Suppression of Frequency Chirping by HHFW Heating of Beam Ions

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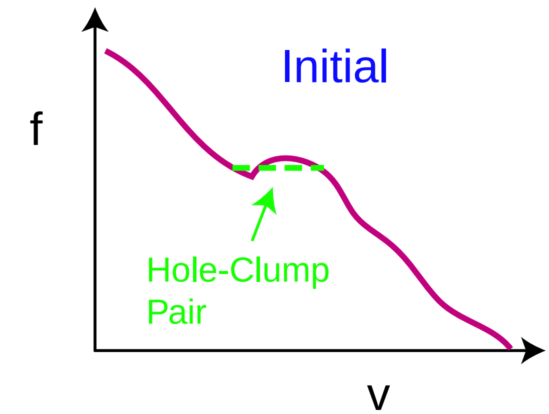
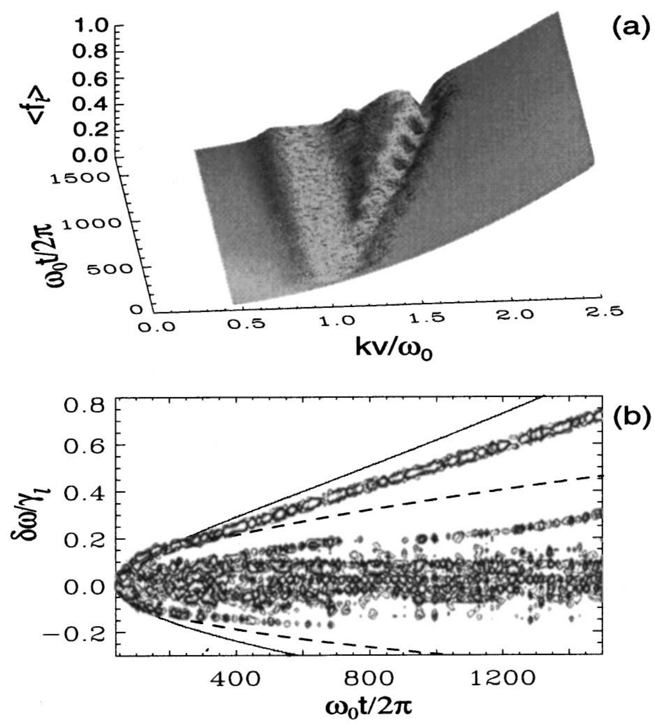
Motivation

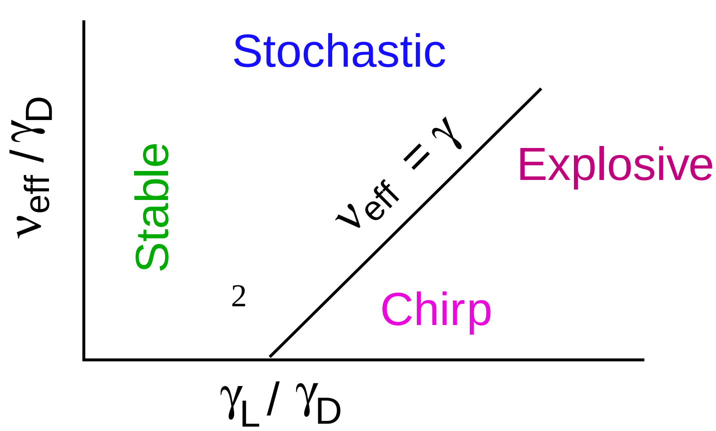
- Nonlinear saturation of fast-ion instabilities determines their ultimate impact on fast-ion transport.
- Why is chirping common in NSTX (MAST, START) but rare in DIII-D?

Outline

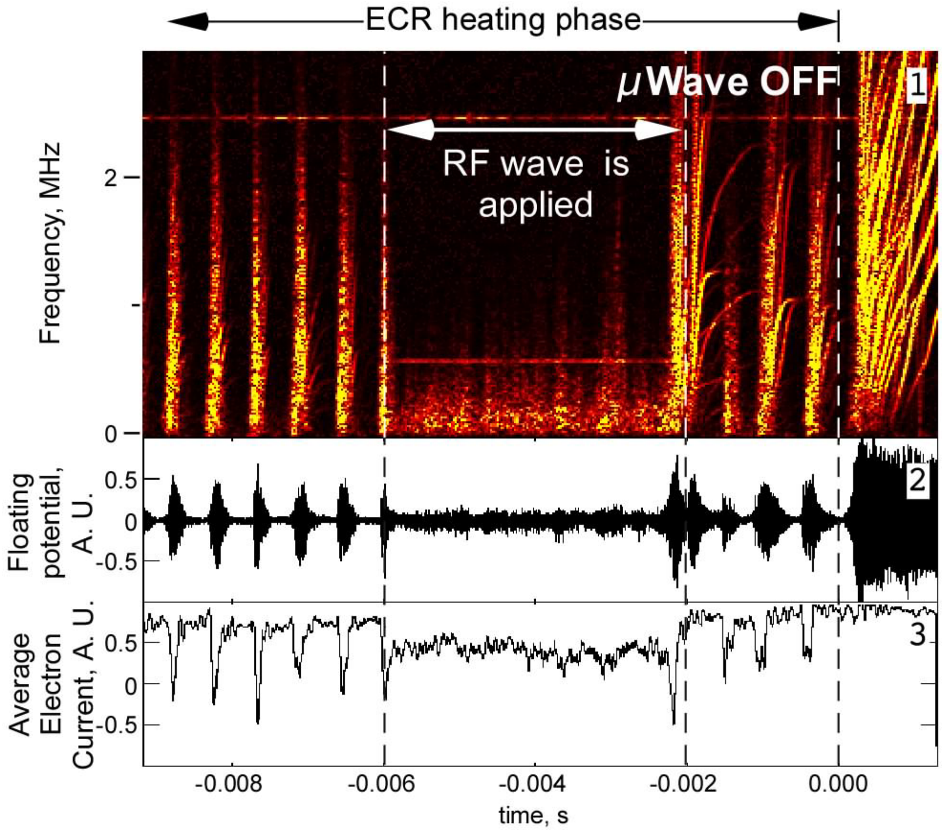
- Berk-Breizman theory
- Previous experimental results
- Getting the chirping instability and the fast waves to interact with the same fast ions
- Runplan


Initial
f
Hole-Clump
Pair
v


(a)
<f>
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
νeff / γD
Stable
νeff = γ
Explosive
2
Chirp
γL / γD

Increased Collisions Suppress Chirping in Dipole Experiment



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

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.

Runplan

1) Establish baseline condition with strong frequency chirping. Reference discharge: 109022 (800 kA, 4.5 kG) (3 shots).

1b) If chirping is weak, vary beam parameters, density, or current to obtain stronger chirping (0-8 shots).

1c) Inject HHFW outside time of interest initially (0 additional shots). Use $k_{\|} = 14\ \mathrm{m}^{-1}$.

2a) If HHFW is working well and causing a neutron enhancement, move HHFW to time of interest (2 shots).

2b) If HHFW is not coupling well, vary gap, $k_{\|}$, etc. (0-8 shots)

3) If suppression is achieved, HHFW power scan (4 shots).

4) Repeat for a different beam source (3-5 shots).

5) Repeat for a different beam voltage (3-5 shots).

6) Repeat for a different value of $k_{\|}$ (3-5 shots).