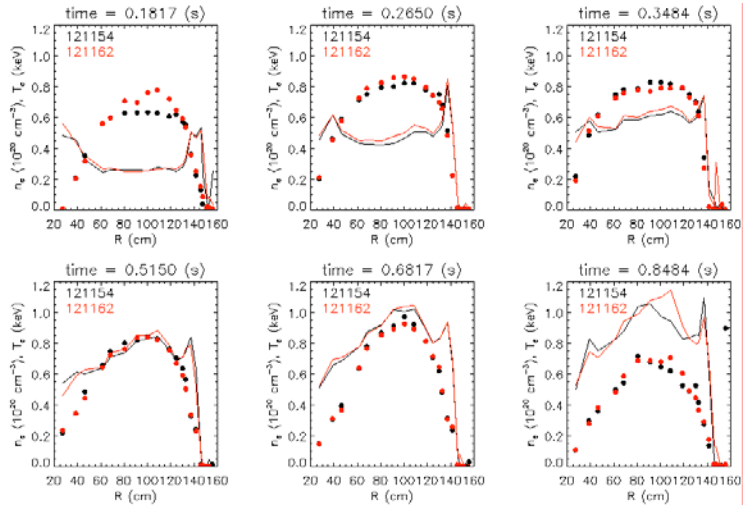
- We used one Neon and one background shot.
- At late times MHD kicks in due to impurity accumulation.

The background shots are reproducible

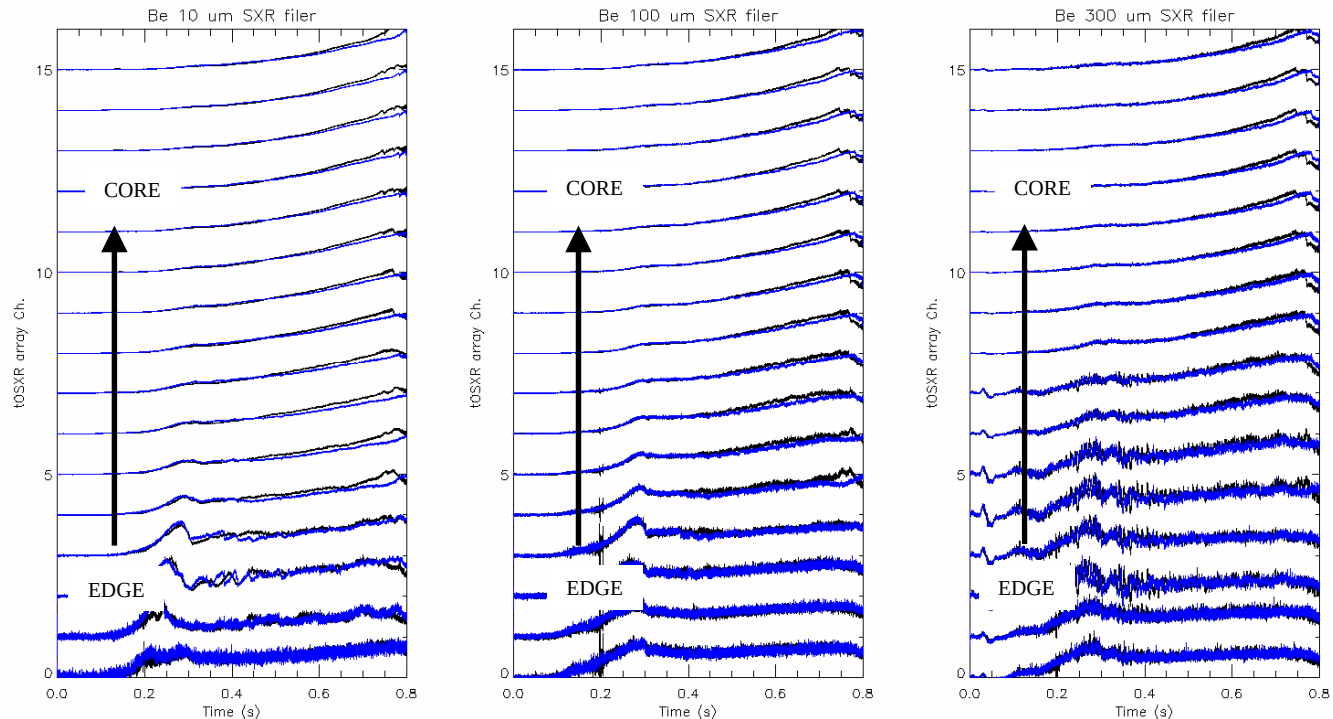
NSTX#s 121165 & 121162



MPTS
(B. LeBlanc, PPPL)

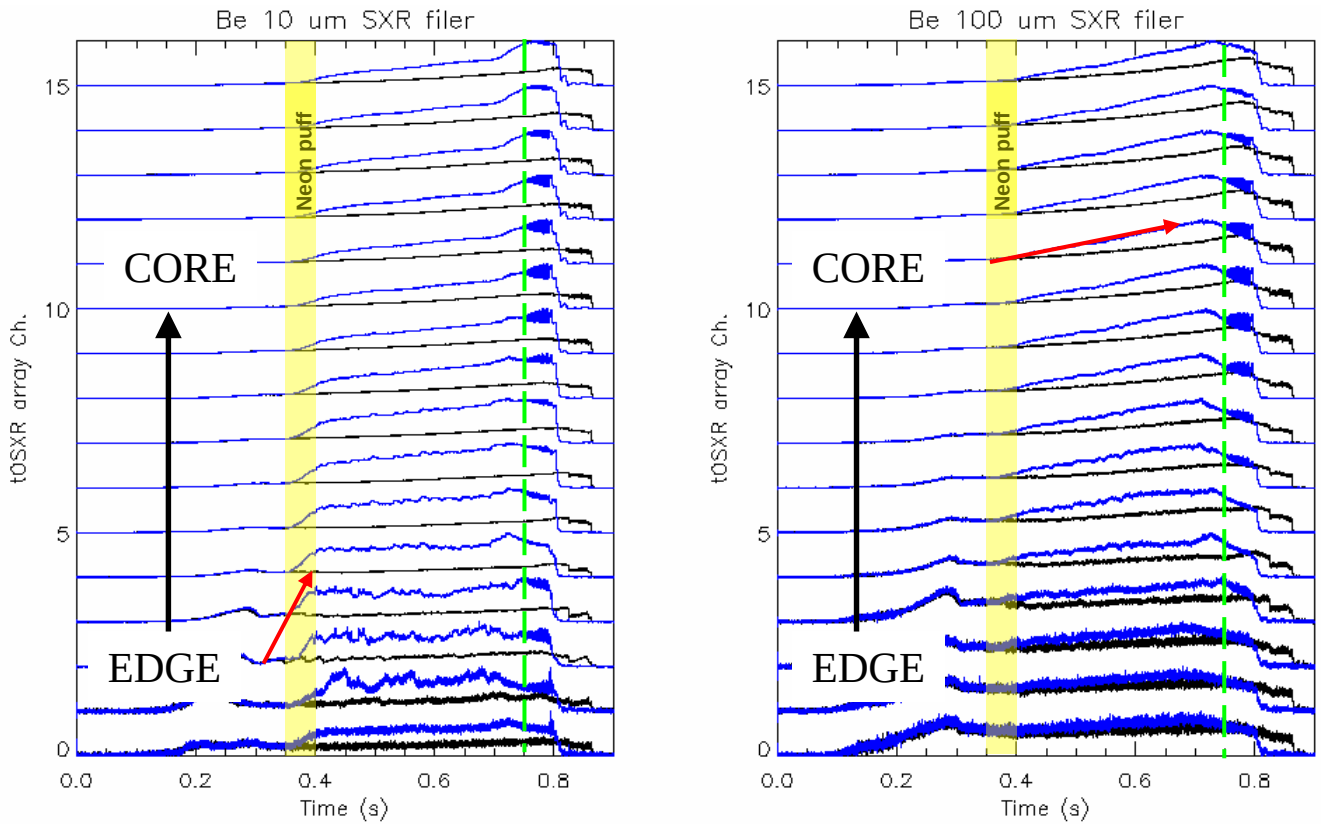


tOSXR signals
(121162 & 121154)



The edge Neon builds up fast, core builds up slow

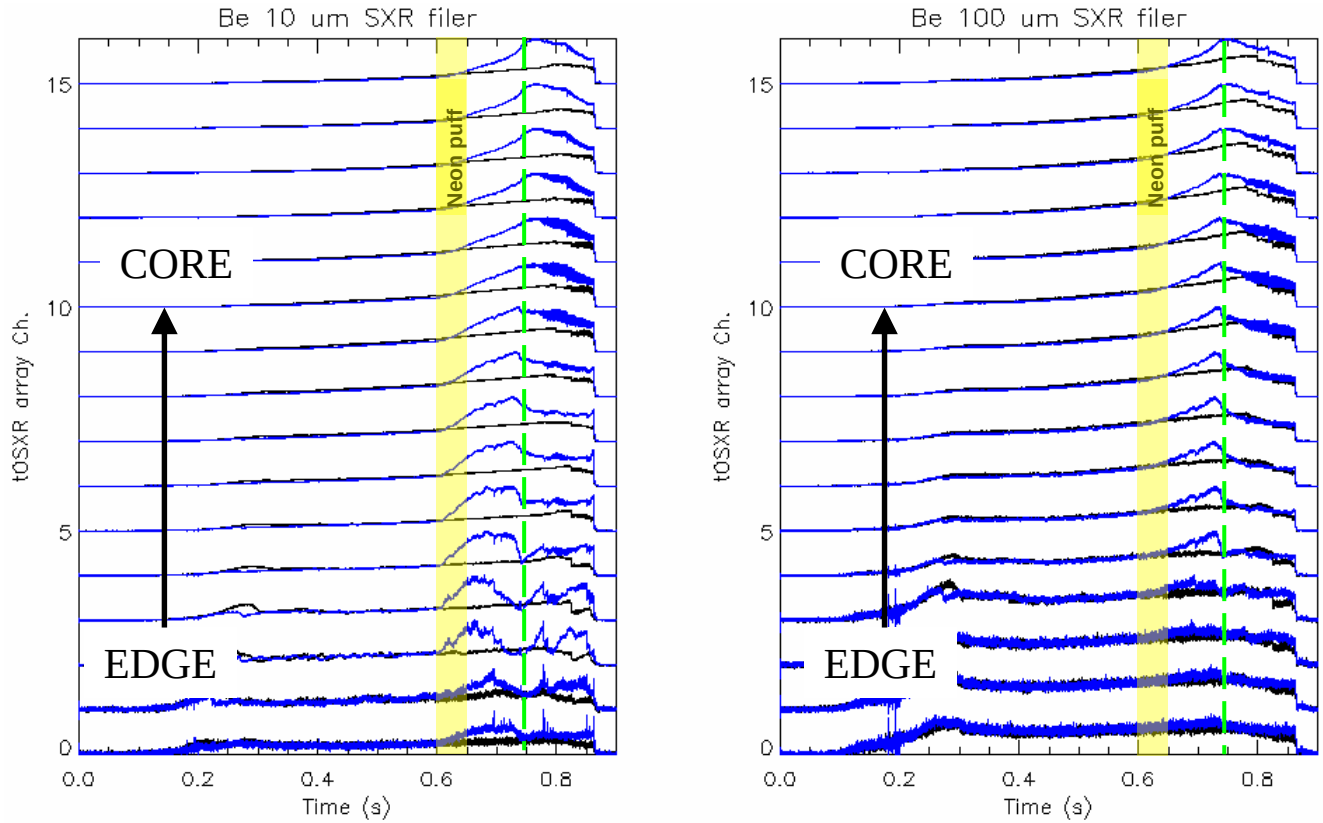
121165 (neon) vs. 121162 (background)



- Good SNR of tOSXR signals when Neon was injected.
- Fast edge vs slow core Neon build up.
- Strong peaking of impurities (~0.7 s) and flattening of T_e (consistent with MPTS)
- Late *(1,1)* MHD mode triggered by impurity accumulation (~0.75 s).

Late Ne puff to assess time dependence of transport

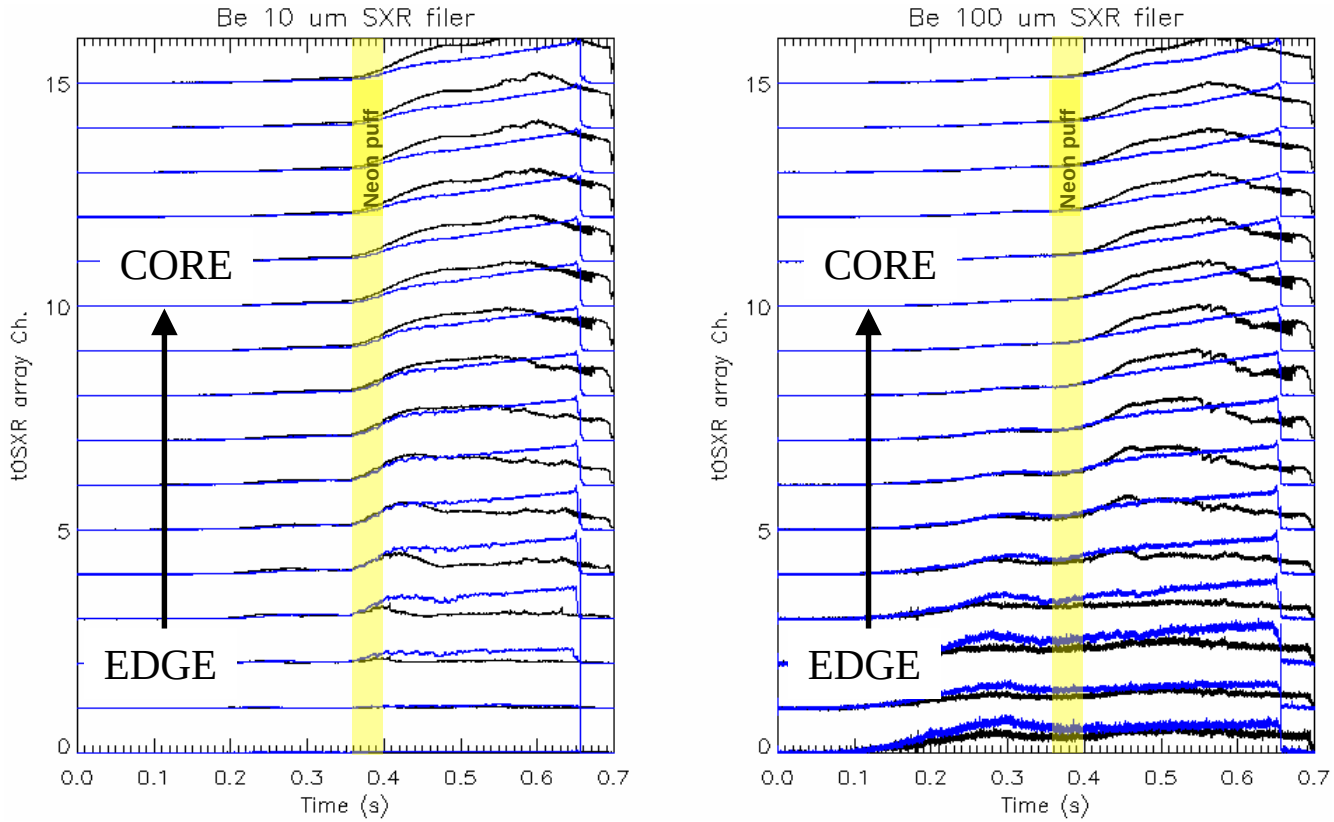
121166 (neon) vs. 121162 (reference)



- Possibly faster core penetration of Neon with late injection.
- Bolometer also shows faster peaking.

Slower impurity penetration at high fields

121174 (1.2 MA, 5.5 kG) vs. 121182 (0.9 MA, 4 kG)



- Fast decay of edge emission and stronger core buildup at low B!
- No *(1,1)* mode at high fields.

Summary and plans

- Successfully used small (1.5 and 2 Torr·*l*/s, 50 ms) Neon gas-puffs to study impurity penetration into NSTX core. Three injection times were also established.

- The neon penetrates the core on the tens to hundred ms time scale, with a final peaking of the neon density late in the shot indicating an inward convective velocity.

- A field scan at fixed q-profile shows slower penetration at higher field.

- (1,1) modes due to impurity accumulation also suppressed at high fields.

- What happened with the CD_4 and why will it work in 2007?

PLAN FOR 2007 RUN : Z-SCALING

- Repeat the Neon injections to touch baseline with XP 613.
- Use Methane (CD_4) and Argon injections (from Bay J Mid-plane) to perform the Z-scaling and B-scan (@ q-fixed).

Acknowledgments

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JOHNS HOPKINS UNIVERSITY

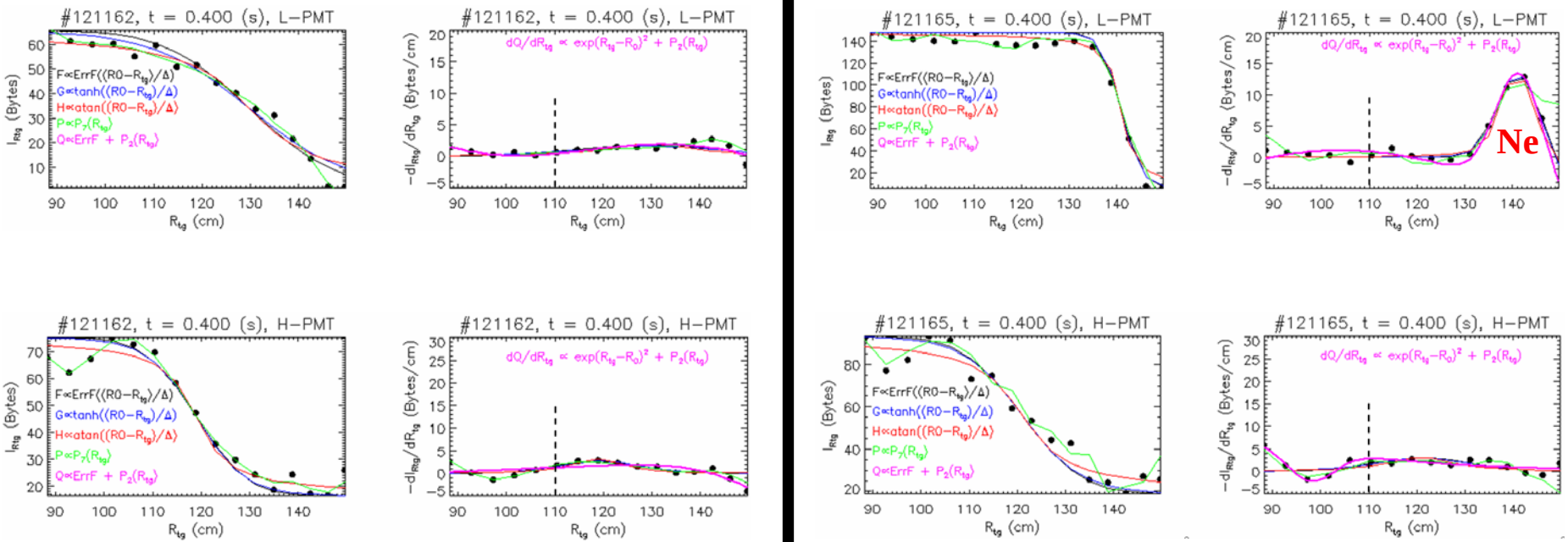
PPPL PRINCETON PLASMA PHYSICS LABORATORY

Preliminary data for Abel-inverting neon profiles (0.4 s)

Background shot # 121162 (t~0.4 s)

vs.

Neon shot # 121165 (τ_{Ne}=[350,400] ms, t~0.4 s)



- Right after the injection there is a shell of emission ~ 140 cm
- The high energy channels remain unchanged.

Preliminary data for Abel-inverting neon profiles (0.7 s)

Background shot # 121162 (t~0.7 s)

vs.

Neon shot # 121165 (τ_{Ne}=[350,400] ms, t~0.7 s)