Suppression of Frequency Chirping by HHFW Heating of Beam Ions

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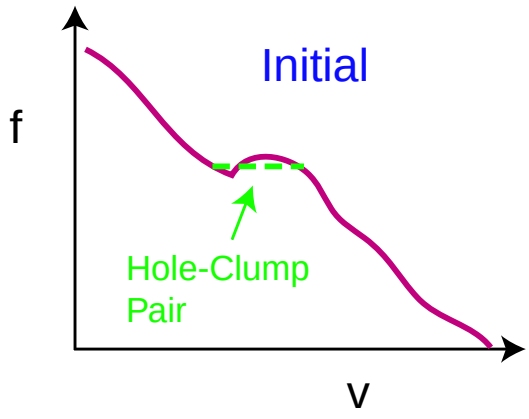
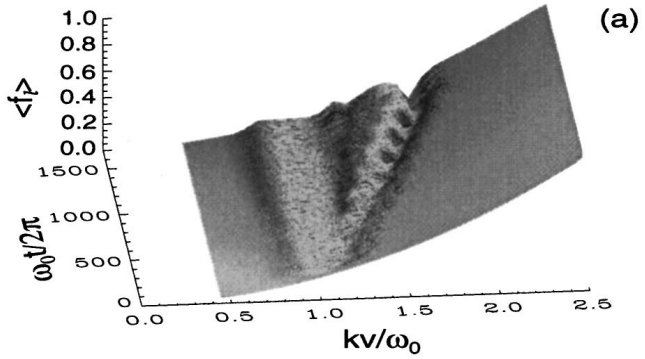
Motivation

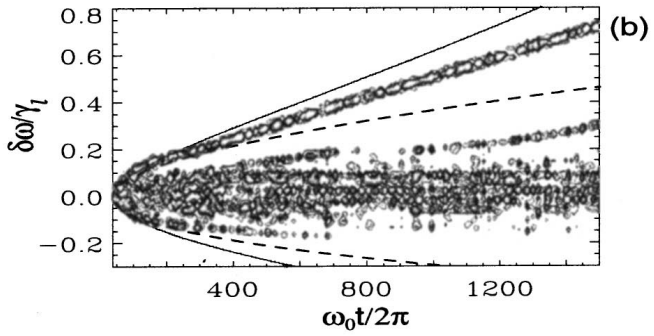
- Nonlinear saturation of fast-ion instabilities determines their ultimate impact on fast-ion transport.
- Why is chirping common in NSTX (MAST, START) but rare in DIII-D?

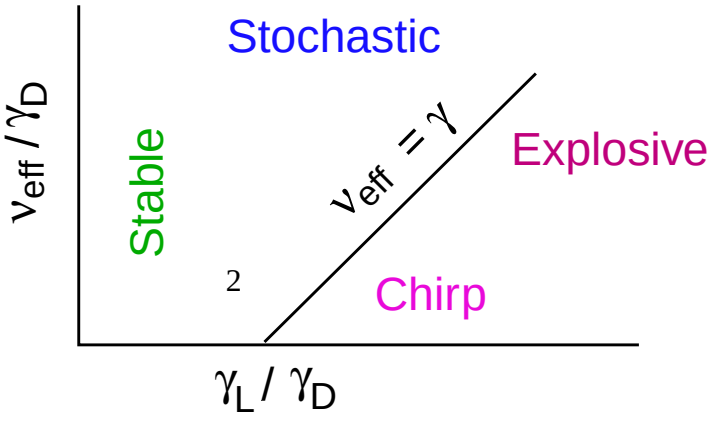
Outline

- Berk-Breizman theory
- Previous experimental results
- Getting the chirping instability and the fast waves to interact with the same fast ions
- Runplan

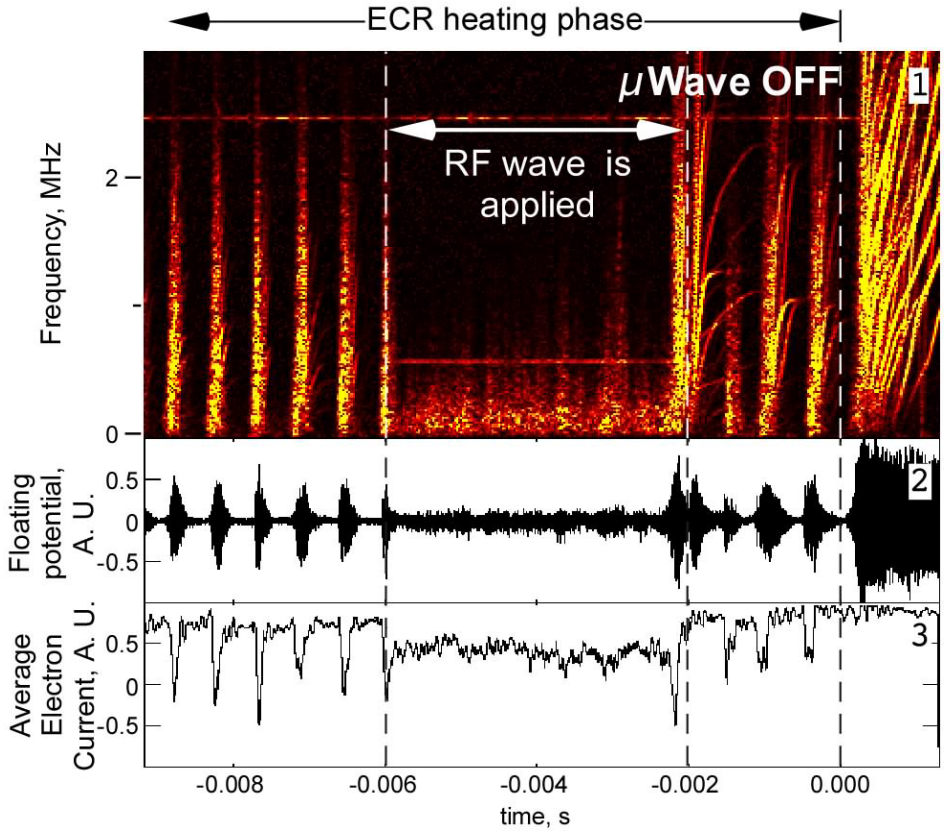

Initial
f
Hole-Clump
Pair
v


(a)
<f_P>
1.0
0.8
0.6
0.4
0.2
0.0
1500
1000
500
0
ω0t/2π
0.0
0.5
1.0
1.5
2.0
2.5
kv/ω0


(b)
δω/γl
0.8
0.6
0.4
0.2
0.0
−0.2
400
800
1200
ω0t/2π


Stochastic
Stable
Explosive
Chirp
2
νeff = γ
νeff / γD
γL / γD

Increased Collisions Suppress Chirping in Dipole Experiment



D. Maslovsky *et al.*, Phys. Plasmas **10** (2003) 1549.

Surveyed all previous Beams & HHFW shots: some hints of desired effect but nothing definitive. (HHFW rarely injected during strong chirping.)

Runplan

The Challenge: strong chirping regime with good RF coupling.

1) Establish baseline condition. Use DND with rtEFIT for outer gap control. Try for L-mode at modest current (0.7 MA) for strong chirping. Reference discharge: 112345. Source A at ~ 90 kV.

2) Add HHFW. Power scan if HHFW suppresses chirping.

3) Source C at ~ 90 kV with and without HHFW.

4) (If time permits) Source B at ~ 90 kV with and without HHFW.

5) Sources A and B at ~ 65 kV with and without HHFW.

6) Sources C and B at ~ 65 kV with and without HHFW.

Q: How do we get the HHFW to detrap the resonant ions?

A: Select an operating regime where chirping causes drops in neutron rate and where HHFW causes an increase in neutron rate.