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X609 - dependence of ELMS and power balance on drsep

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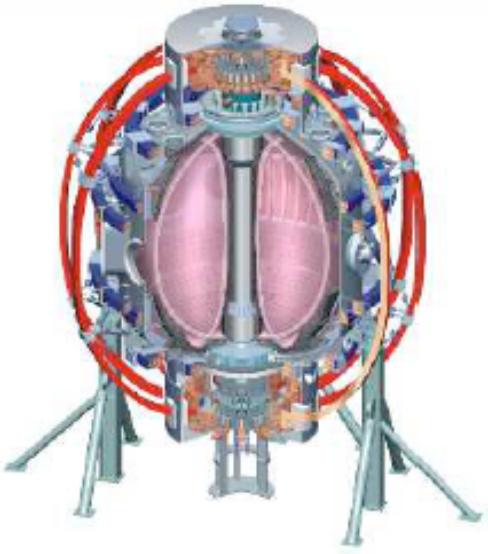
OAK RIDGE NATIONAL LABORATORY

(H. Meyer, J. Hughes)

NSTX Results Review
Princeton, NJ
Aug. 6-7, 2008



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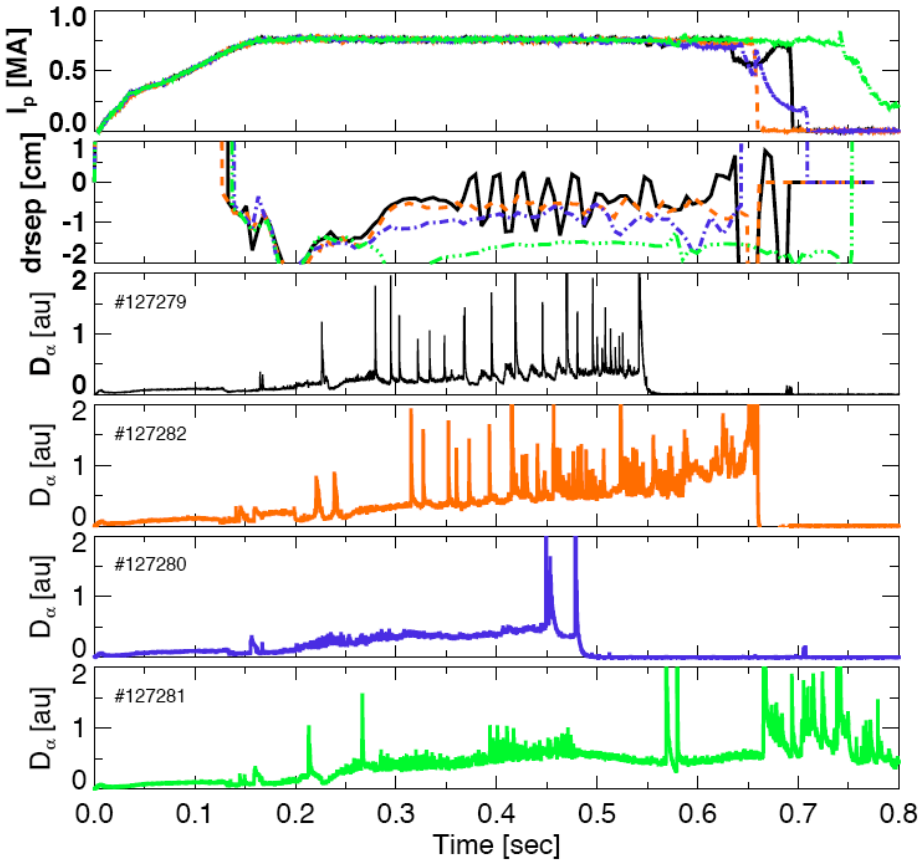
Triangularity and δ_r^{sep} both play important roles in determining the ELM regime and power balance

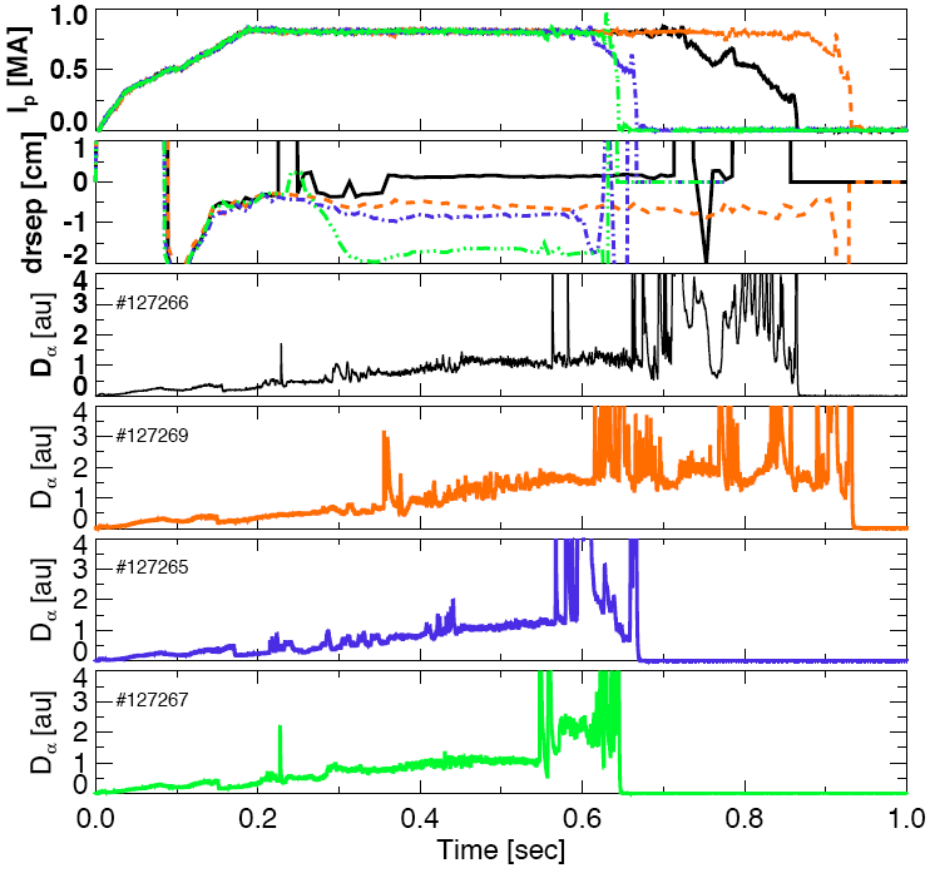
- High δ~ 0.65-0.7: mostly Type V ELMs observed over: $0<\delta_r^{sep}<-2$ cm
  - I_p=0.8 MA, B_t=0.45 T, P_{NBI} = 4, 6 MW
  - Peak stored energy tends to decrease modestly from DN->LSN
  - Bottom divertor heat flux ***reduced*** as lower divertor made more dominant (not understood)
- "Low" δ~ 0.5-.55: transition from Type I ELMs to Type V ELMs observed over: $0<\delta_r^{sep}<-2$ cm
  - I_p=0.8 MA, B_t=0.45 T, P_{NBI} = 6 MW
  - Type I ELMs more likely as $\delta_r^{sep} \sim 0$, as observed previously
  - Type V ELMs more likely as δ_r^{sep} made more negative
  - Peak stored energy tends to decrease modestly from DN->LSN
  - Bottom divertor heat flux generally increased as lower divertor made more dominant

Type I ELMs observed with the most regularity near double-null in low δ_L ~ 0.5

Low δ_L ~ 0.5

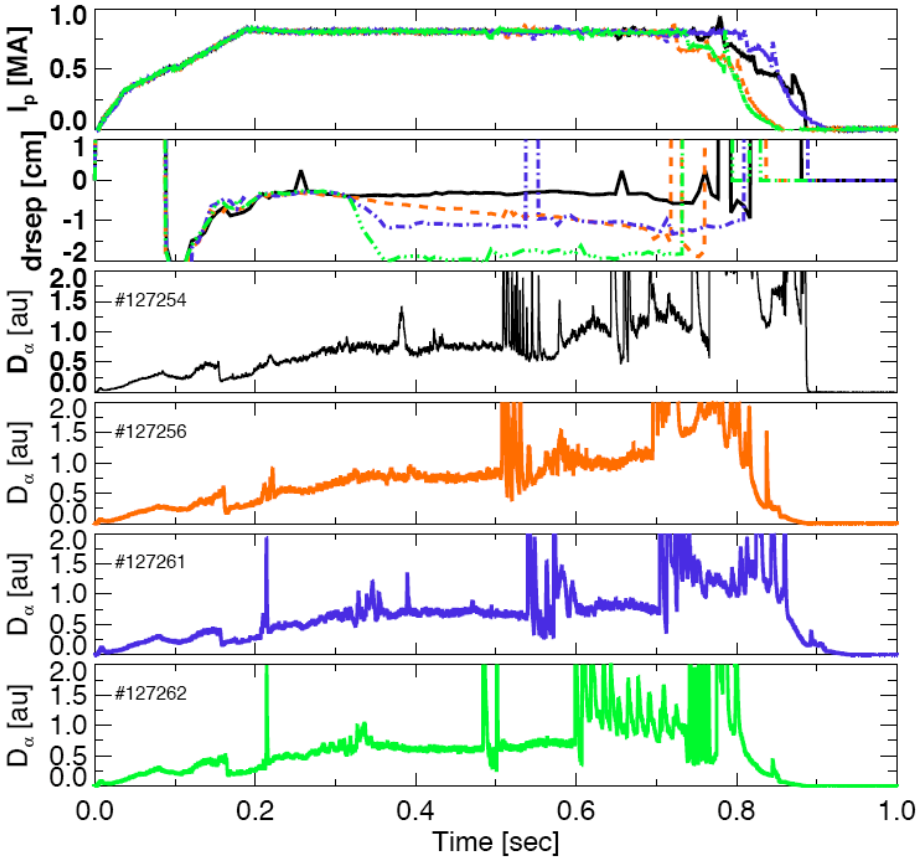


High δ_L ~ 0.65

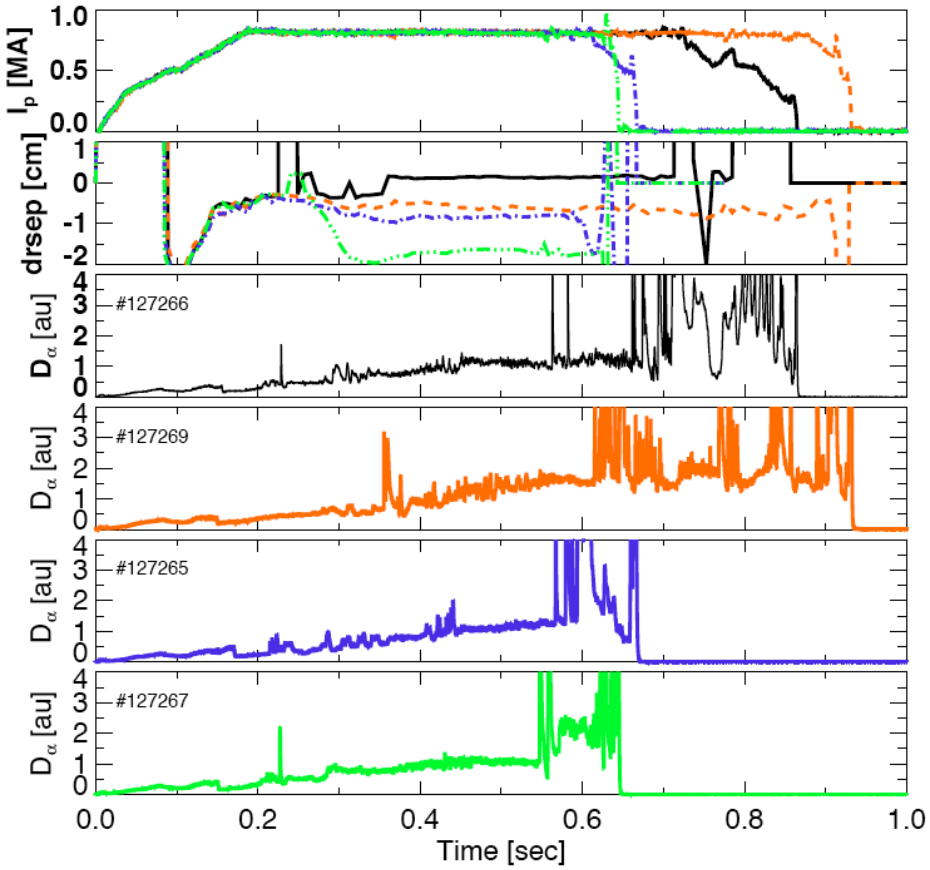


High triangularity discharges had mostly Type V ELMs with a few larger ELMs near 0.5-0.6 sec

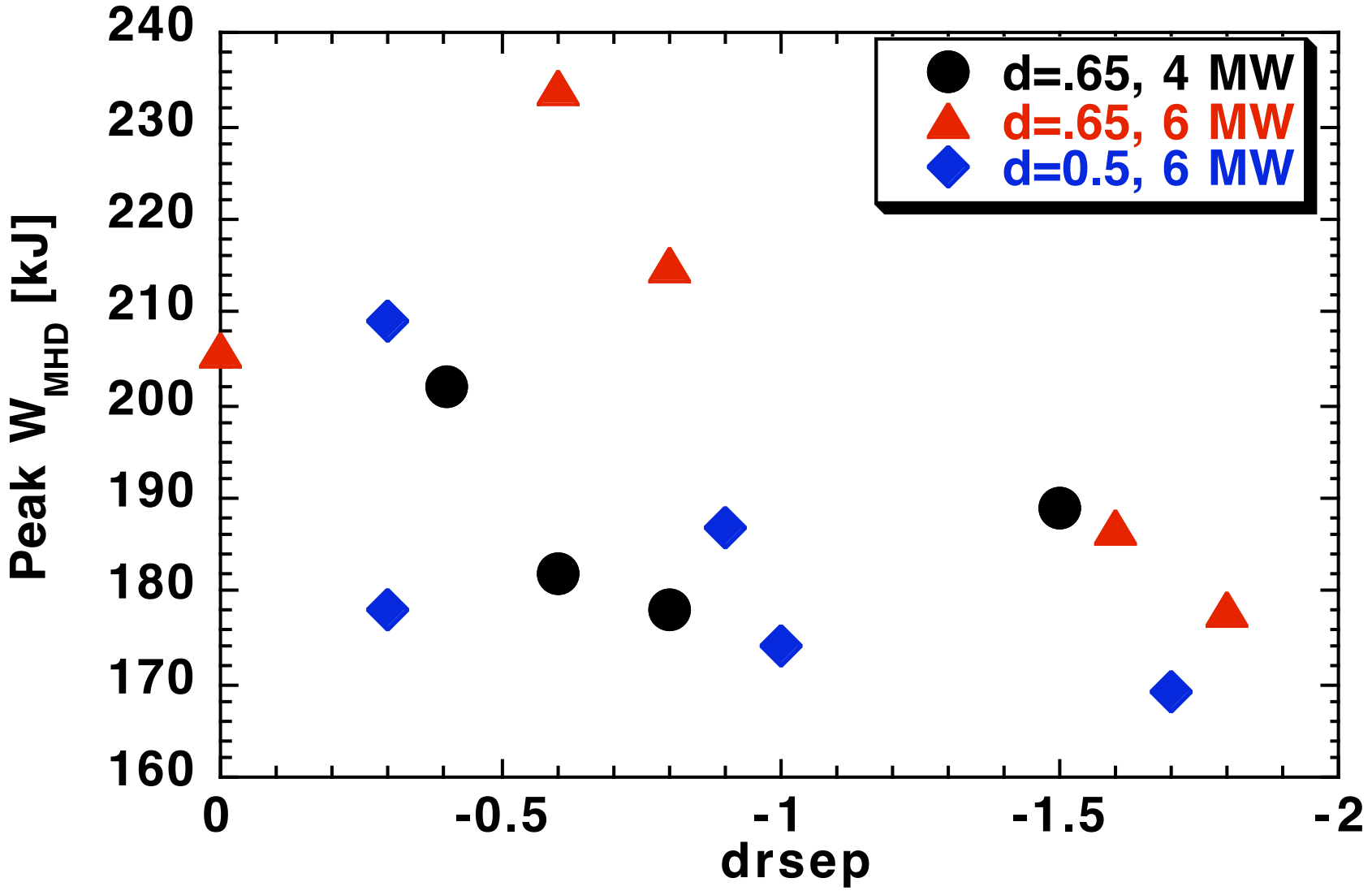
High δ_L ~ 0.65, P_{NBI}=4 MW



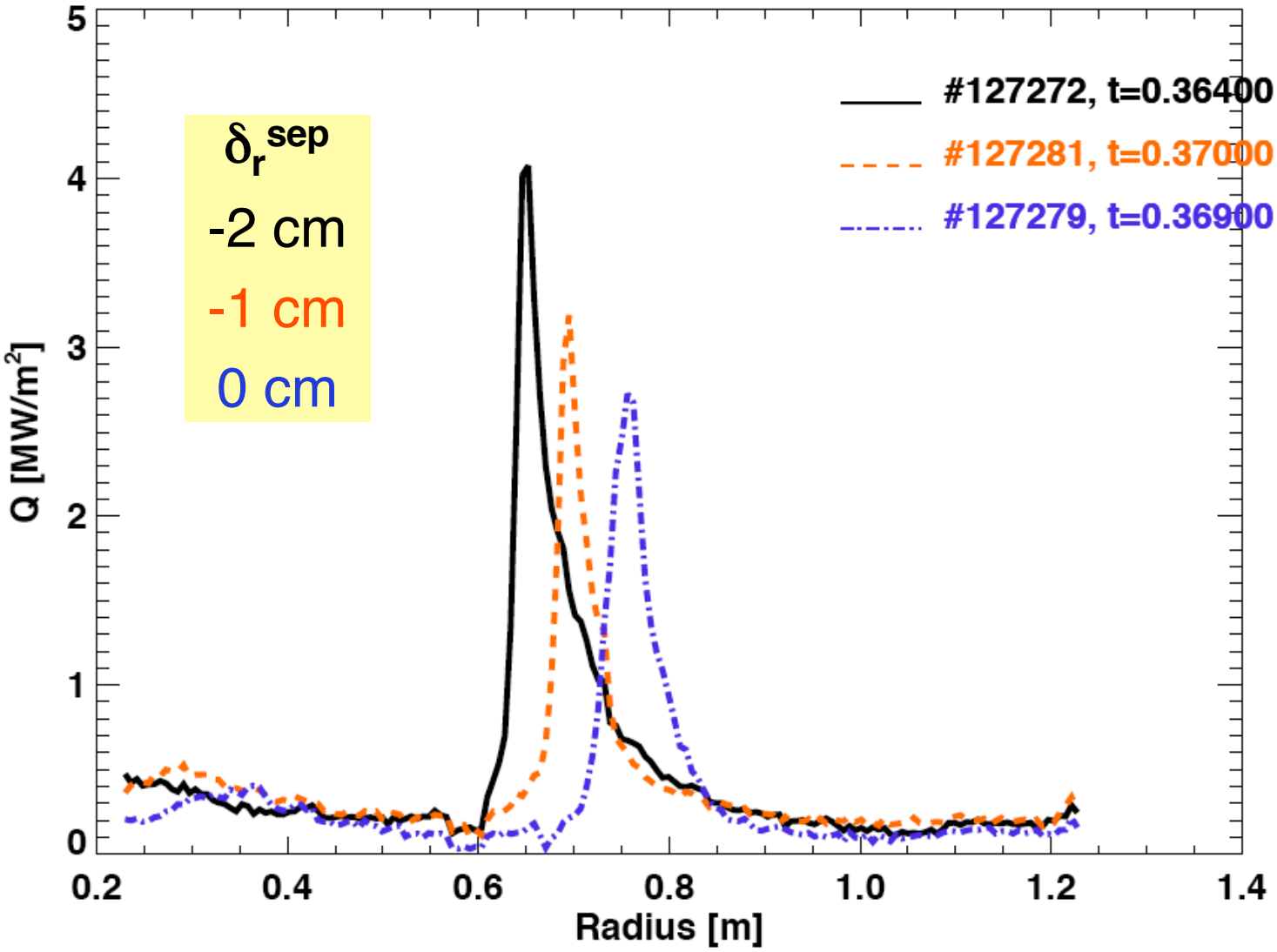
High δ_L ~ 0.65, P_{NBI}=6 MW



Peak stored energy tends to decrease modestly in going from DN to LSN



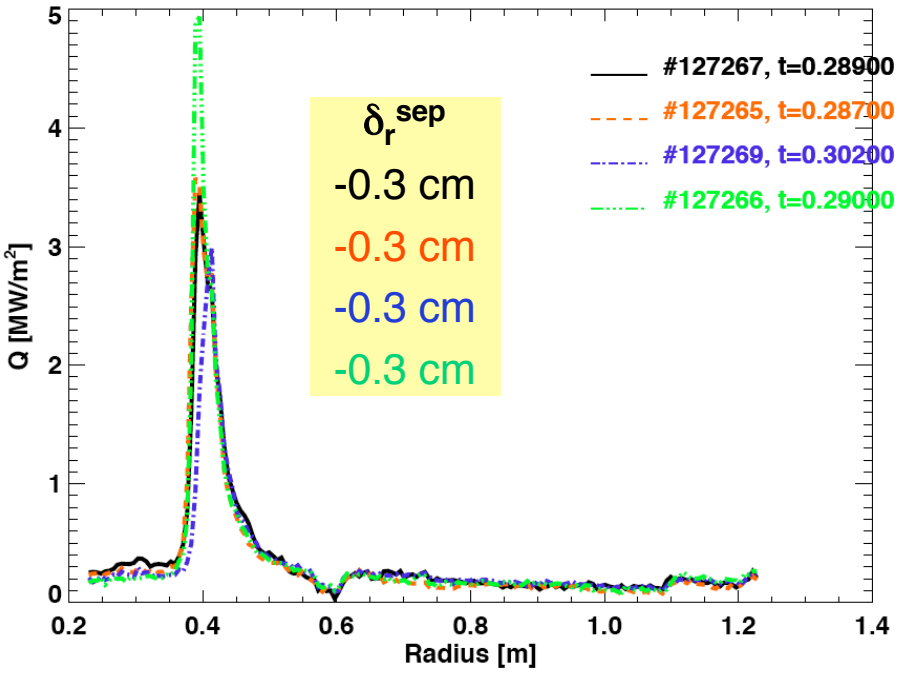
Bottom divertor peak heat flux increased as lower X-point made dominant with δ_r^{sep} decrease



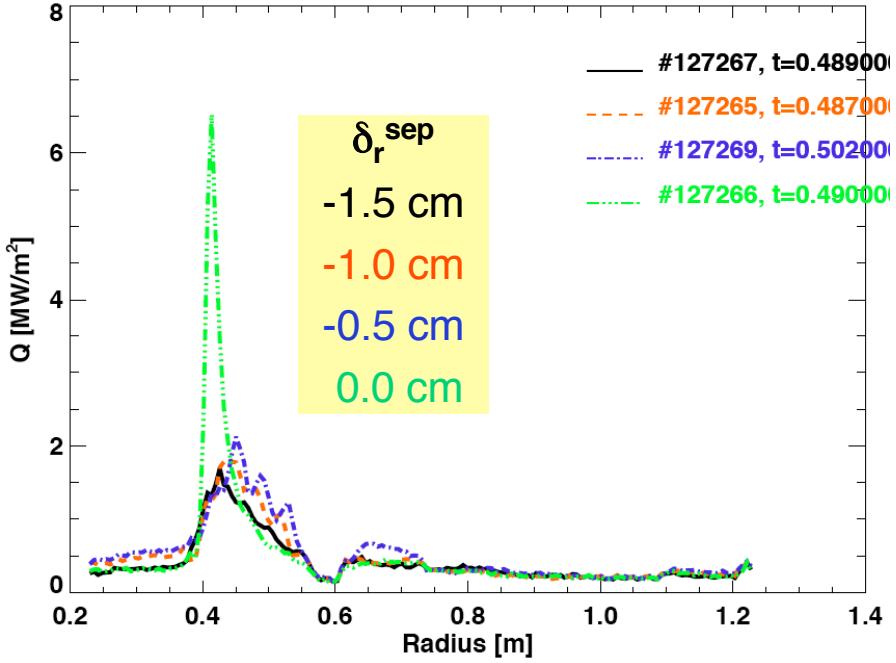
Puzzling result: ***Less*** heat flux measured in lower divertor as δ_r^{sep} reduced (i.e. lower X-point more dominant)

High δ_L ~ 0.65, P_{NBI}=6 MW

Early, δ_r^{sep} similar



Late: δ_r^{sep} scan



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XP721 - comparison of small ELMs with C-Mod and MAST

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R. Maingi, ORNL Oak Ridge National Laboratory

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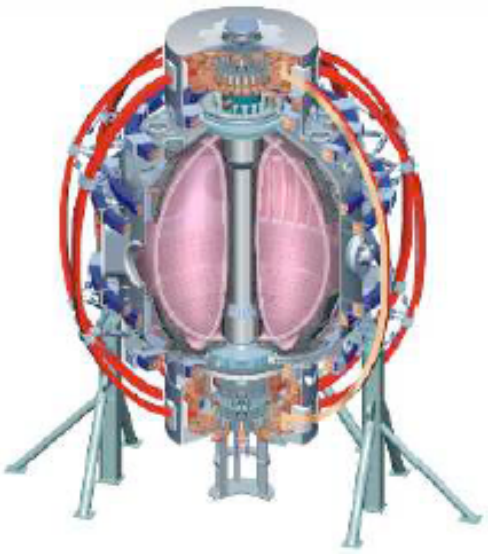

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Small ELMs observed with a β_{ped} threshold in all three devices

- Performed β_{ped} scan to find small ELM window in each machine
  - NSTX Type V ELMs: 5-6%<β_{ped} < 10% {upper limit: Type I ELMs co-exist with Type V} (LSN shape)
  - MAST small ELMs (not Type V): "H-mode"< β_{ped} <3% (DN shape)
  - C-Mod: 0.3%<β_{ped} (LSN shape)
- MAST small ELMs are high-n (lots of filaments) whereas NSTX Type V have only 1-2 filaments
  - C-Mod analysis of GPI to be done
- One conclusion: there are different types of small ELMs
  - e.g. small ELMs in NSTX near DN shape seem to have a β window and more filaments, as in MAST

XP 721 confirmed Type V ELM/no ELM β window at lower q95 in 2008

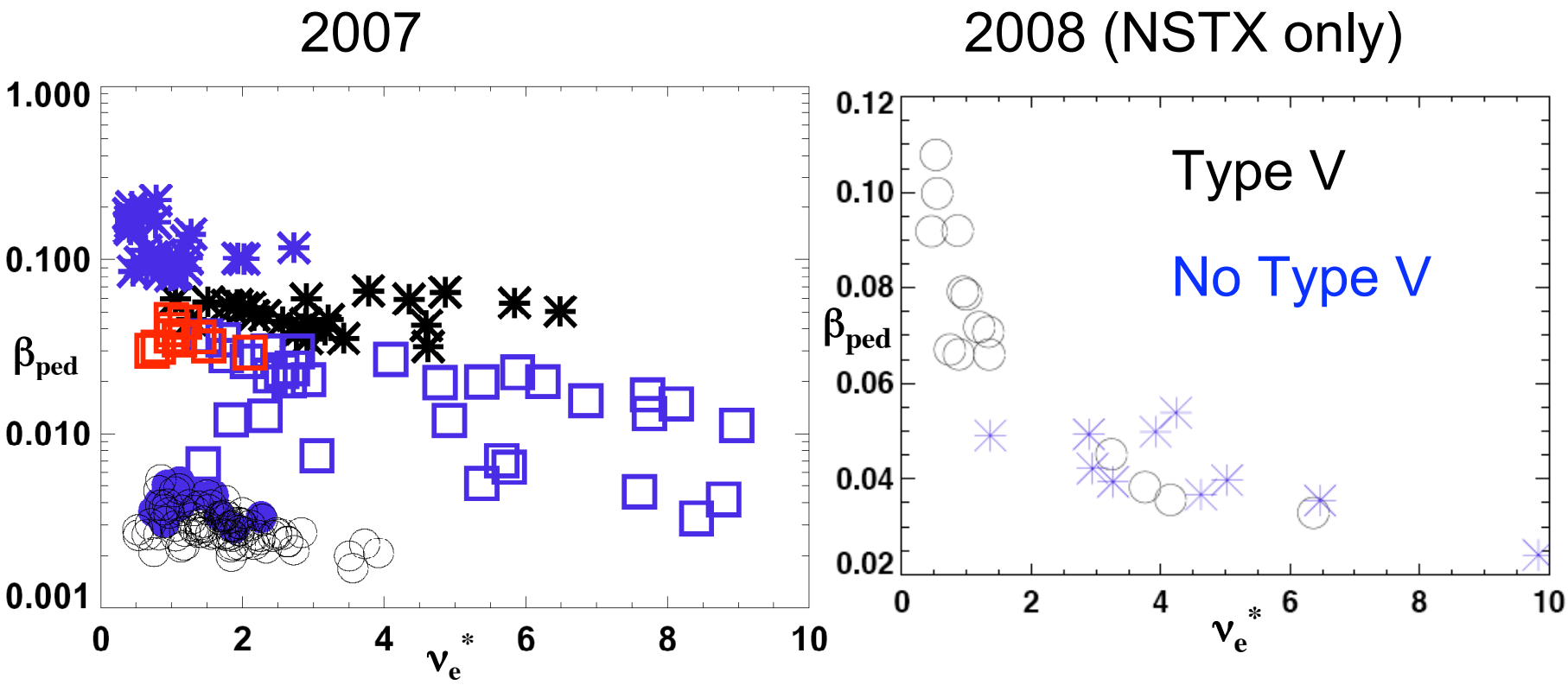

Figure 1: Small ELM edge operational space in Alcator C-Mod (circles), MAST (squares), and NSTX (stars). The color BLACK signifies no small ELMs, BLUE signifies that small ELMs were observed, and RED signifies large ELMs only, i.e. no small ELMs.

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XP818 - ELM stabilization experiments with external midplane coils

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S. Gerhardt, J. Menard (PPPL), J-K. Park (PU), S. Sabbagh (Columbia)

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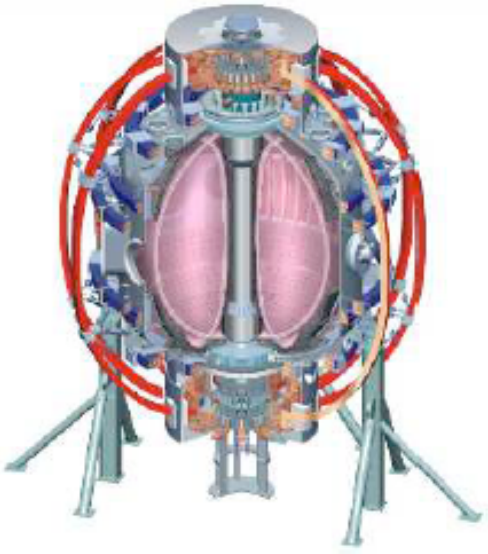
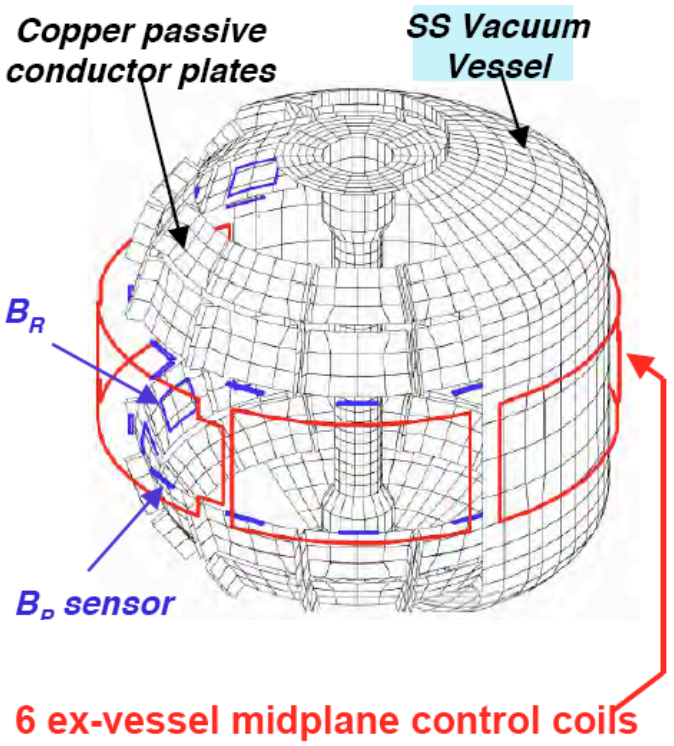


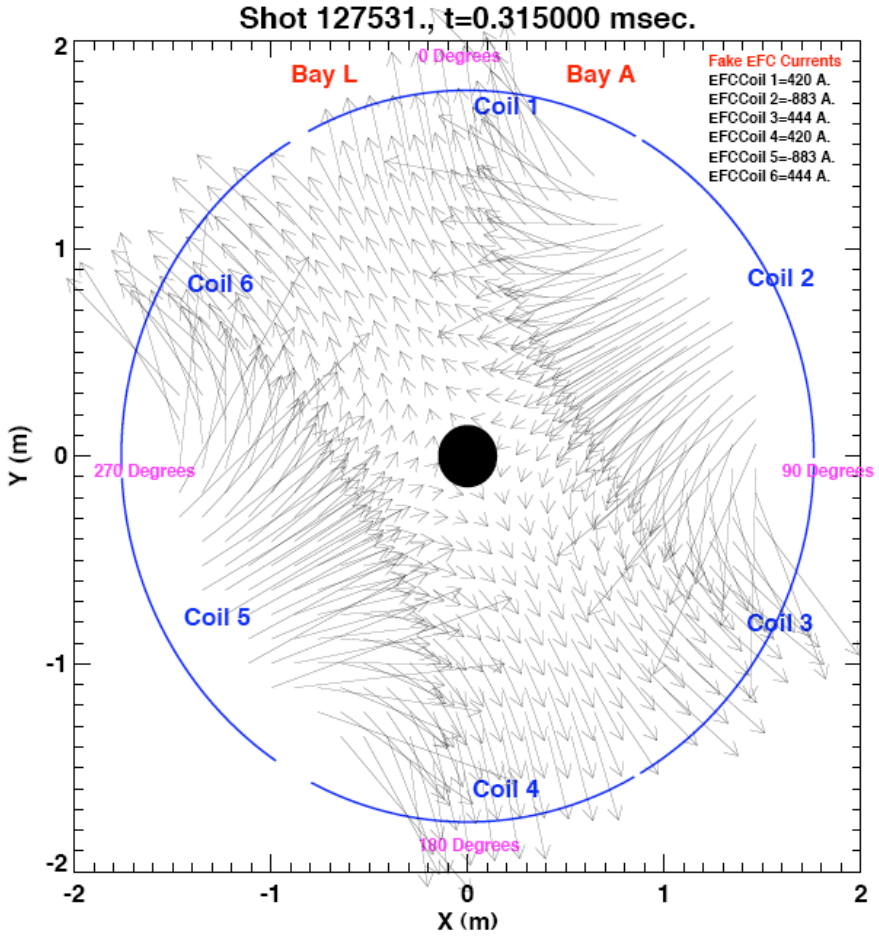
ELM characteristics can be modified with NSTX midplane coils (no stabilization observed)



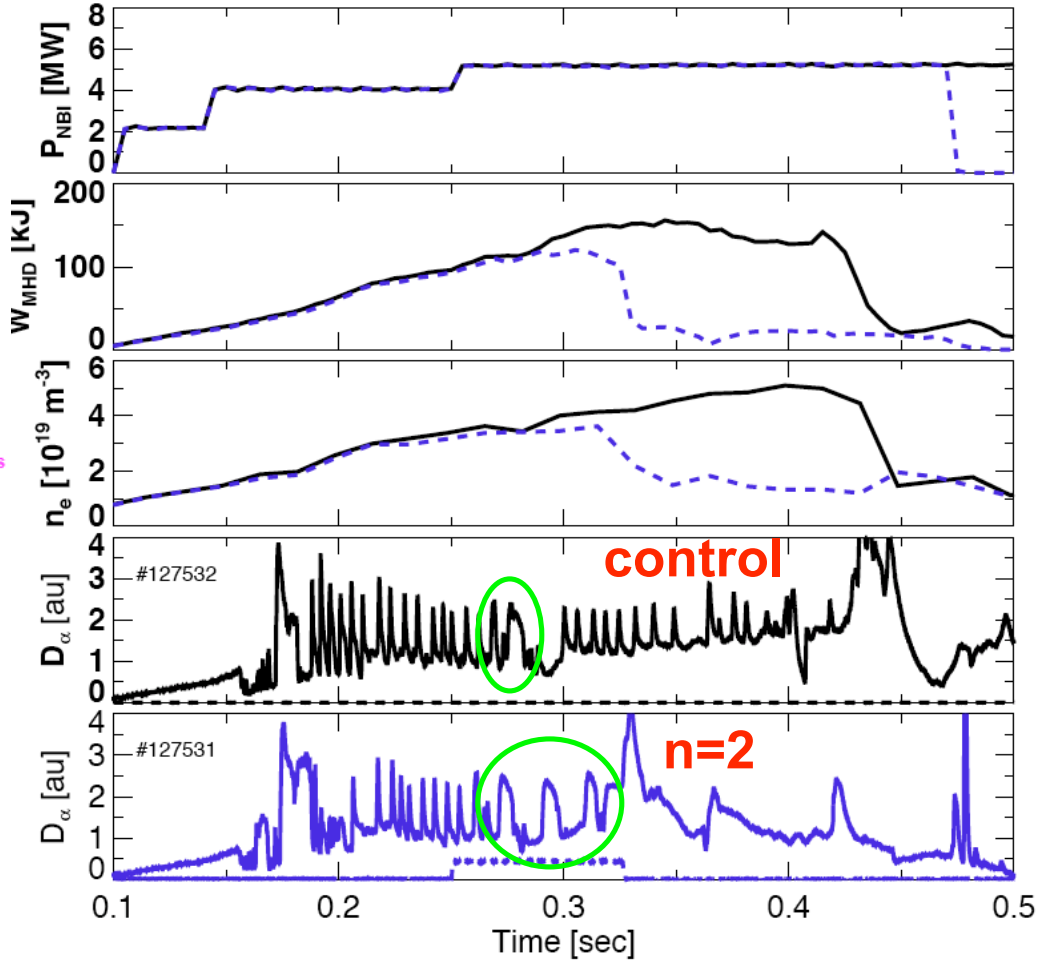
- ELM characteristics modified with n=2 or n=3 at low q_{95}~7-8
  - Single ELMs appear to be "clumped" together, effectively increasing amplitude and decreasing frequency
  - Observed with either DC or AC fields
  - "Clumping" of ELMs observed periodically in target discharges, but probability higher with SPAs

ELMs modified with midplane n=2 field

Field perturbation at midplane (plan view)

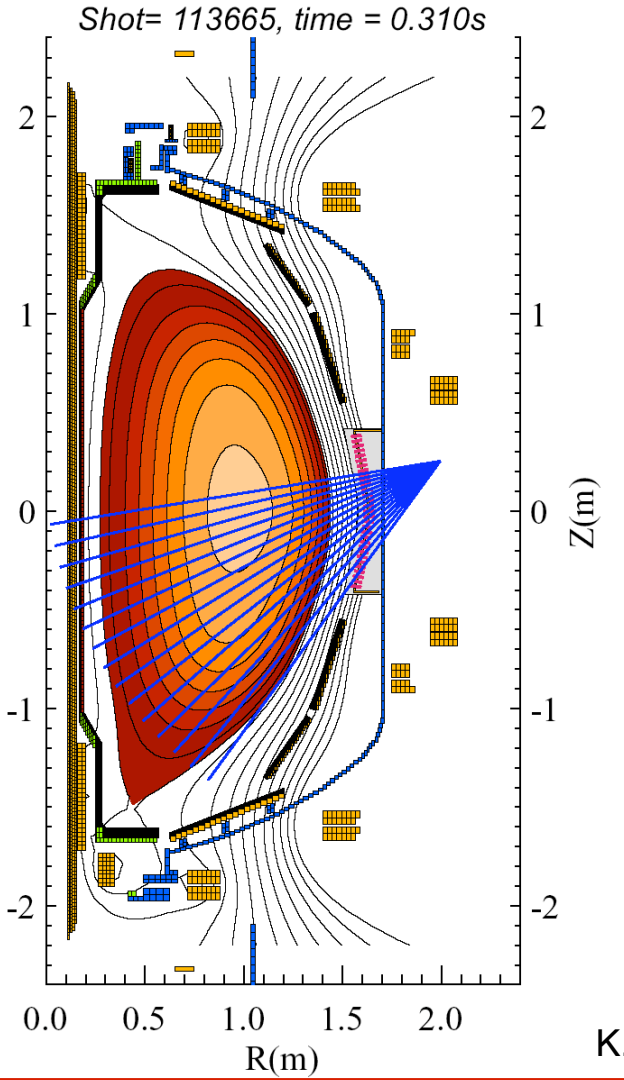


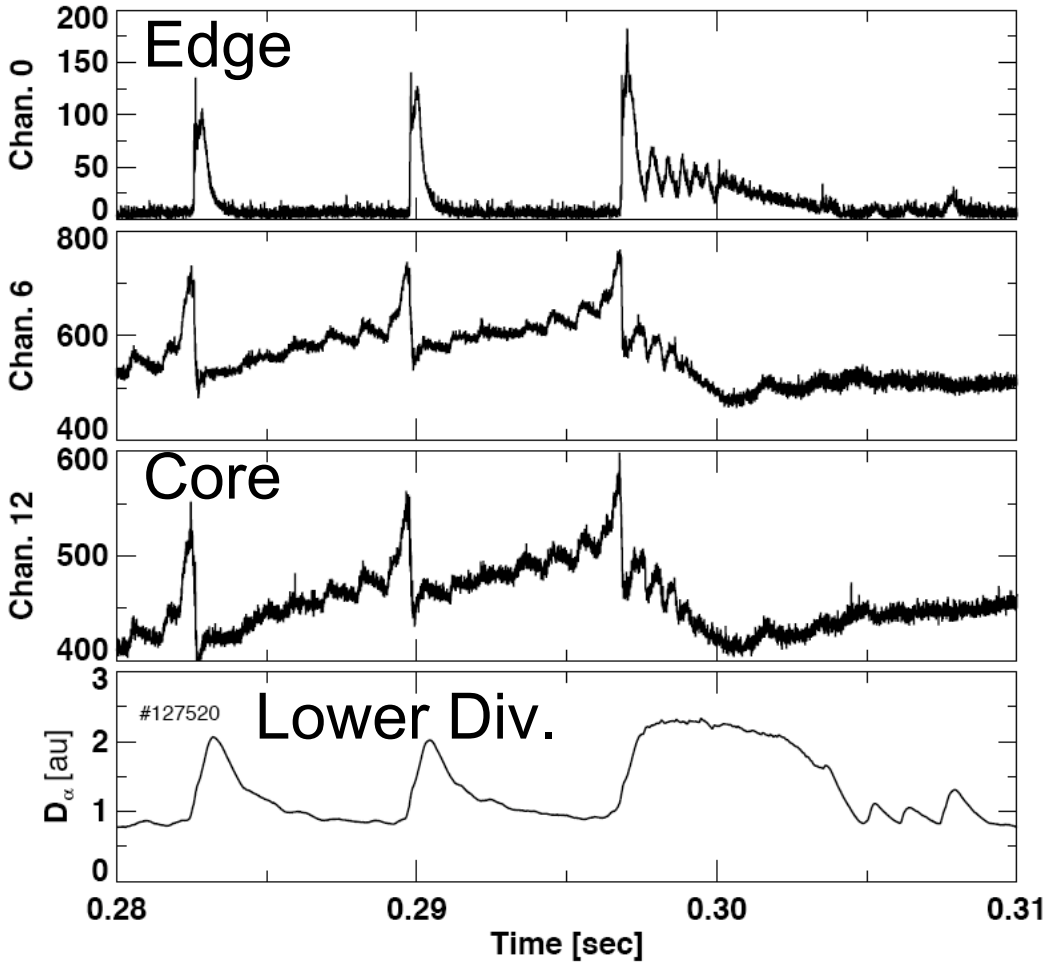
ELMs "clumped" together



Multiple ELMs and/or ELM filaments observed with USXR

USXR midplane view

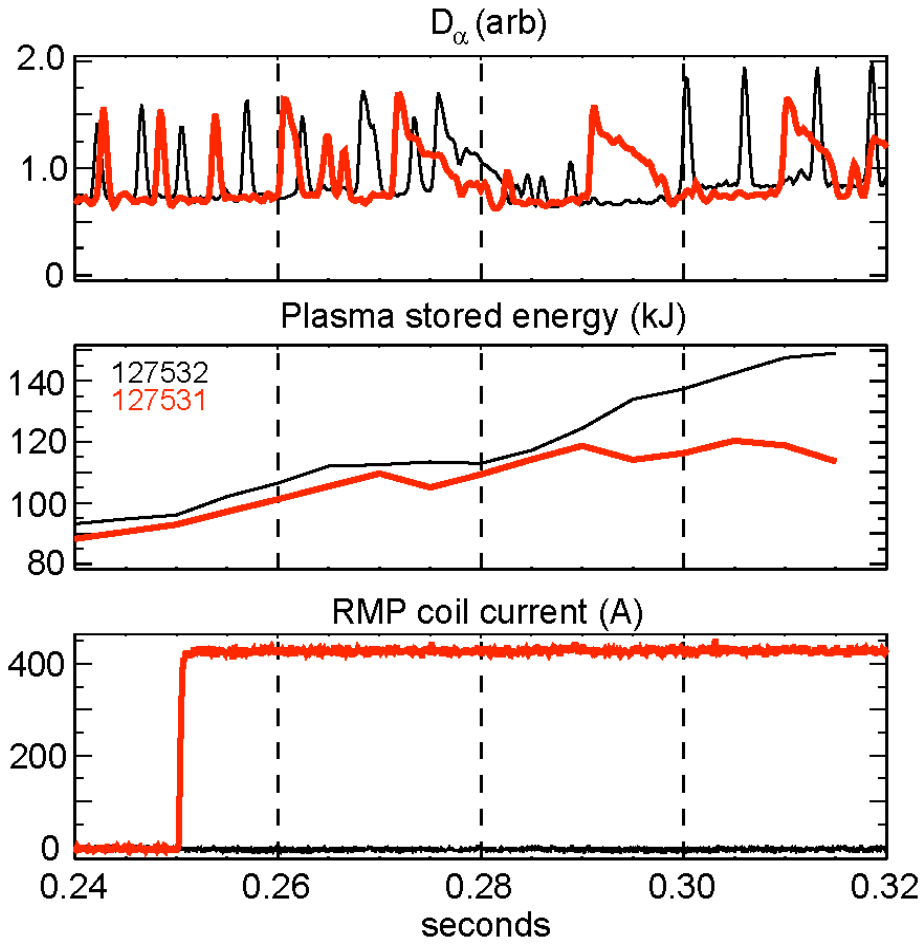




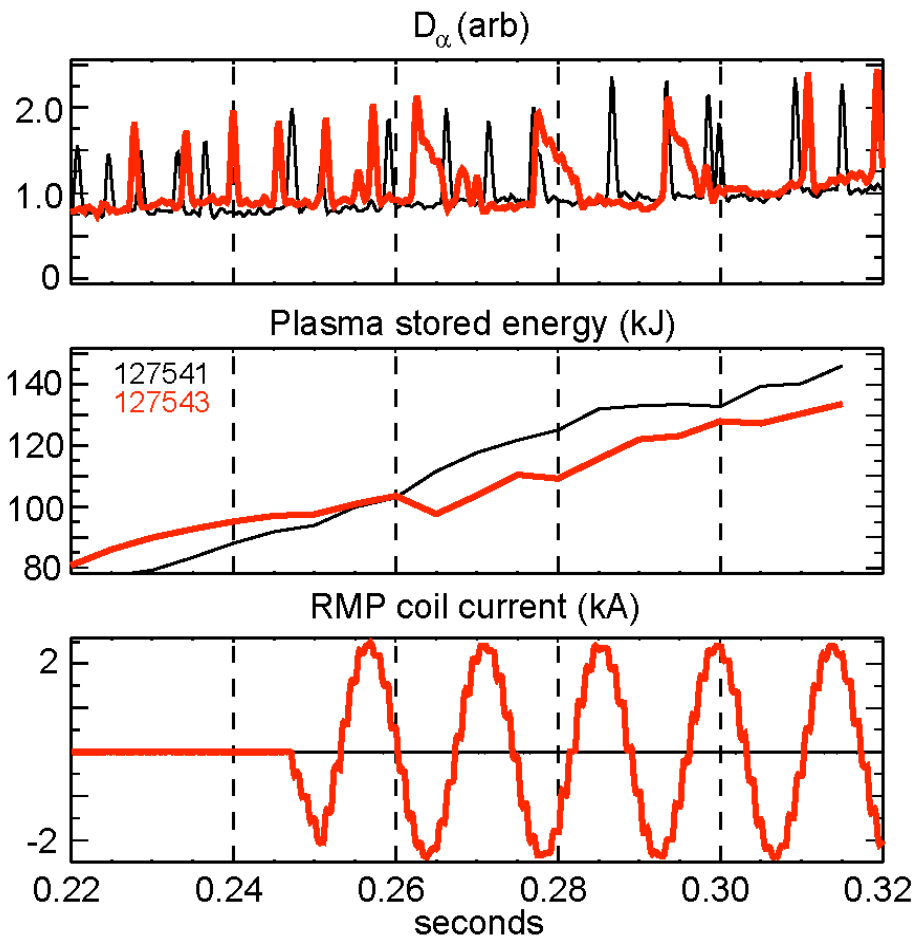
K. Tritz

ELMs modified with either DC or AC fields

DC field



AC field



Bonus slide: Heat flux profile becomes more peaked and triangular with Li-enhanced ELM-free operation