Debriefing – 4.11.2019

F18 – RUNAWAY CONTROL

FTU Experimental Campaign 2019-C2

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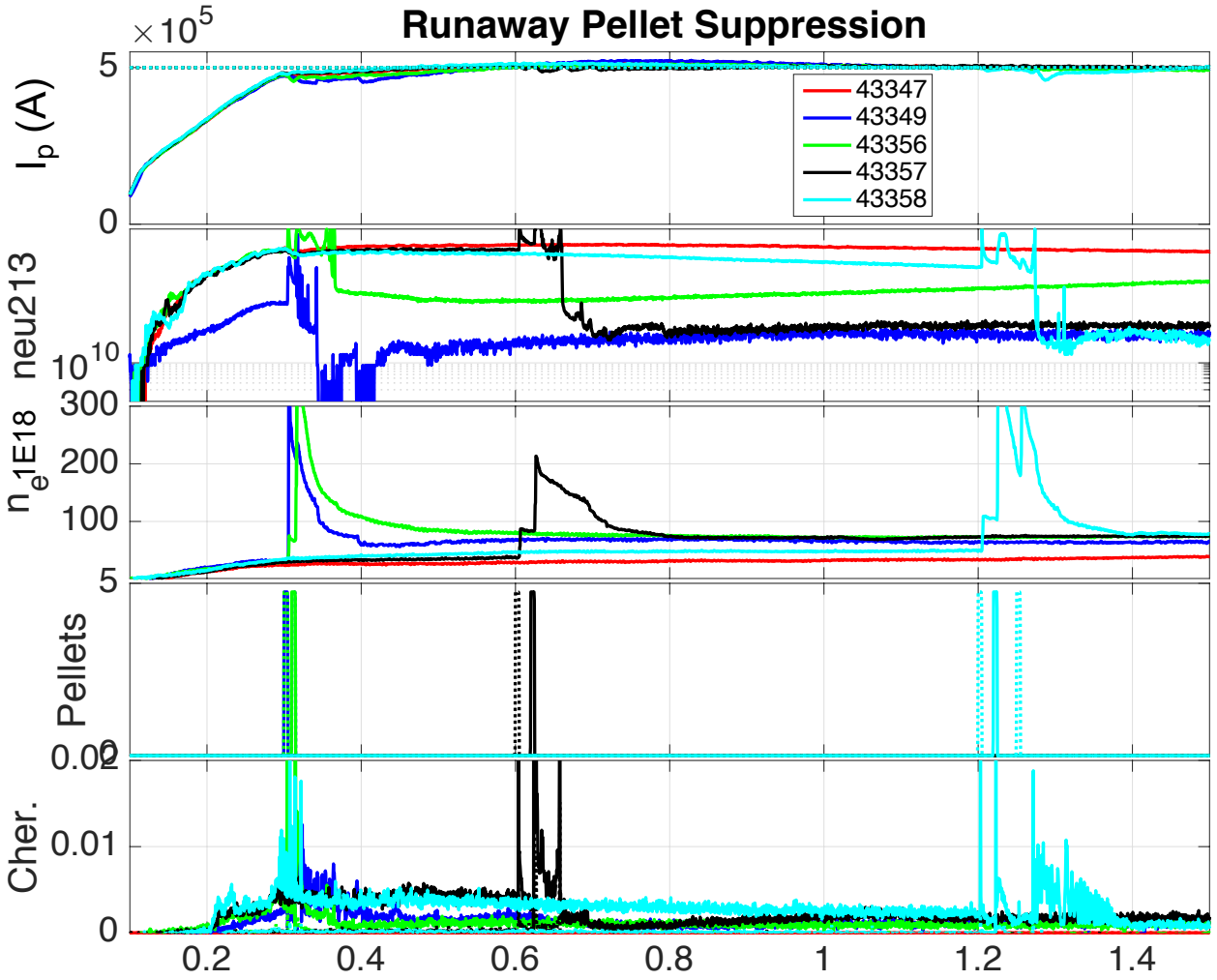
Pellets on quiescent runaways(flat-top)

5.3T, 500kA, D_2 pellet injection on low density - (BP:big p. 2E20, SP:small p. 1E20)



#43347: no pellet.
#49: BP@300ms+SP@310ms
#56: SP@300ms+BP@310ms
#57: SP@600ms+BP@620ms
#58: SP@1.2s+BP@1.22s
+ SP@1.25s

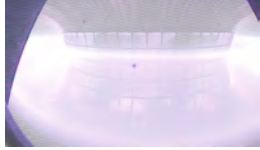
Neu213: gamma rays + neutron.

Central line density (1E18)

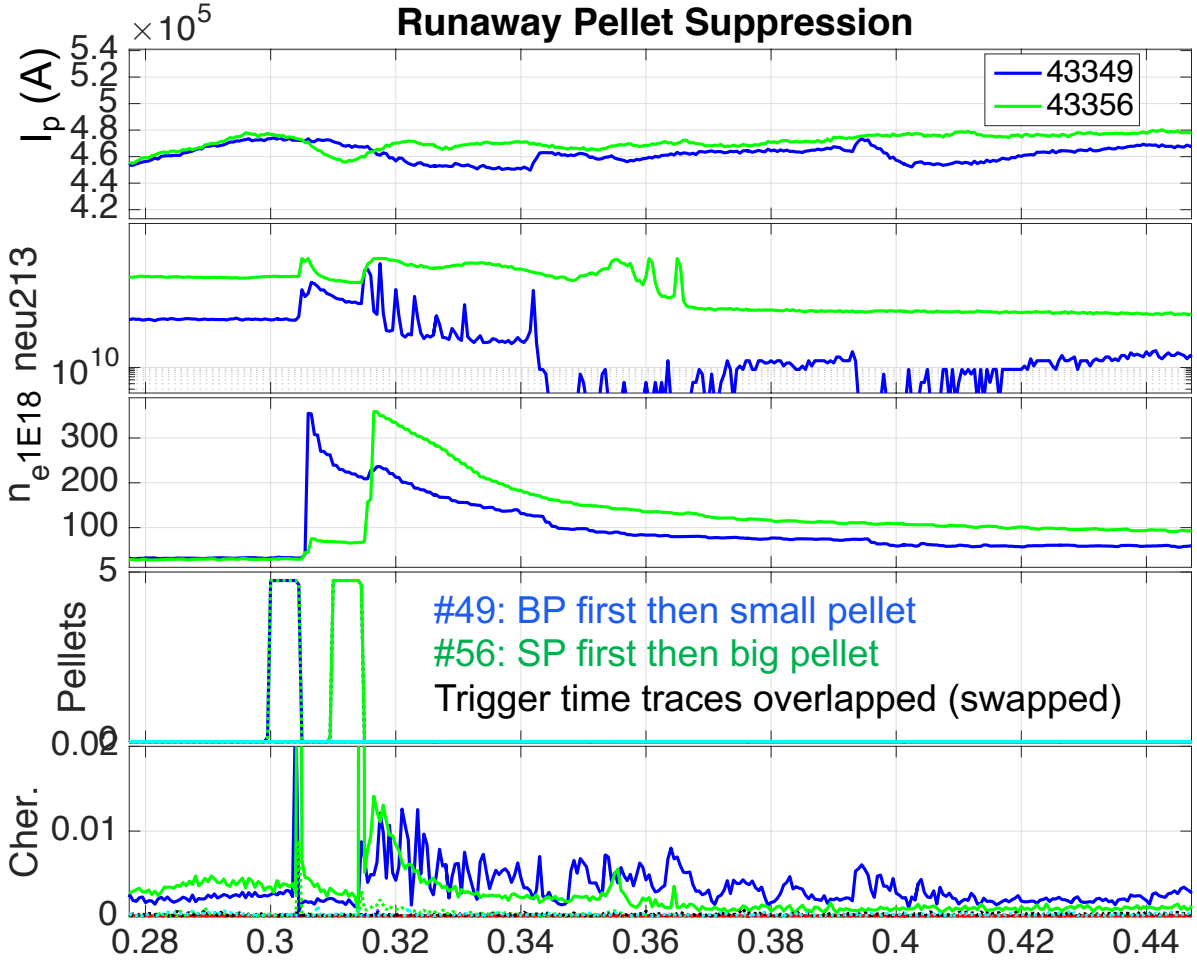
Pellets trigger: dots small pellets, solid big pellet.

Cherenkov probe: direct measure of REs leaving the core.

Pellets on quiescent runaways(flat-top)



5.3T, 500kA, D_2 pellet injection on low density - (BP:big p. 2E20, SP:small p. 1E20)

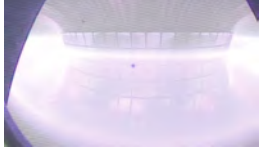


#49: BP@300ms+SP@310ms
#56: SP@300ms+BP@310ms

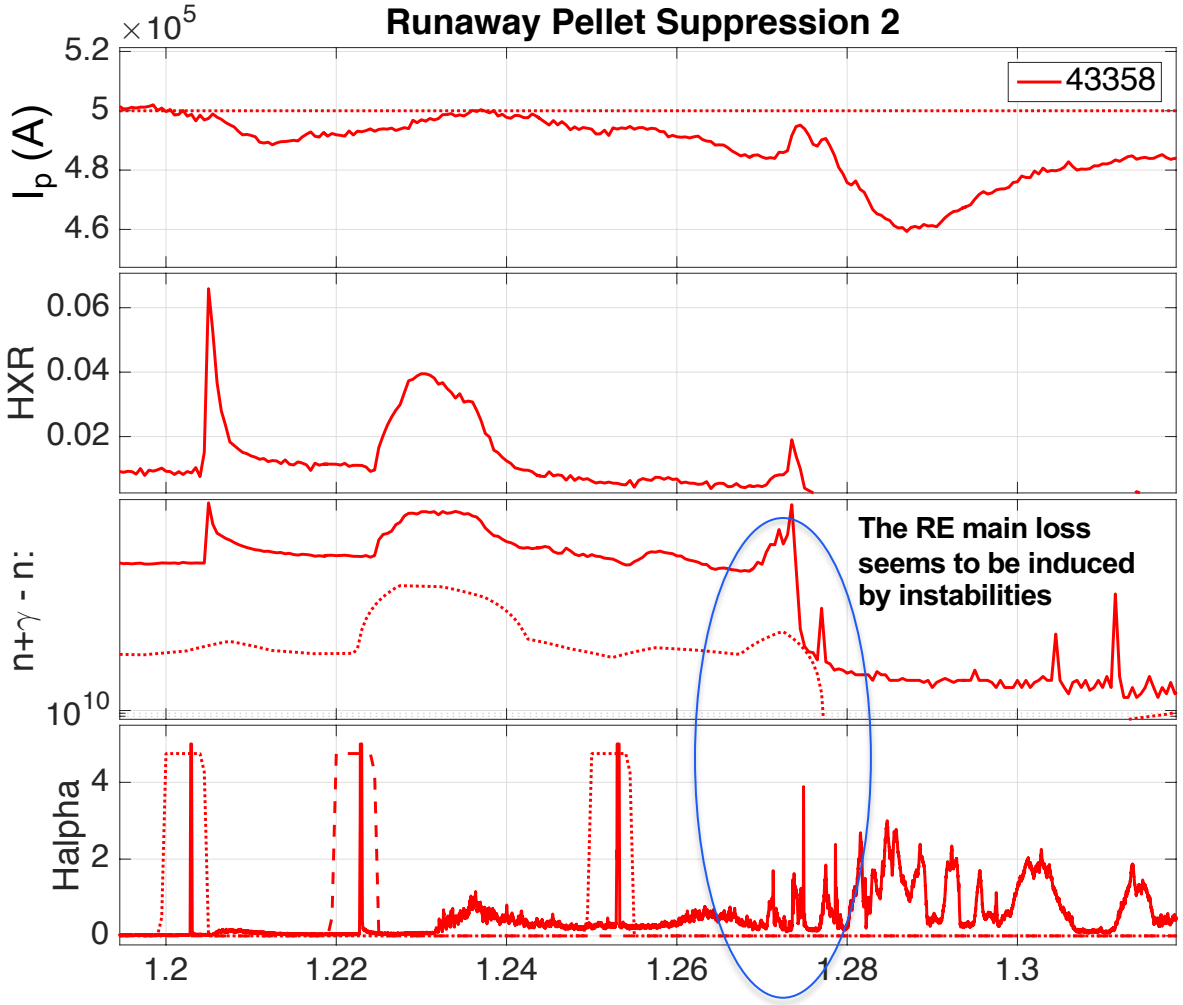
#49: The first large pellet is largely ionised meanwhile the following small pellet does not seem to be fully ionized (different deposition/ablation? need time to analyze)
The initial RE level is smaller than #56 and all the REs have been killed.

#56: the order of the pellet is swapped with respect to #49, the instabilities induced seem to take longer and a fraction of RE survives even respect to other similar discharges (#57,#58).

Pellets on quiescent runaways(flat-top)



5.3T, 500kA, D_2 pellet injection on low density - (BP:big p. 2E20, SP:small p. 1E20)



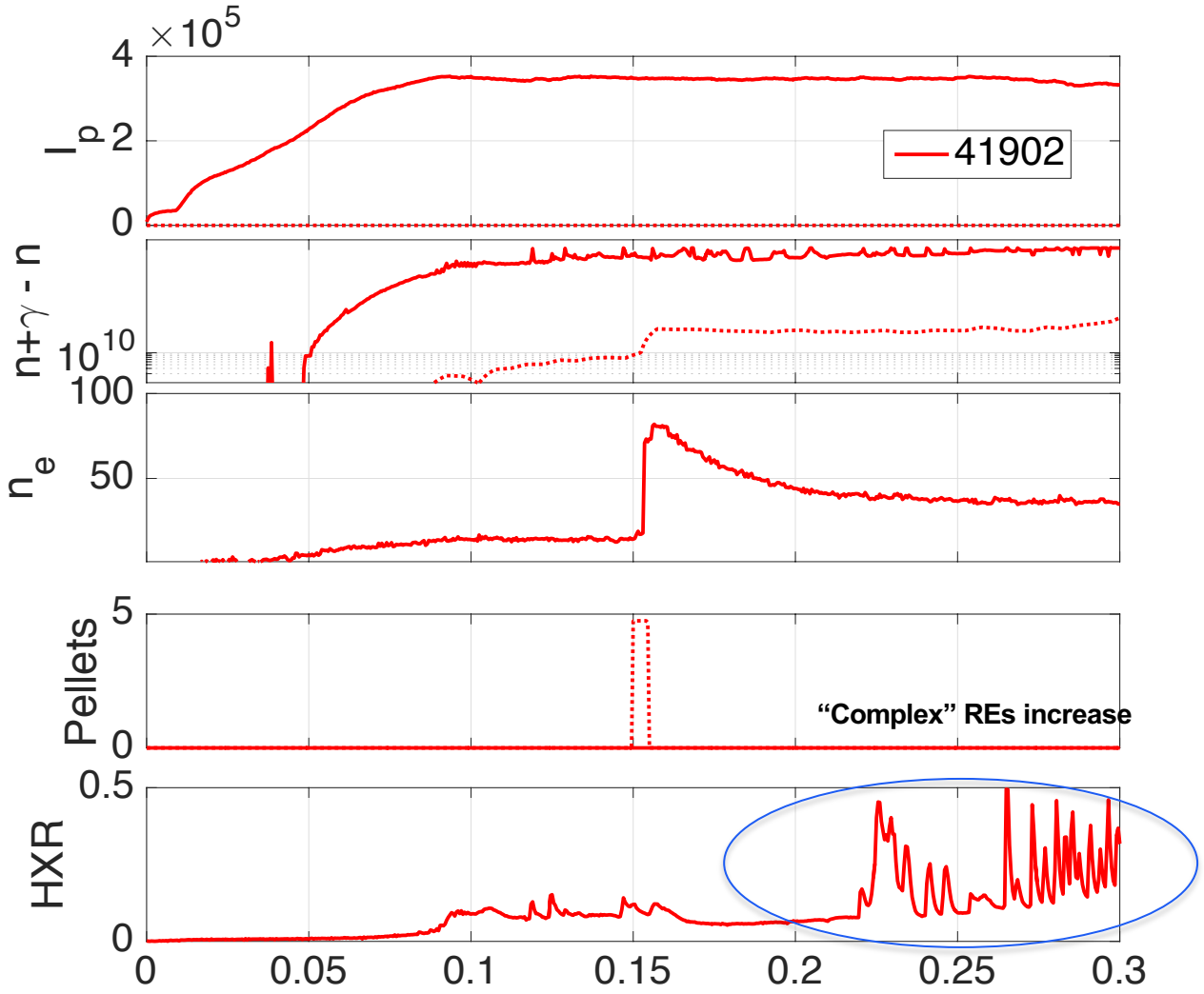
HXR: first spike due to first small pellet interaction with REs, second large pellet seems to find a RE population with larger pitch angle (less focused) meanwhile the third one does not seem to have large interaction with REs (although they seems to be there yet…)

The difference among solid (gamma+neutron) and dashed (neutron) revels the RE population/energy

H-alpha and diamonds reveals that the first SP does not penetrate much into the beam, the BP after it reaches almost the centre, the last SP flights much longer than the first SP and even deeper than the BP: depleted RE population.

Pellets on quiescent runaways(flat-top)

5.3T, **360kA**, small single D_2 pellet injection on low density (higher REs level)

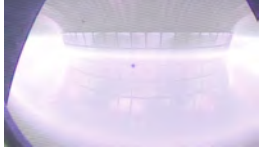


In 360 kA discharges the number /energy of REs in flat-top current discharges is usually larger (smaller densities).

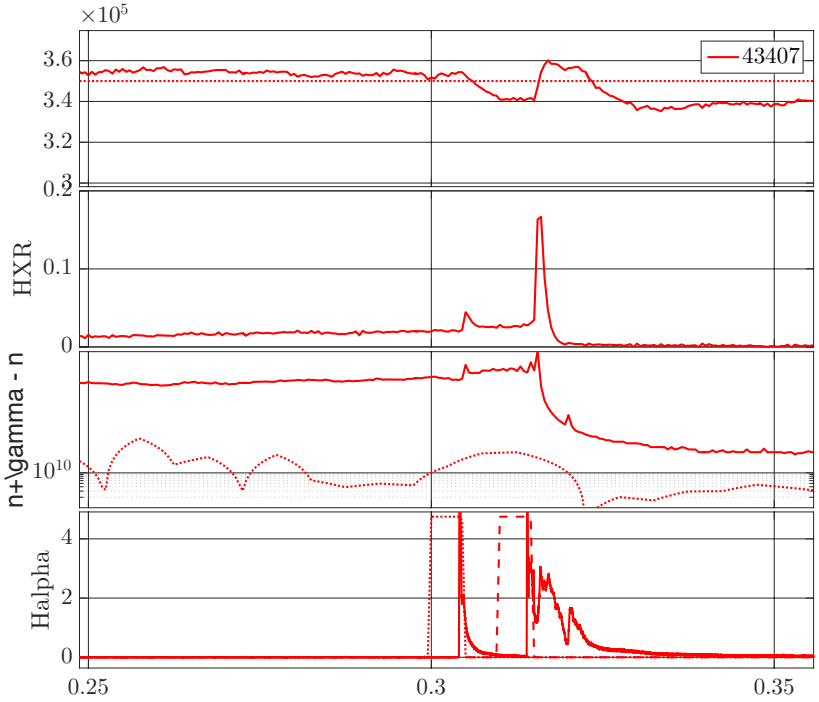
In most cases small pellets injected into such scenarios increase the RE population (although this requires some time) in what seems to be very complex dynamics associated to MHD mode instability, oftenly leasing to disruptions with RE beam formation.

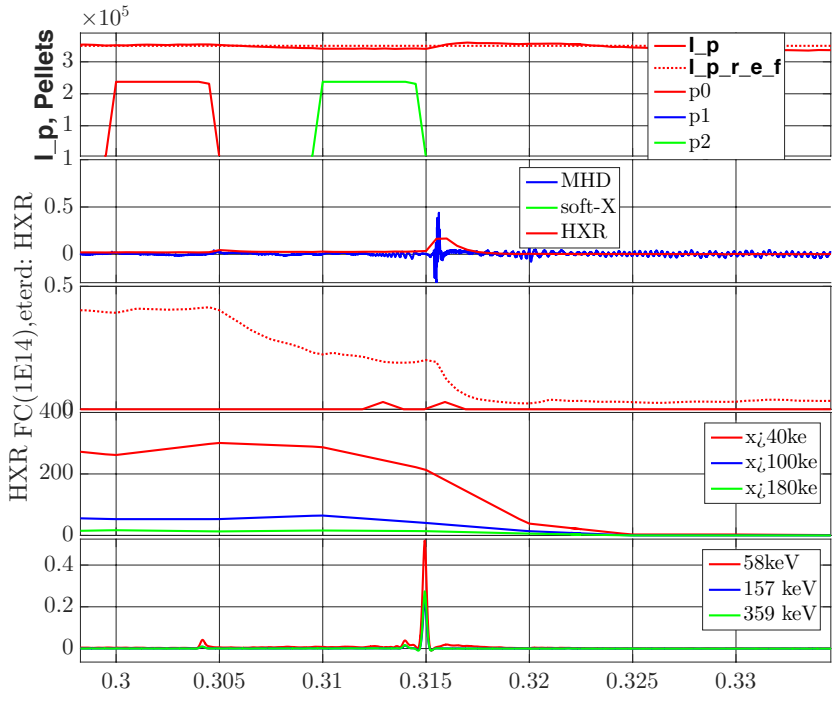
NOTE: pellets shoot in RE beam with cold background plasma has clear H-alpha marks of ablation but not ionization takes place.

Pellets on quiescent runaways(flat-top)



5.3T, **360kA**, small@0.3s + big@0.31s : **the large pellet quickly induce REs loss.**

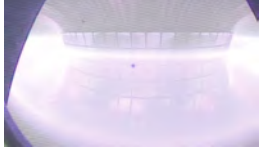




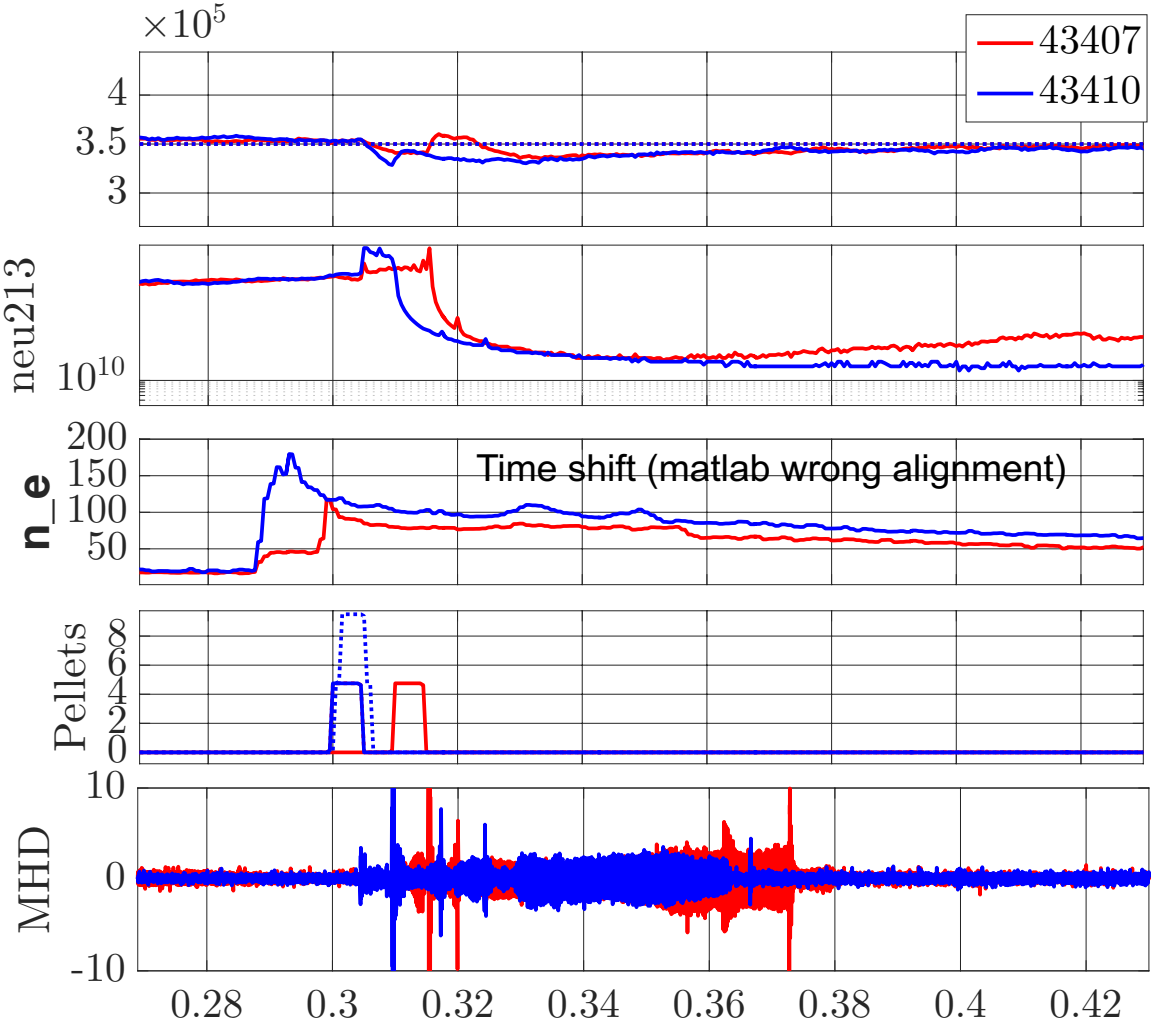
In this 360kA discharge for the first time a large pellet is injected 100ms after a small pellet: it seems to quickly induce an instability expelling the REs. The density peak right after the big pellet reaches 1.17E20. By fast H-alpha, the large pellet after the small one seems to go deeper in the plasma with REs.

Note: a small amount of REs formed again after the injection and expulsion…see next figure.

Pellets on quiescent runaways(flat-top)



5.3T, **360kA**, big@0.3s+small@0.301s+small@0.302s : **simultaneous pellets leads to quickly and complete REs loss.**

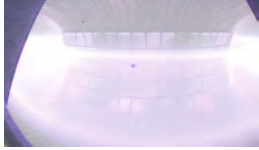


The pellets launched almost together in the #43410 seem to be very effective to induce a prompt loss of REs.

Need comparison with 500kA discharge.

Density peak reaches about 1.8E20.

Discussion



500kA:

- Pellets induce “instabilities” and **REs take time to be killed/reduced** (20-60ms?). Can this time be reduced with **simultaneous** (<2ms) pellets?
- HXR peaks reduces with multiple pellets: RE number / energy should be decreased.
- #58: the last small pellet **produces higher density** jump than the first one although temperature is less (compare with no REs discharge in the database….): fast H-alpha seems to prove that the first pellet evaporates quicker and more externally then other ones (rough estimation: 1st SP 15cm, 2st BP 22cm, 3st SP 25cm).

360kA

- **Multiple/simultaneous** pellets seem to be able to **quickly reduce/kill the RE population** (need to be analyzed yet the pellet penetration for such discharges).

TO ANALYZE:

- REIS data need to be analyzed (synchrotron radiation spectra) to estimate RE energy distribution.
- H-alpha fast for #43410.