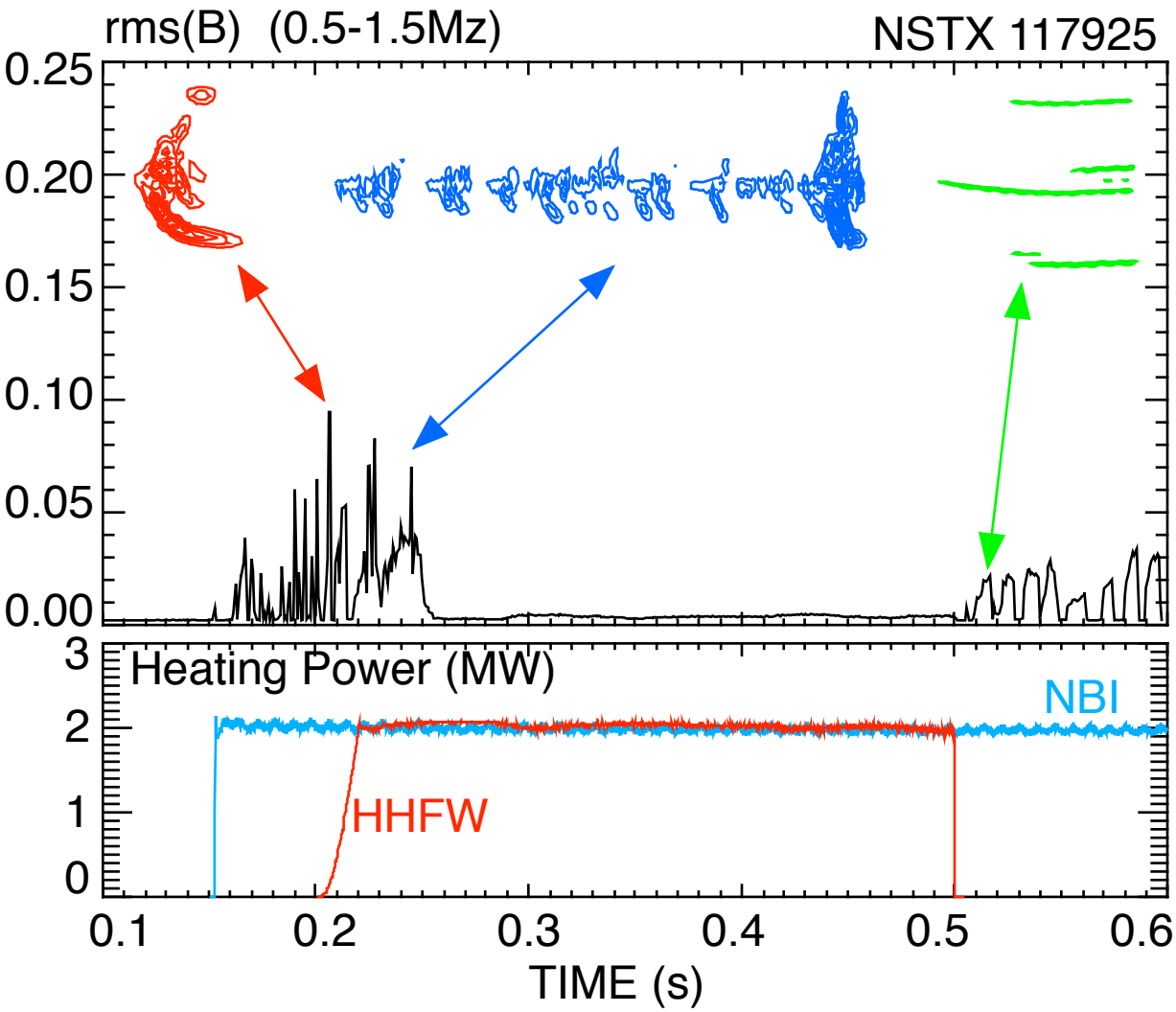
Angels & RF

understanding phase-space structures key to non-linear fast ion mode evolution

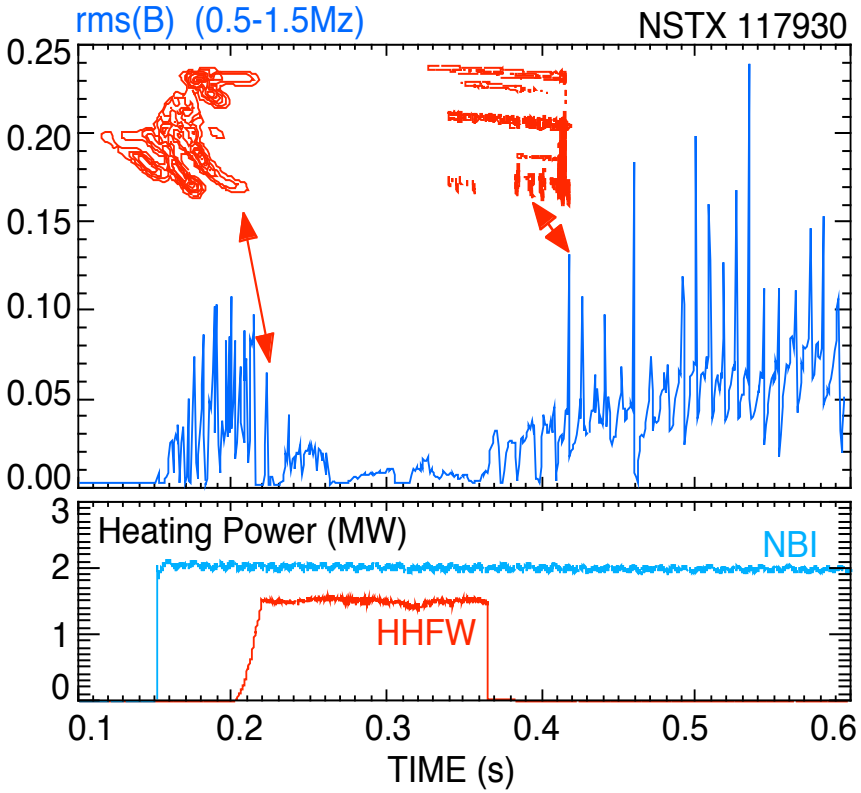
- Hole-clump (Angelfish) physics offers a window on stability and evolution of these structures.
- Experiments proposed, but not executed, to extend these studies.
- Some progress made anyway.

- These shots were from an HHFW current drive study
- They have a variety of HHFW powers and phasing, together with source A (so we have, in principle, MSE data).

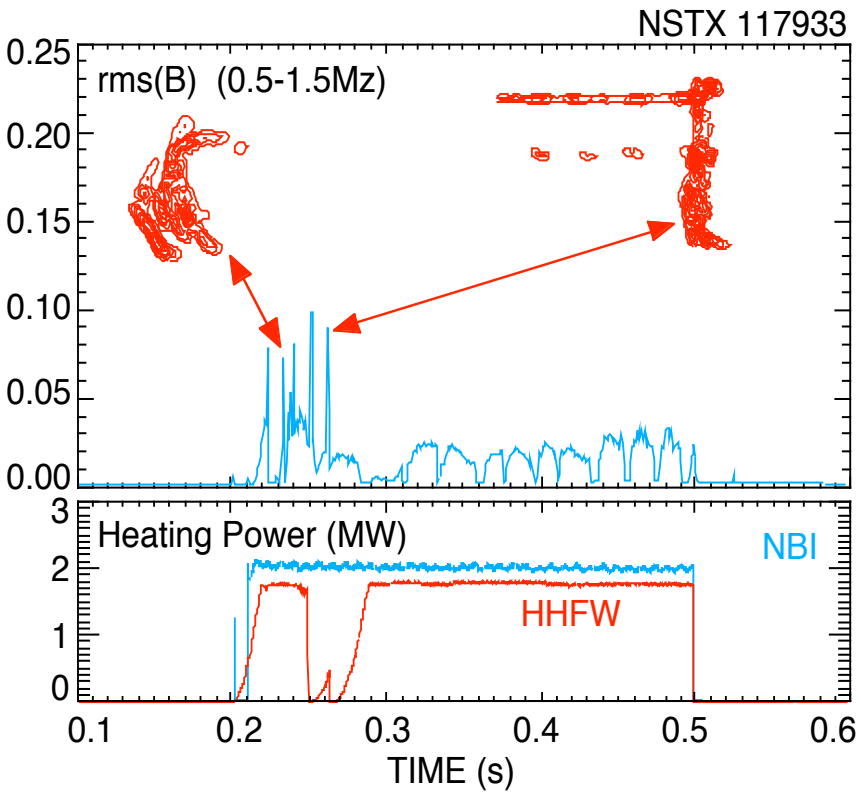
- Angels become weaker and shorter when the RF turns on, mixed with intermittent larger chirps/bursts).
- Then there is a period with no mode activity.
- After RF, the modes reappear, but are no longer chirping - HHFW suppresses mode drive?
- Not bursting, but are modulated by sawteeth - so equilibrium conditions have clearly changed.



- Suppression with relatively low RF power
  - but phasing is "180" vs. "-7 m^{-1}".
- Earlier transition to non-chirping modes



- Example of non-suppression.
  - RF power isn't that low, but now phasing is "+ 7 m^{-1}".

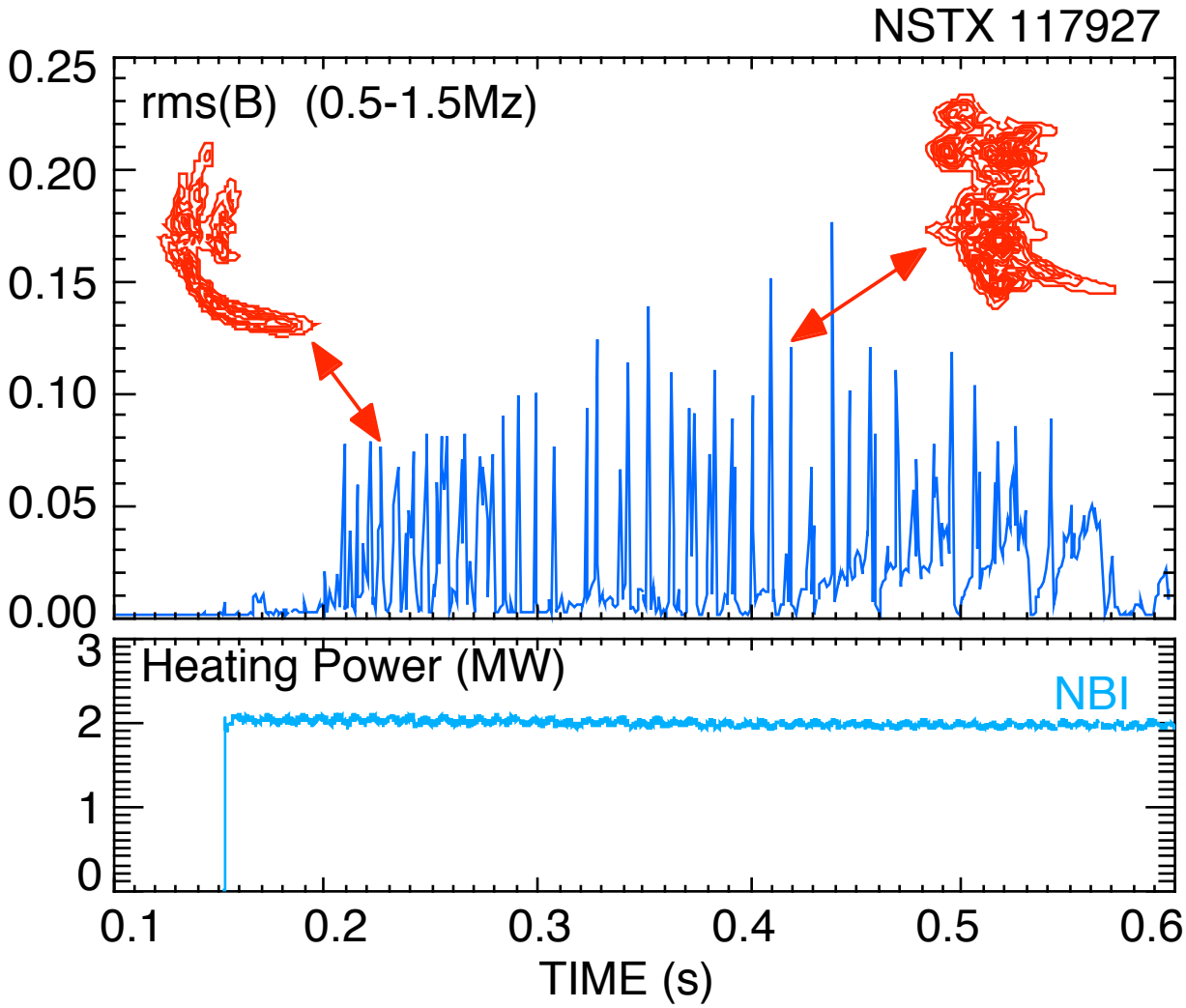


Additional data desired:

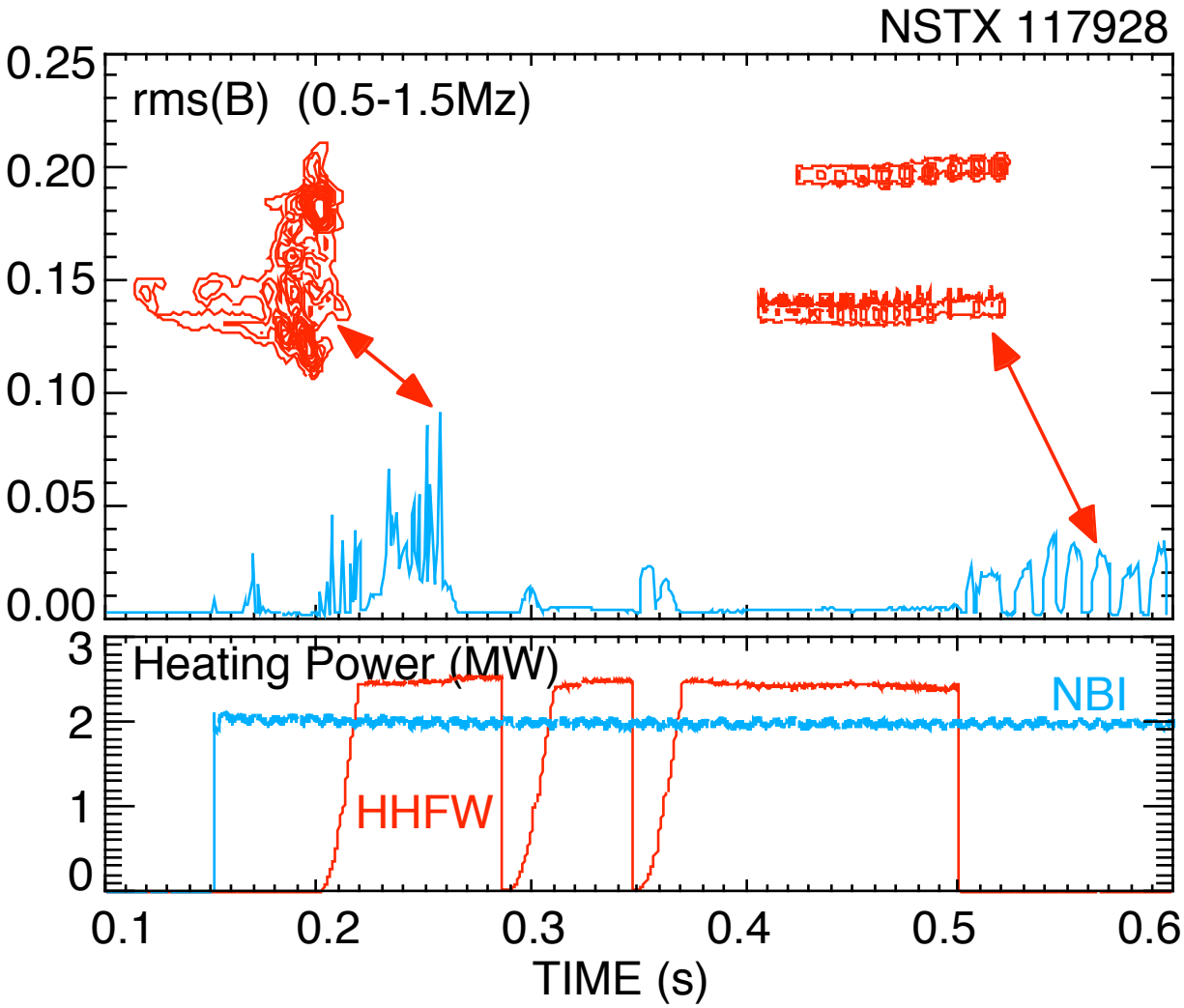
- Try to raise density so that reflectometers can determine mode amplitudes and perhaps localization.
- Determine power threshold for stabilization under variety of conditions.
- Investigate role of phasing on stabilization of modes.
- Is plasma evolution or fast ion distribution evolution responsible for transition to non-chirping modes?

- This was a no-RF shot, and interestingly, the Angels persisted pretty much throughout the discharge.
- Towards the end, they become mixed with cw modes, again, probably modulated by sawteeth.

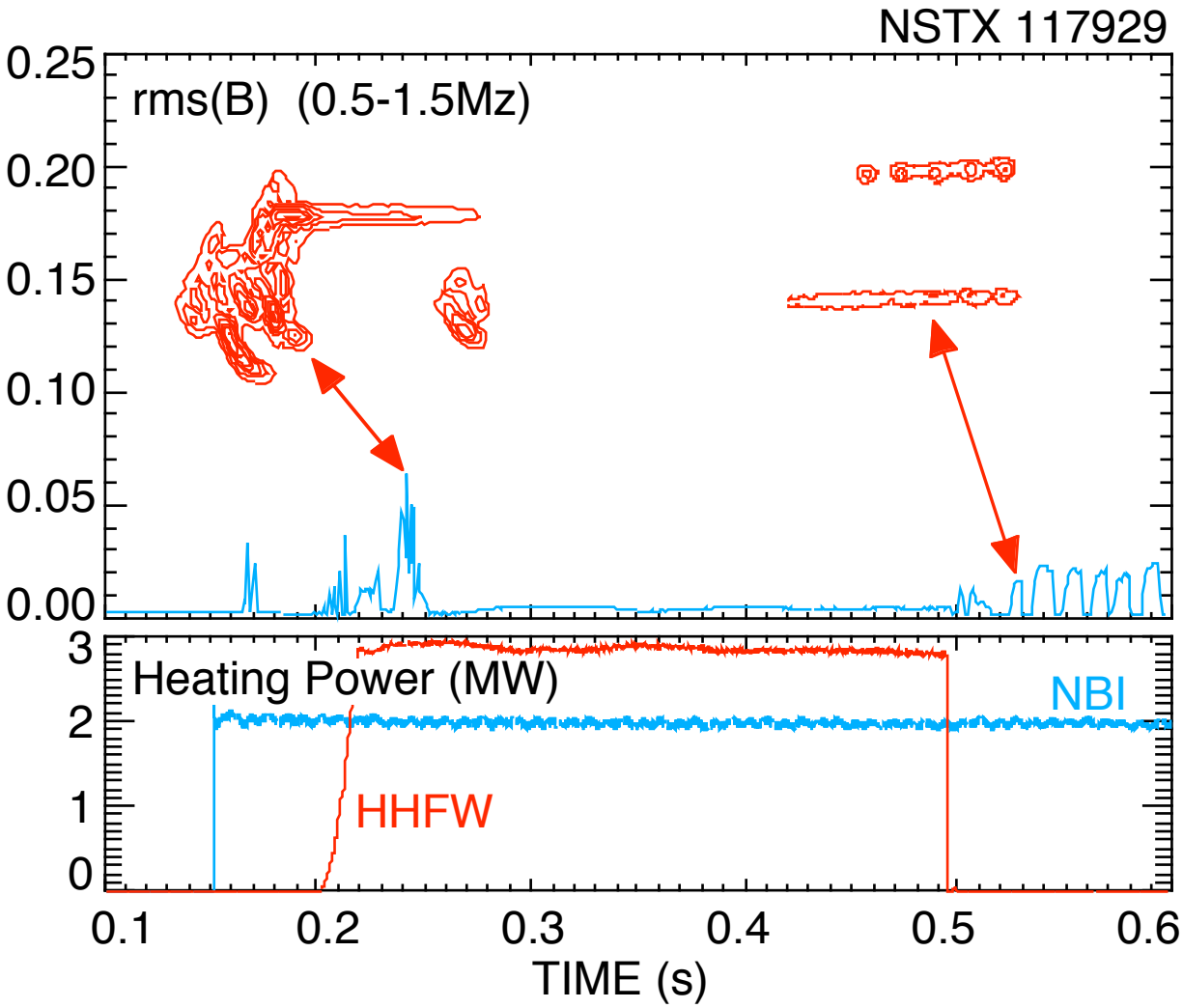
- This makes a good comparison shot to the others with RF.
- There was MSE data, and some reflectometer data



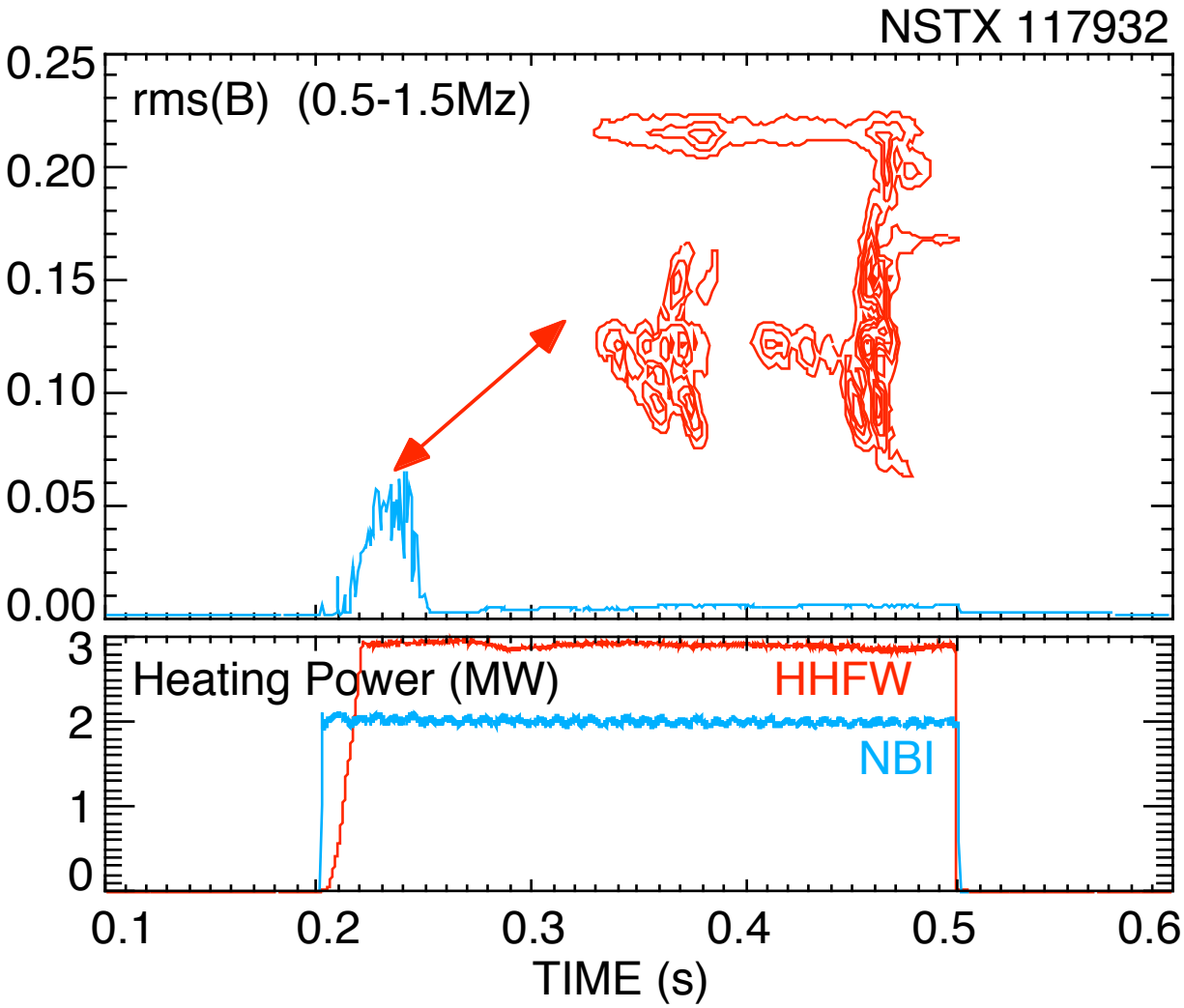
- A more perplexing shot; it looks like HHFW first enhances the Angels, then suppresses them.
- Again, the cw modes appear later, when RF is off.
- Also, when RF faults, modes reappear with no chirping.
- This suggests that HHFW suppresses the hole-clumps by suppressing the mode drive entirely?



- Just more examples



- As in previous examples, suggests that it takes about 50 msec for RF to change distribution function sufficiently to stabilize modes.



- The best example of suppression.
- Angels get weaker and have shorter duration when RF is added, much like I would expect from your model.
- The bursts do get stronger towards the end of the RF pulse, possibly because the equilibrium is changing?
- Also, just before the end of the RF pulse, there is a strong burst/chirp, as if the RF is no longer strong enough to suppress the chirping?