Search for/characterization of the Universal Instability

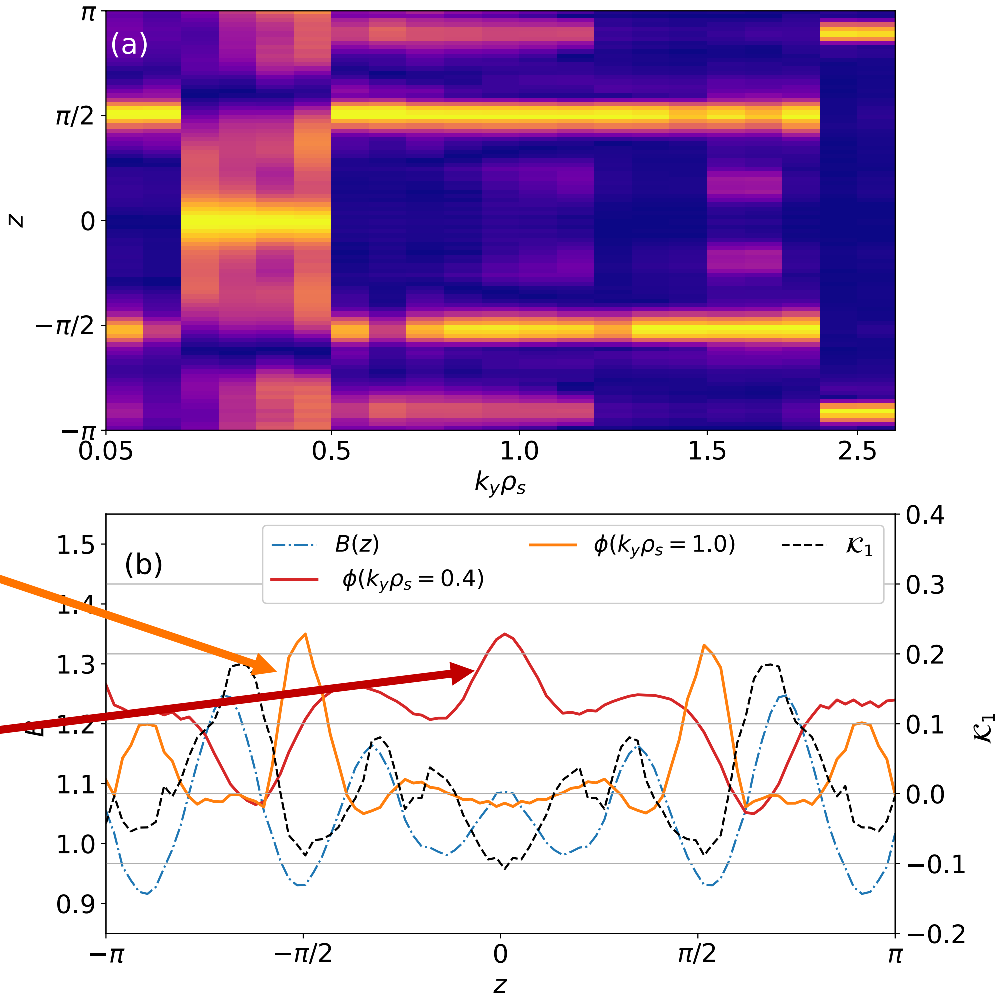
Josefine Proll, Paul Costello, Gabe Plunk, MJ Pueschel, Gavin Weir, Adrian von Stechow, Doppler reflectometry team?

Linear Instabilities in W7-

- Does the removal of TEM reveal new instabilities?
- **Density gradient $\frac{a}{L_n} = 3$ simulations.**

ITEM regime visible with TPM mode structure.

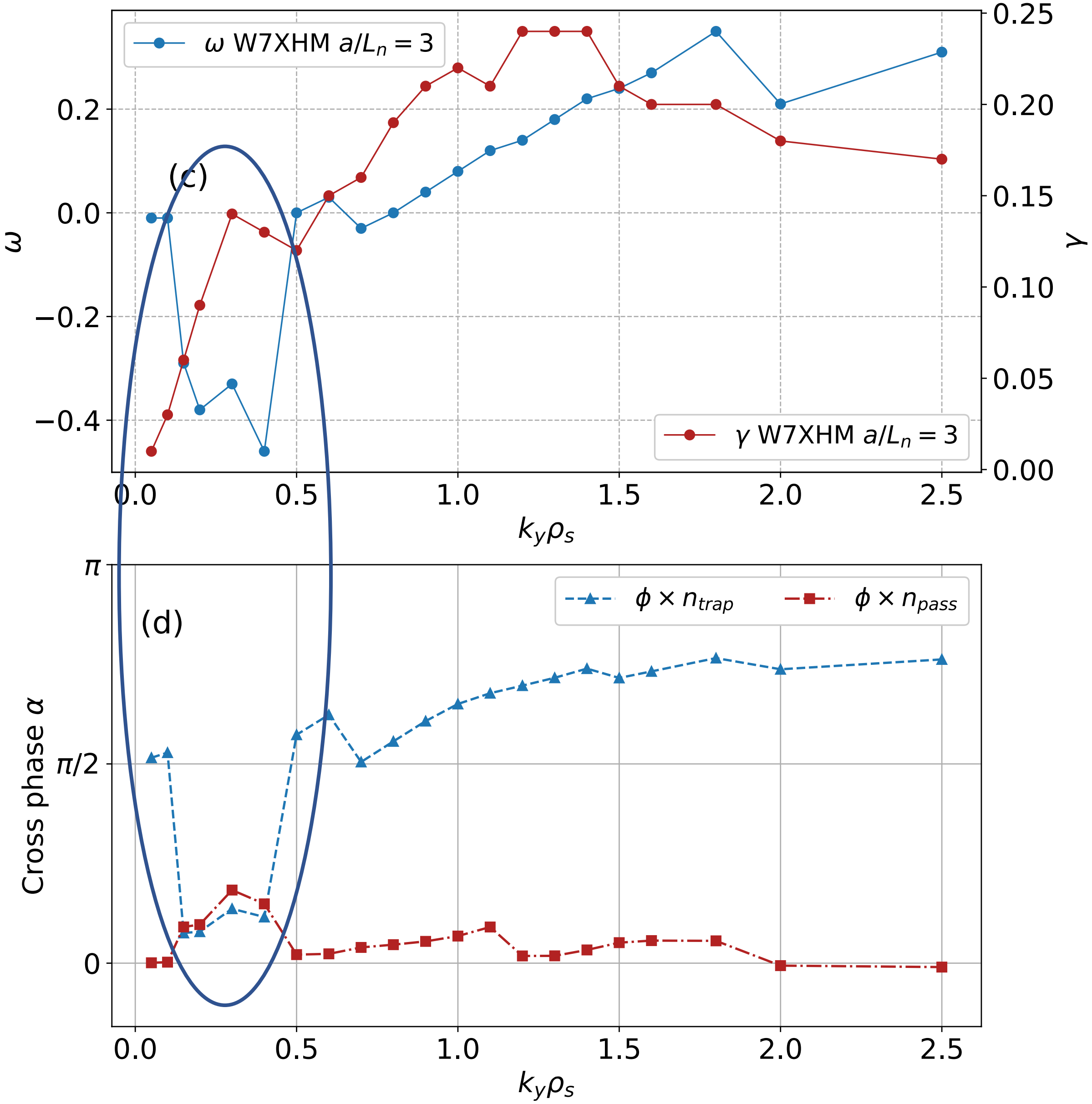
Strange modes at low-k_y.
Clearly distinct in mode structure from TPMs.



[P. Costello, J. Proll, G.G. Plunk to be submitted]

Mode Properties

- Modes are electron-driven.
- Negative mode frequency ($\omega < 0$).
- Passing electrons slightly more out of phase than trapped electrons.
- Mode structure peaks in bad-curvature regions, $\mathcal{K}_1 < 0$.
- No reliance on minima in $B(z)$.



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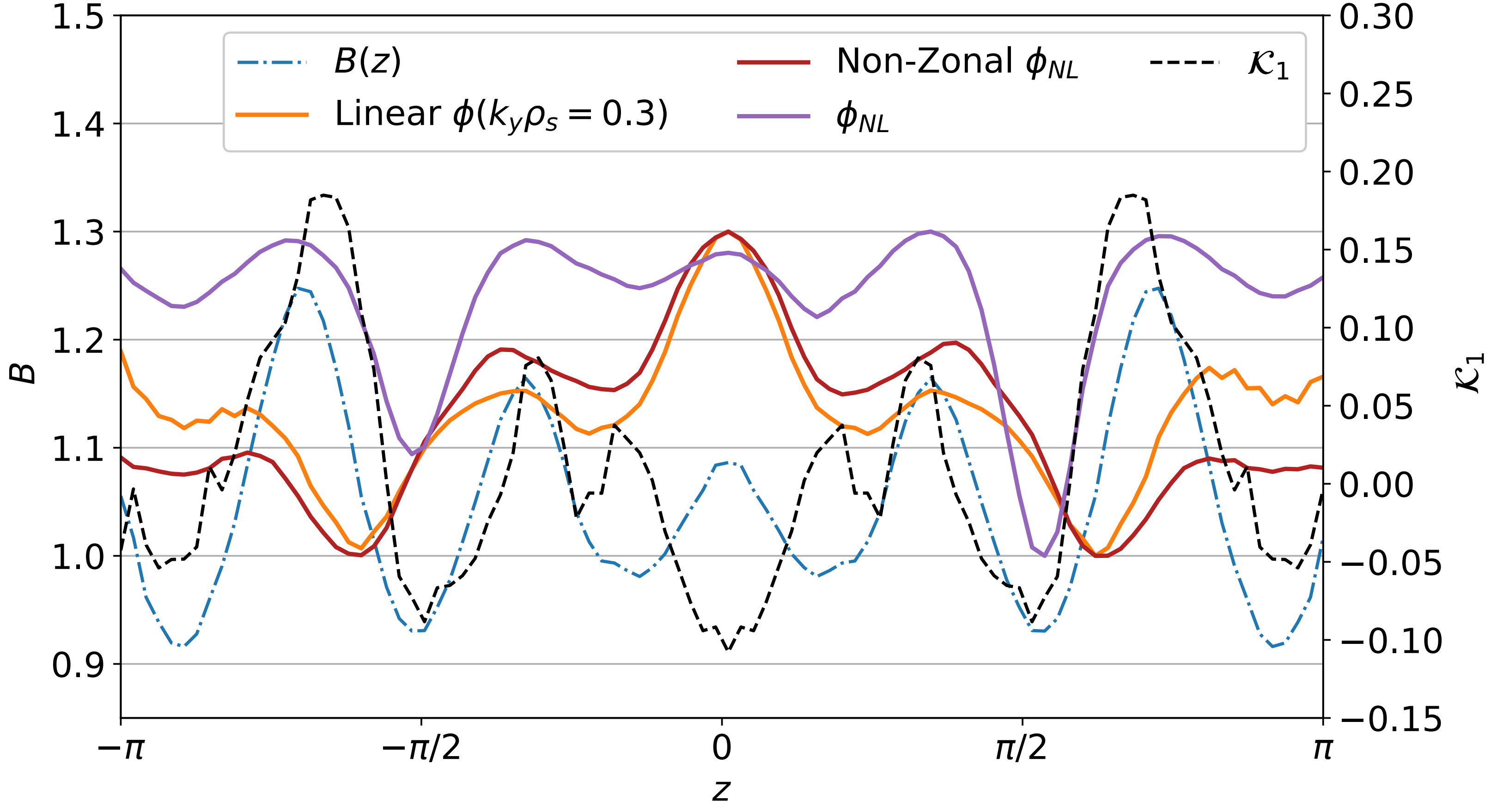
Non-linear Universal Instability

- Non-linear $a/L_n = 3$ simulations in W7XHM.
- Universal modes dominate non-zonal ϕ amplitude.



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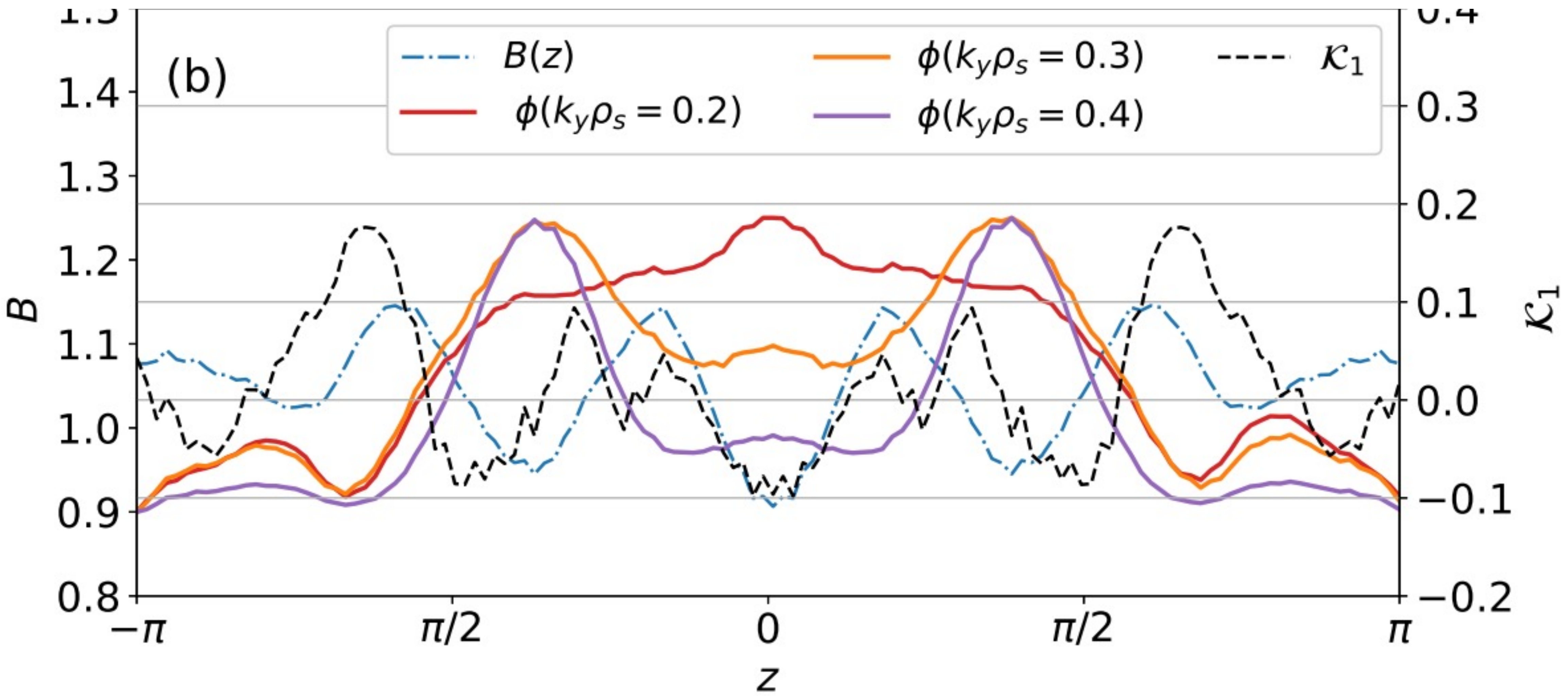
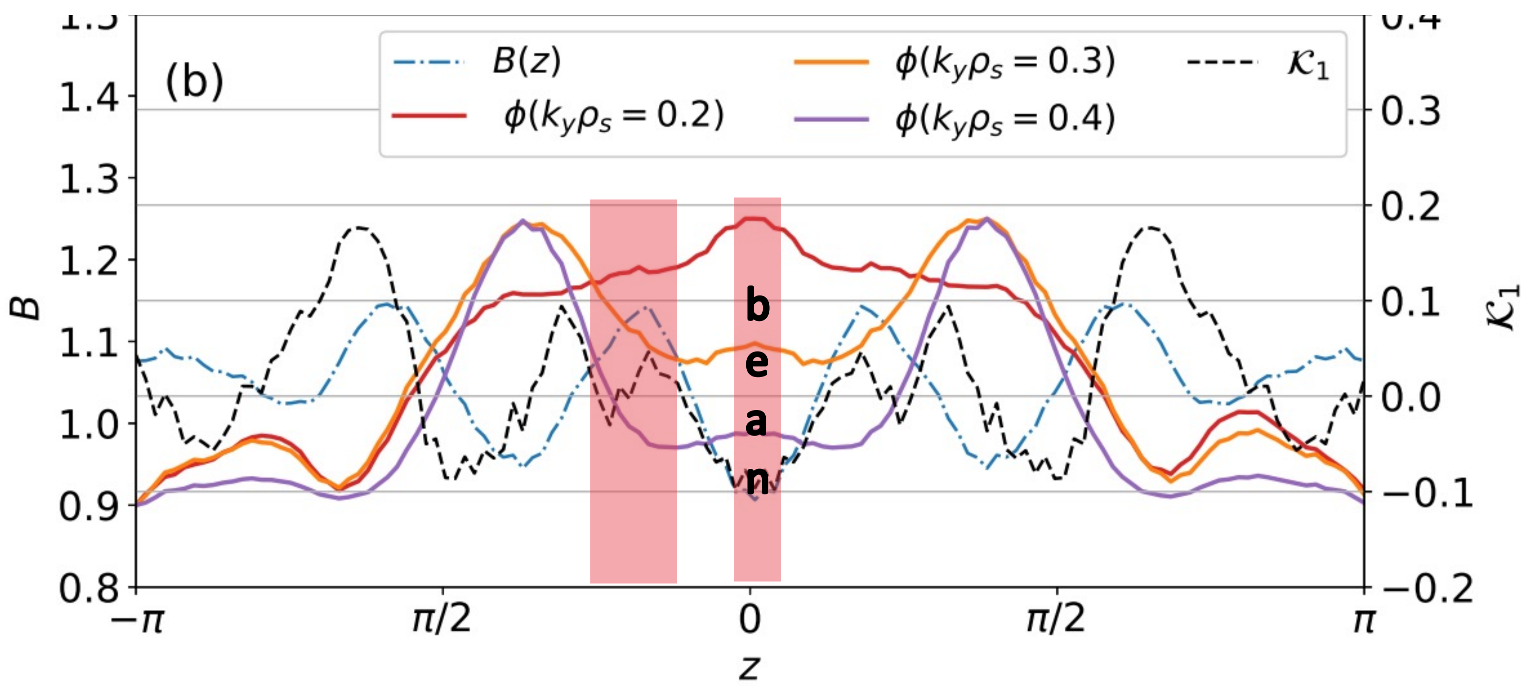
In negative mirror – UI pretty much gone (because TEM is strong enough)



Testing for UI experimentally

- In high mirror and negative mirror
- ideally at strong density gradients (and at small ∇T_i)
- Compare cross phases?
- Compare fluctuation amplitudes
    - TEM: $\tilde{n}_{bean} < \tilde{n}_{triangle}$
    - UI: $\tilde{n}_{bean} > \tilde{n}_{triangle}$



Summary: hunt for the universal instability

Main hypothesis tested:

- The universal instability is visible in the high-mirror configuration, but overpowered by the TEM and thus not visible in negative mirror

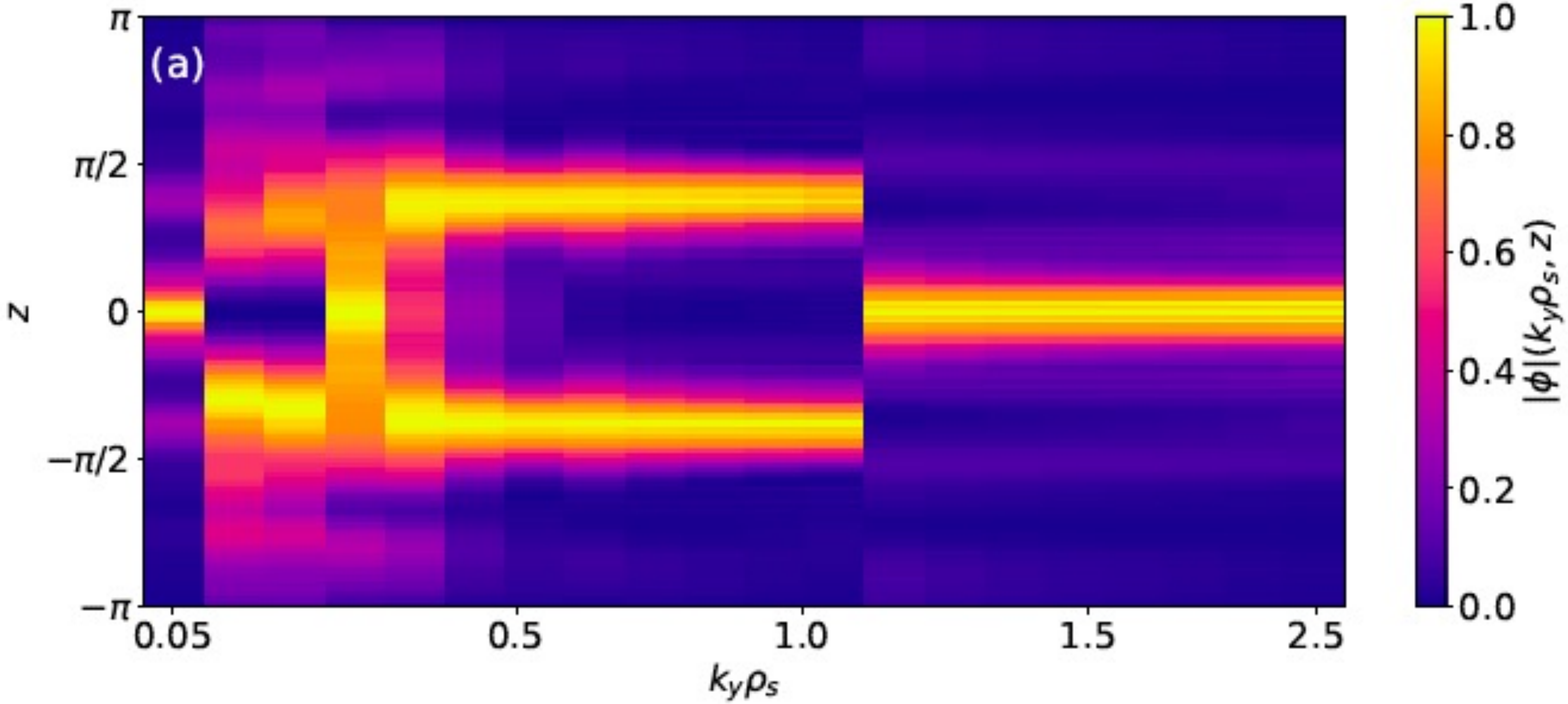
Actuator to test that hypothesis:

- Different configurations (high mirror vs. negative mirror)

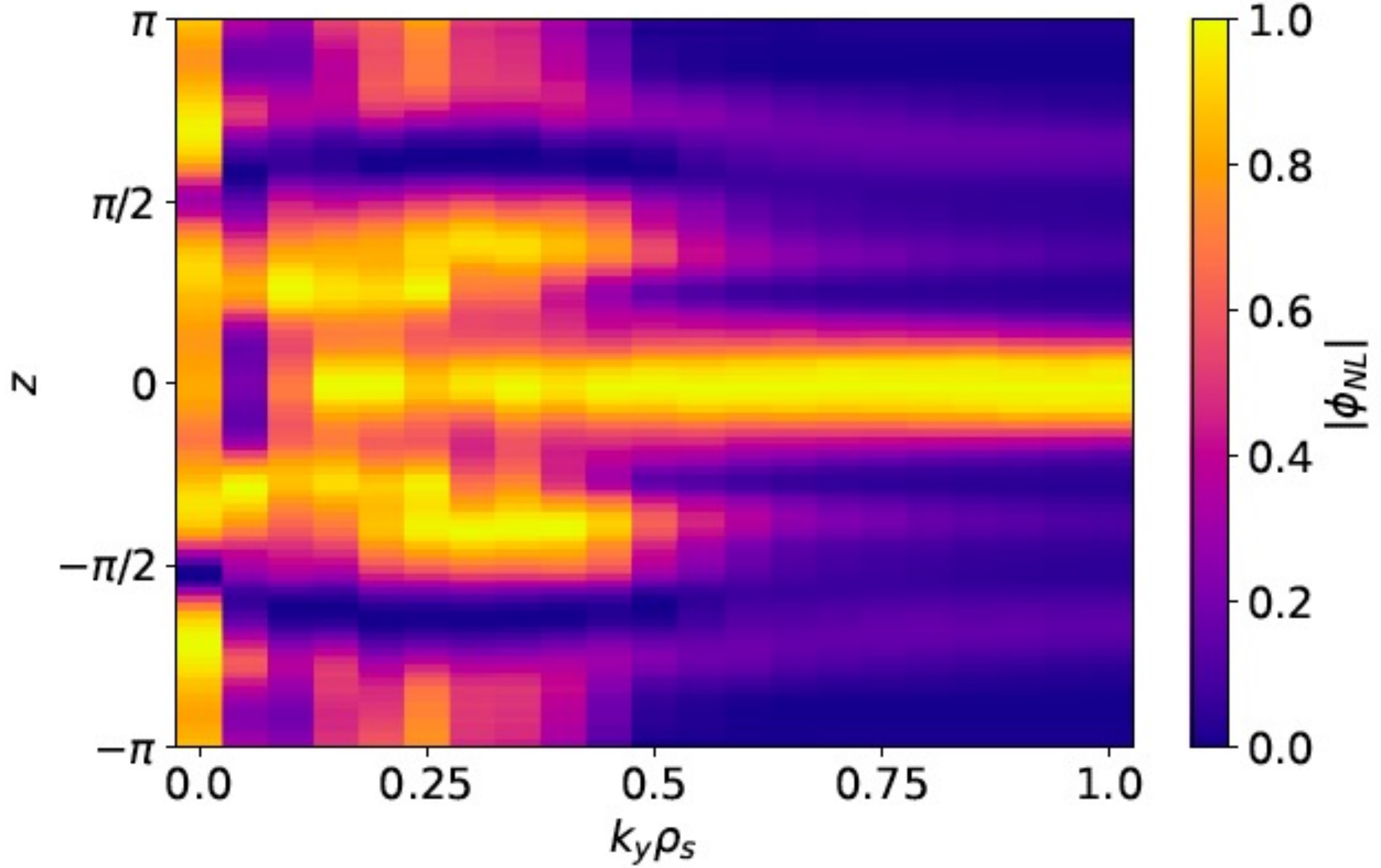
Estimated number of dedicated discharges:

- none, piggyback to “hunt for TEM” should be fine (though small ∇T_i would be useful)

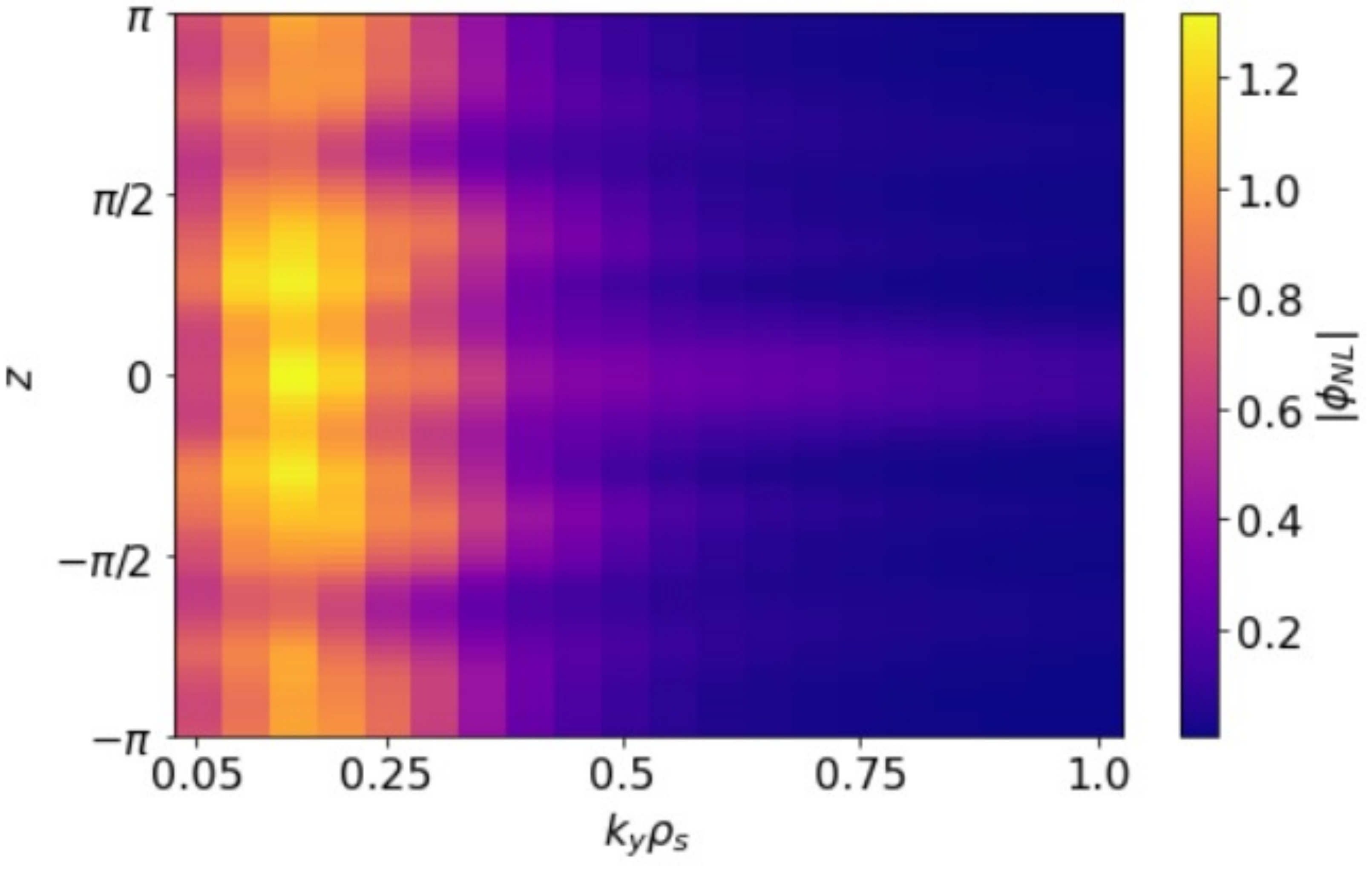
TEM dominant linearly in negative mirror



Universal instability nonlinearly at different scales (high mirror) (normalized)



Universal instability nonlinearly at different scales (high mirror, un-normalised)



Different phase signature in negative mirror