

# Impulsively generated kink wave trains in coronal slabs with application to streamer waves

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M.-Z. Guo, H. Yu @ Shandong U.

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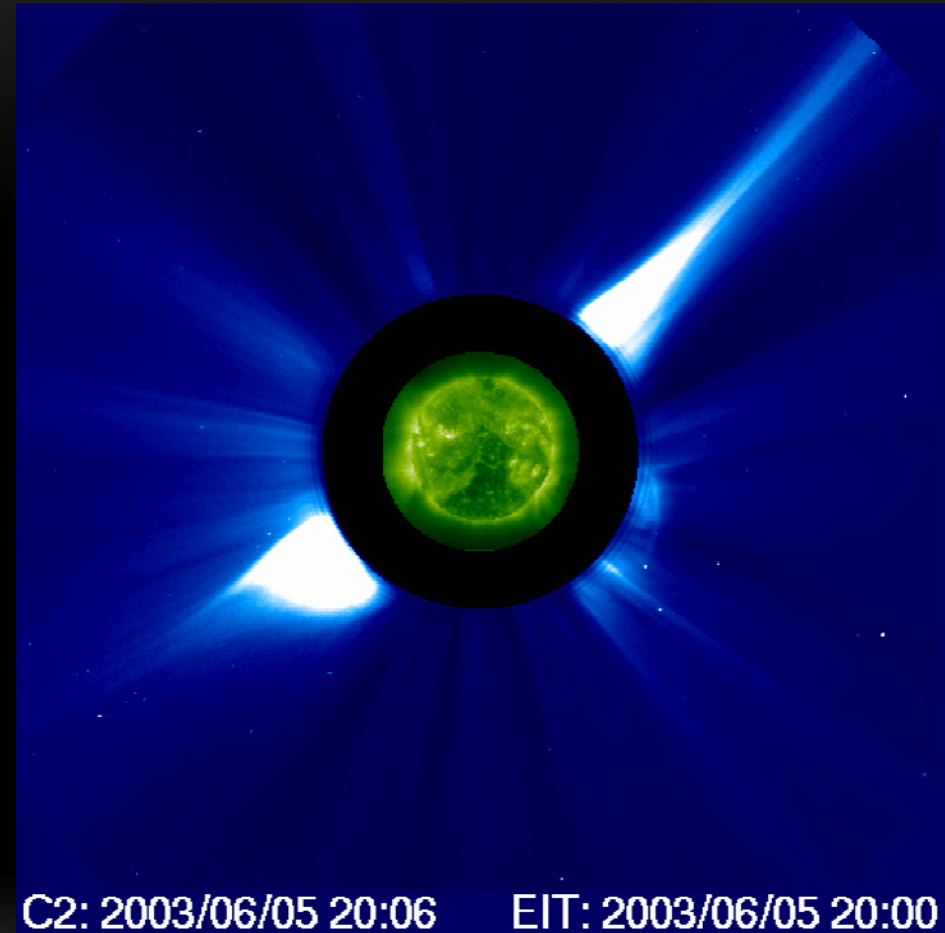
# Impulsively generated kink wave trains in coronal slabs with application to streamer waves

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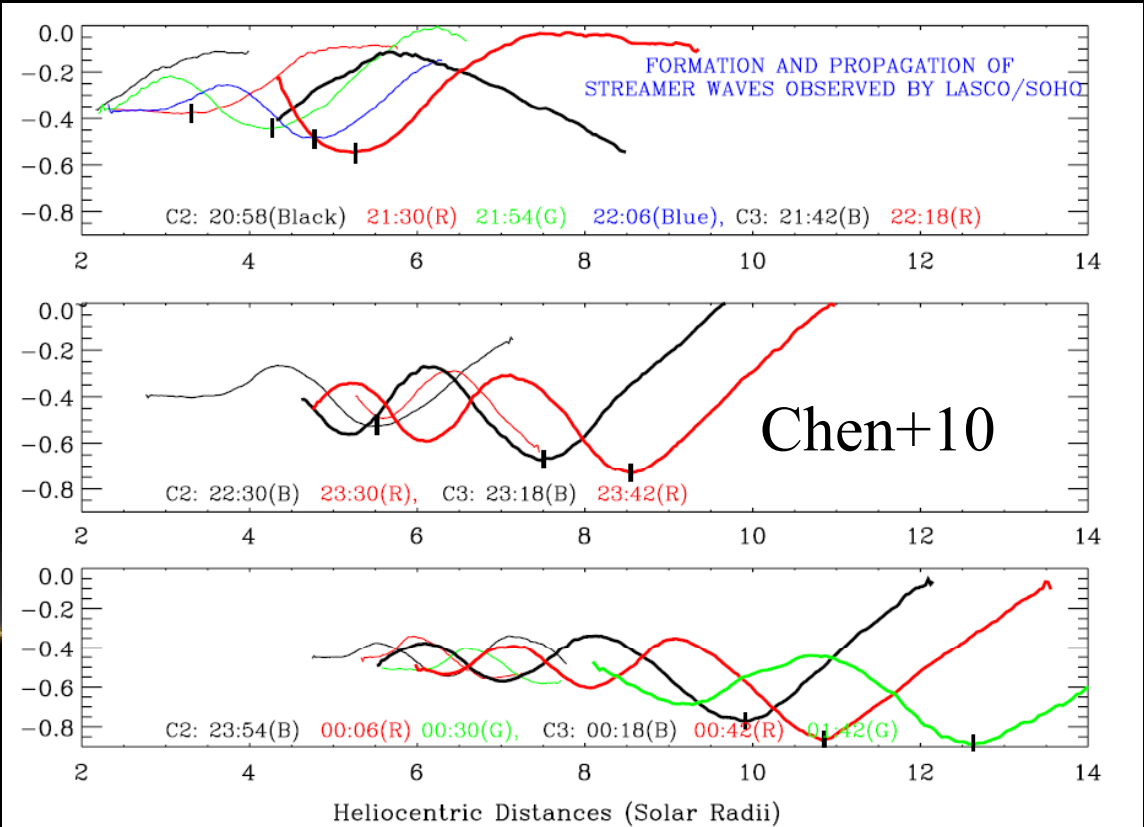
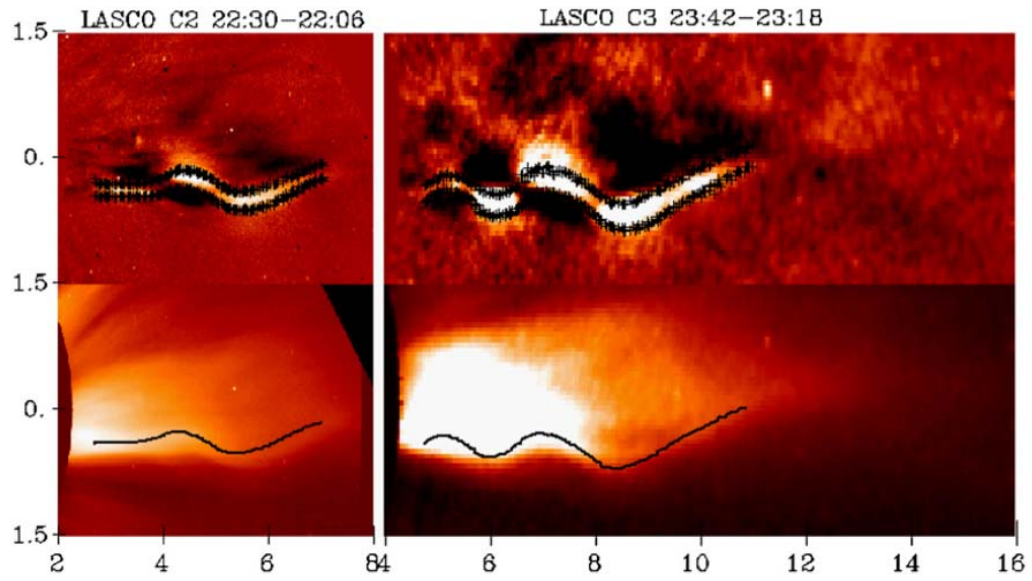
- Streamer Waves: what are they?
- Impulsively generated kink waves as a possible explanation
- Implications for exploiting streamer waves

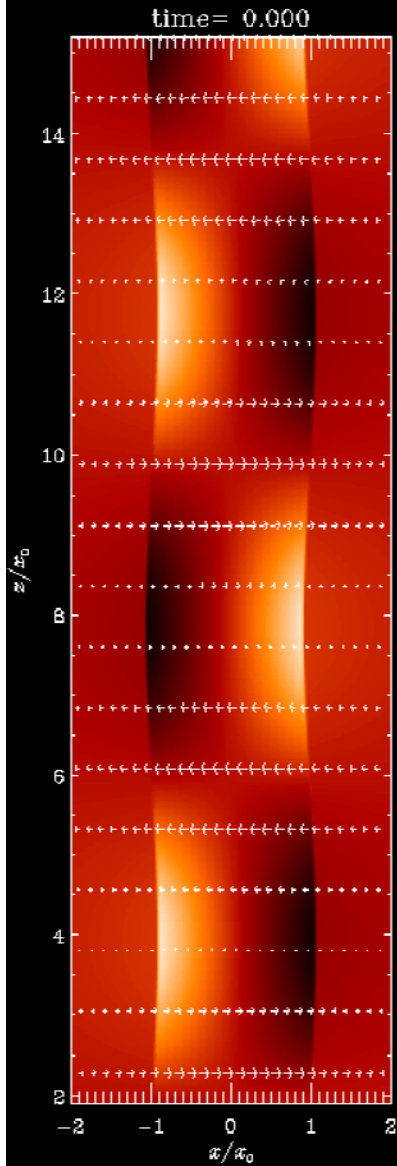
# Streamer waves

Chen, Kong, Li et al. 2010 ApJ  
Chen, Song, Li et al. 2011 ApJ  
Feng, Chen, Li et al. 2011 SoPh

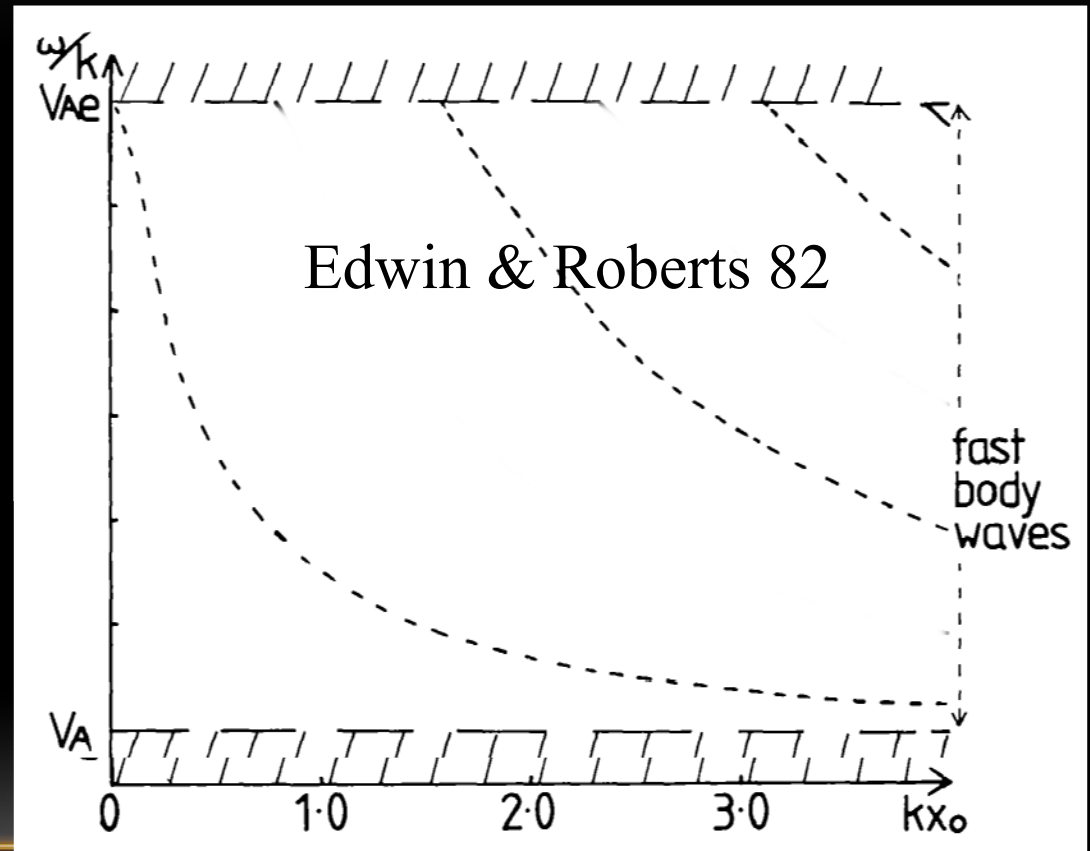


One of the largest-scale wavy motions that can be imaged in the solar system. Better to exploit them seismologically!

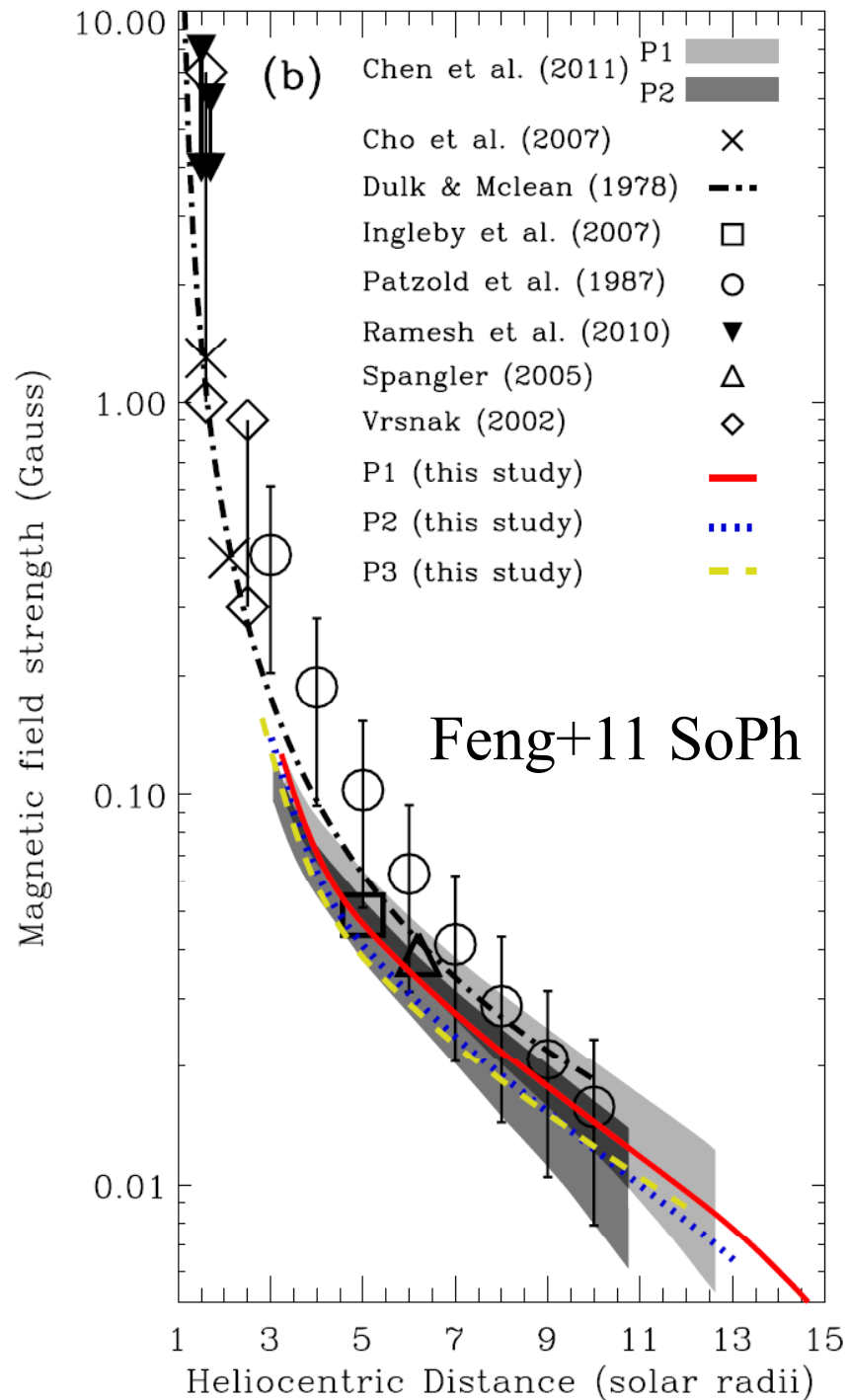




apparent prop. Speed – solar wind speed = prop.  
 Speed in rest frame = ? External Alfv speed



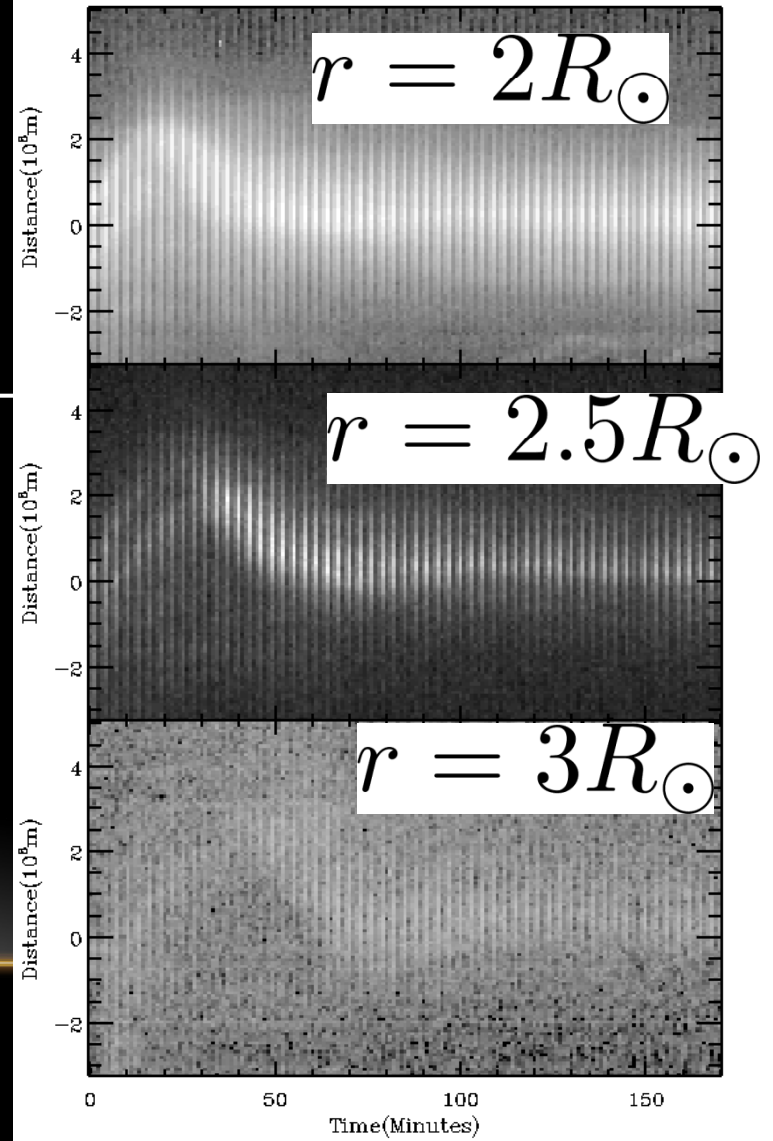
Stationary propagating kink  
 waves in slabs



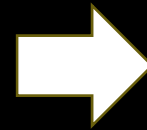
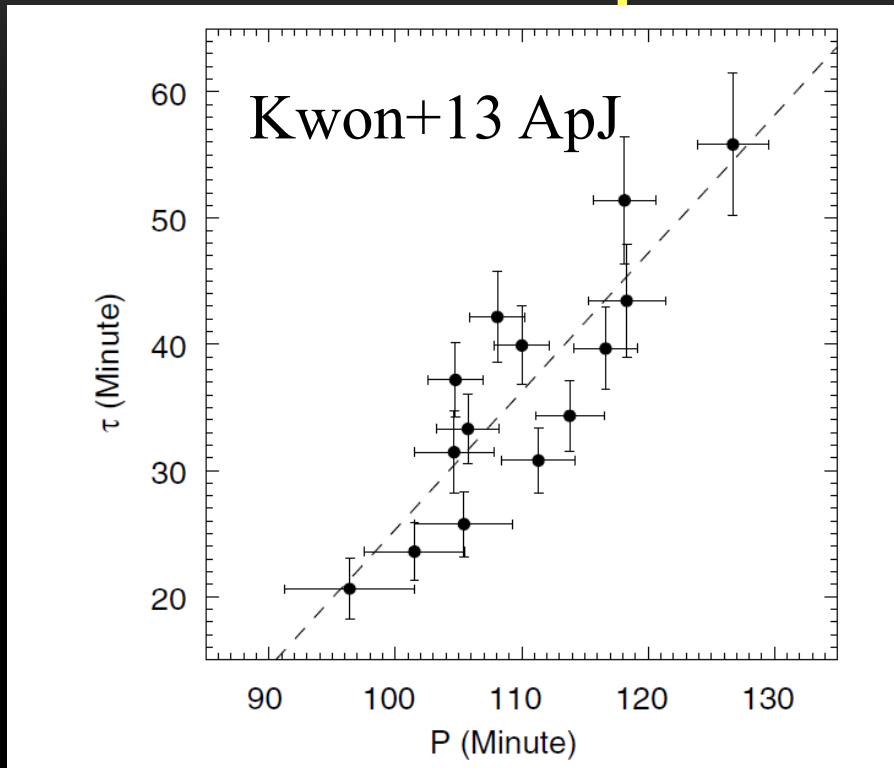
then some  
density profile

- An additional means to deduce the Magnetic field strength in the extended corona

Kwon+13 ApJ



# Rapid attenuation



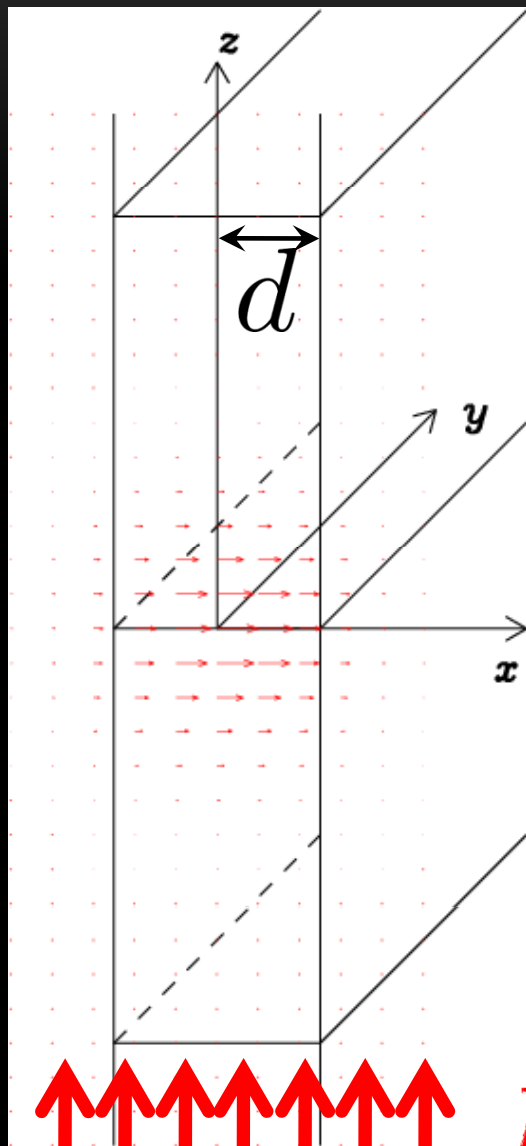
$$\tau \propto P$$

$$\frac{\tau}{P} \leq \frac{1}{2}$$

- Resonant absorption? (theory: Hollweg & Yang 88, Ruderman & Roberts 02, Goossens+11, ...)
  - Requires 3D propagation in a slab geometry
  - Indeed yields a linear scaling between tau and P
  - Such a small tau/P requires large density contrast + diffuse boundary layer between streamer stalk & its surrounding
- May not be necessary



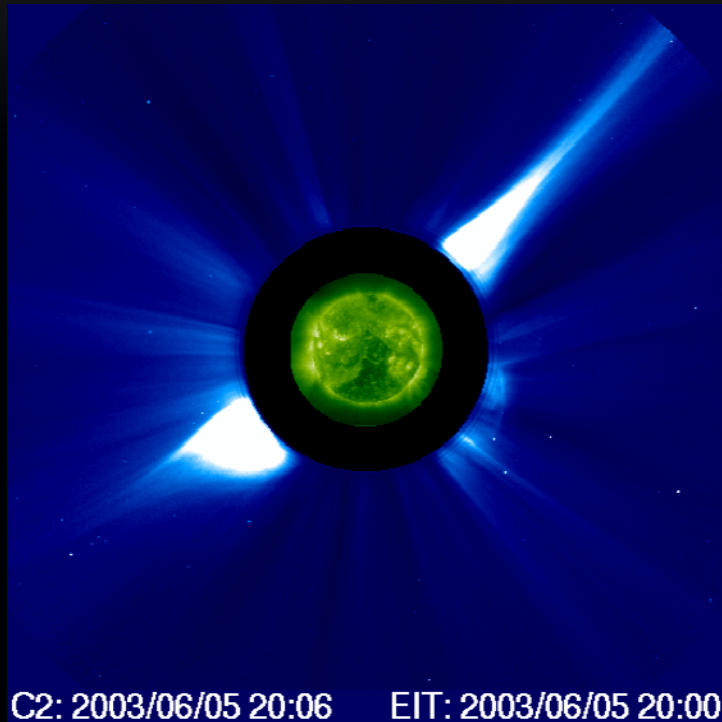
# What to address with a cold slab?



- Time  $\nearrow$ , more wavy patterns appear
- Distance  $\nearrow$ , apparent wavelength  $\nearrow$
- Apparent rapid damping of transverse displacement
- Validity of “prop. Speed in rest frame” = “external Alfvén speed”

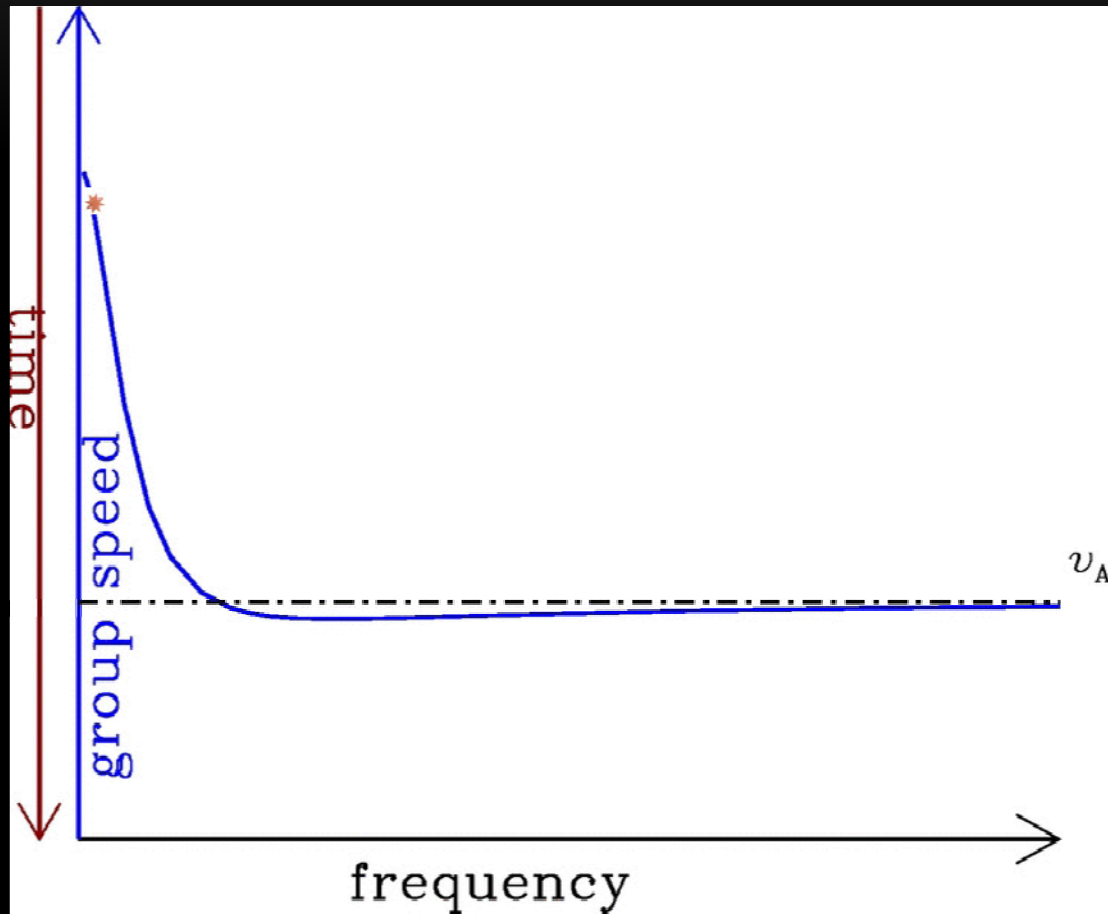
Variations in the  $y$ -dir neglected, hence no resonant absorption!

# Caveats

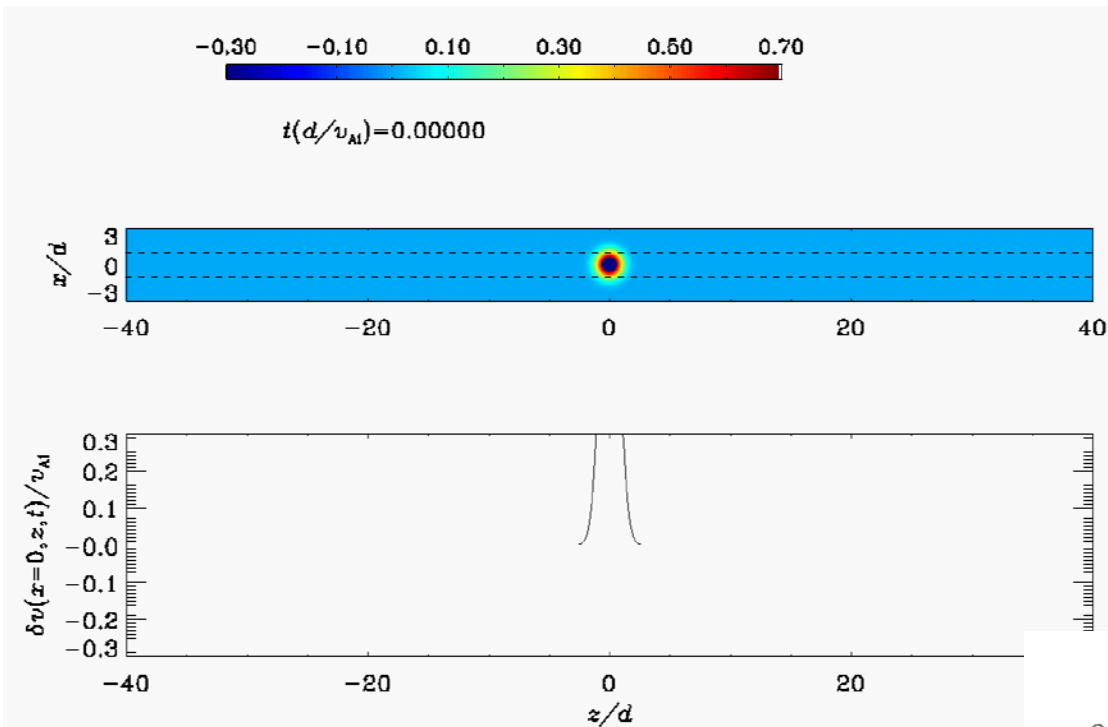


- Current sheets?
  - Should be fine for thin CSs (Feng+11, appendix; Hornsey+14)
- Finite gas pressure
- Lateral expansion, longitudinal structuring in mag. fld, den, flow speed..
- Flow shear between internal and external fluids
- ...

# Analogy with sausage wave trains

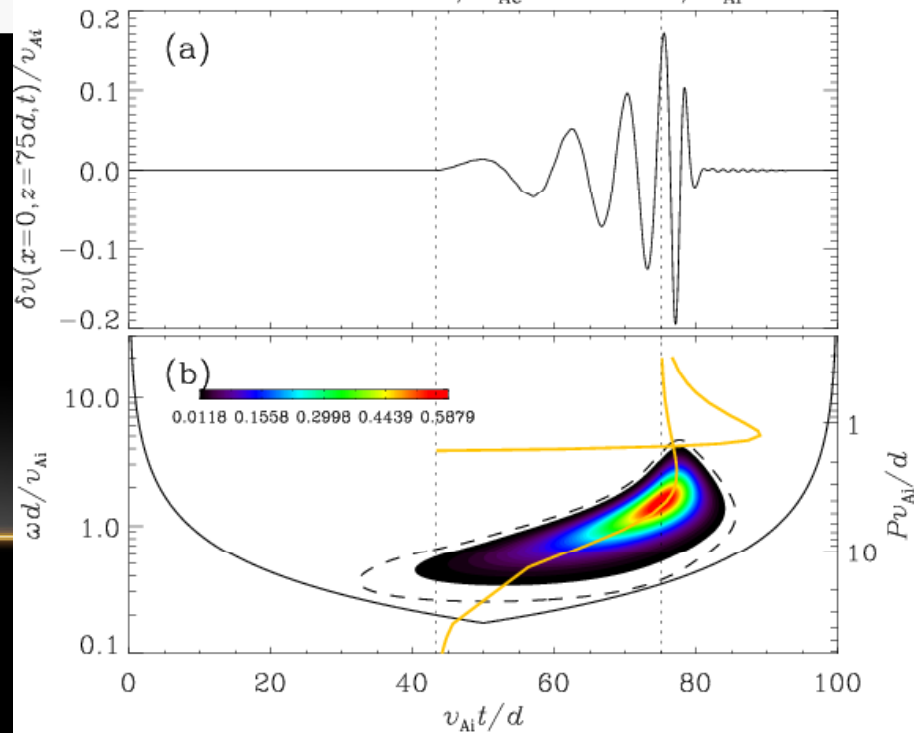


Roberts+83, 84;  
Edwin & Roberts 86,  
88; Nakariakov &  
Roberts 95

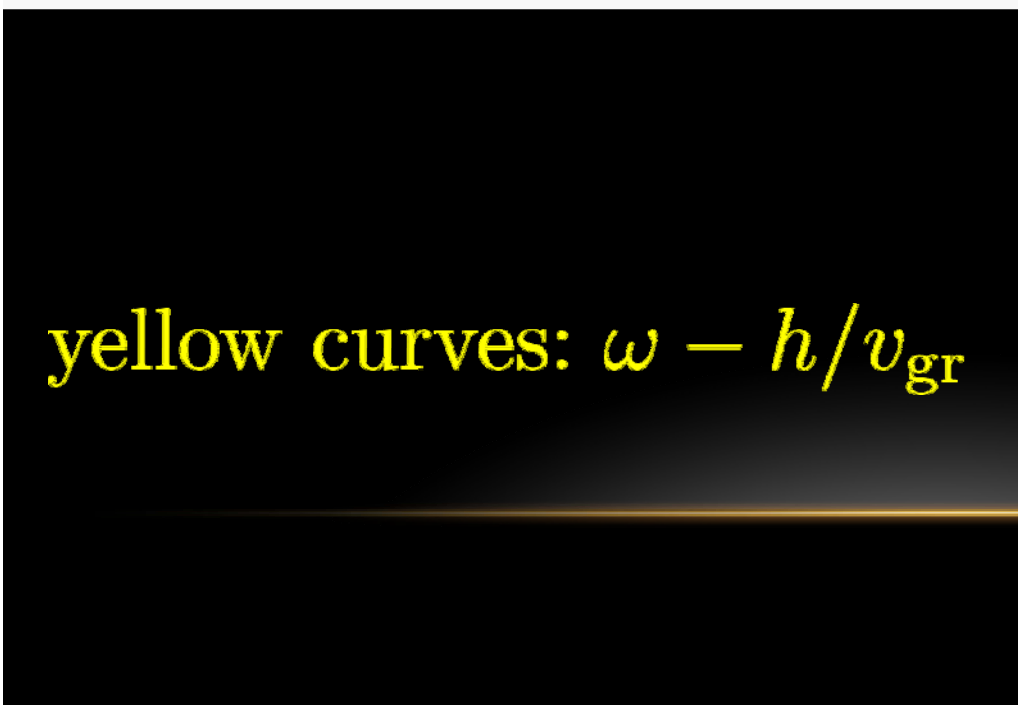


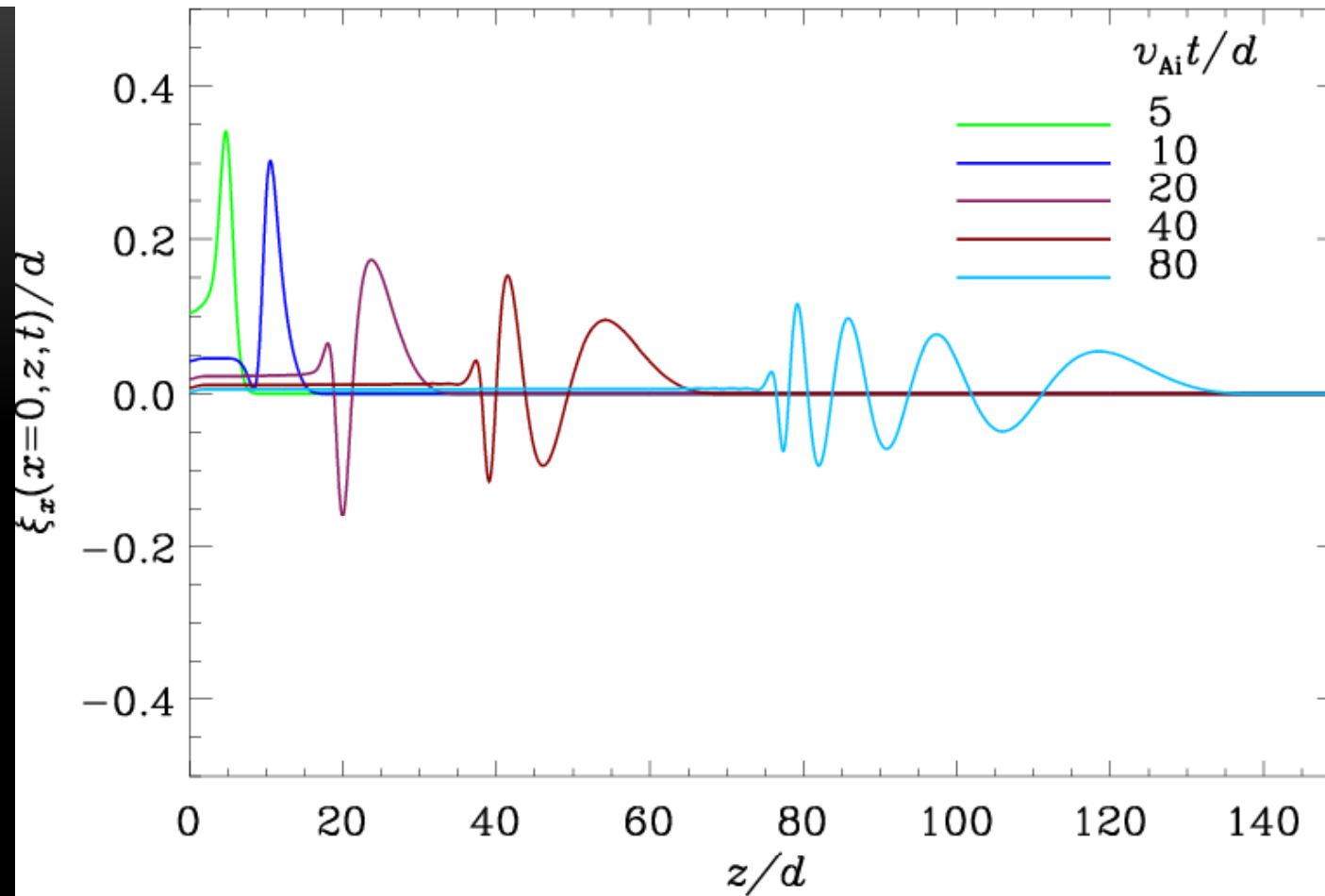
top-hat,  $\rho_i/\rho_e=3$

$h/v_{Ae}$   $h/v_{Ai}$

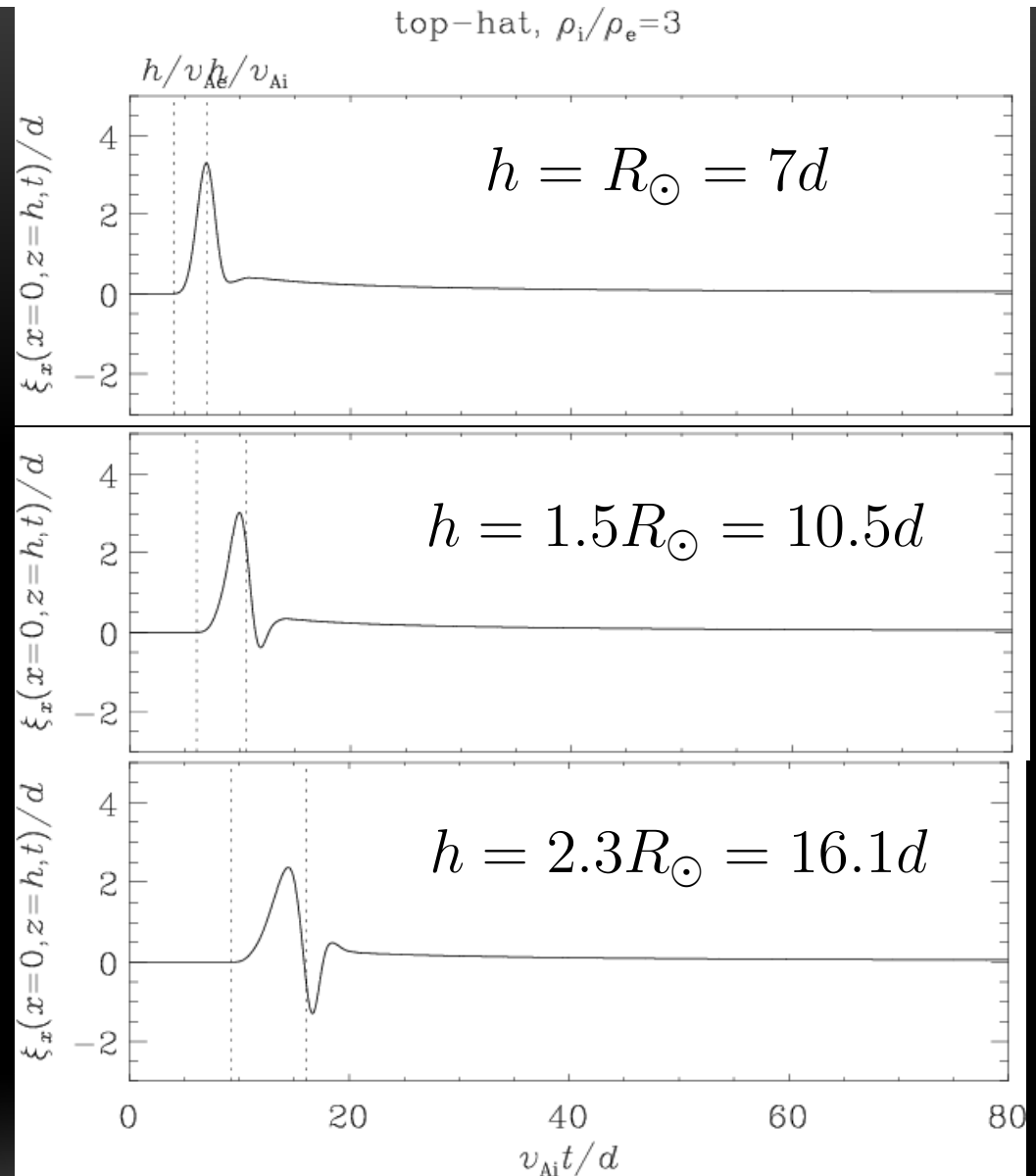
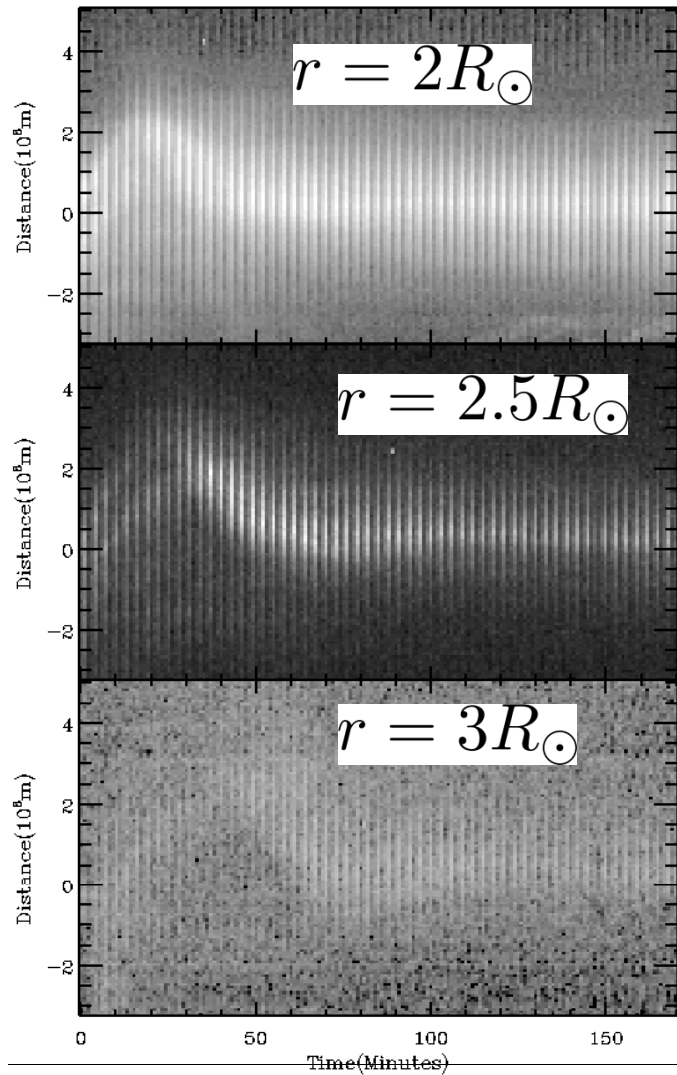


yellow curves:  $\omega - h/v_{gr}$



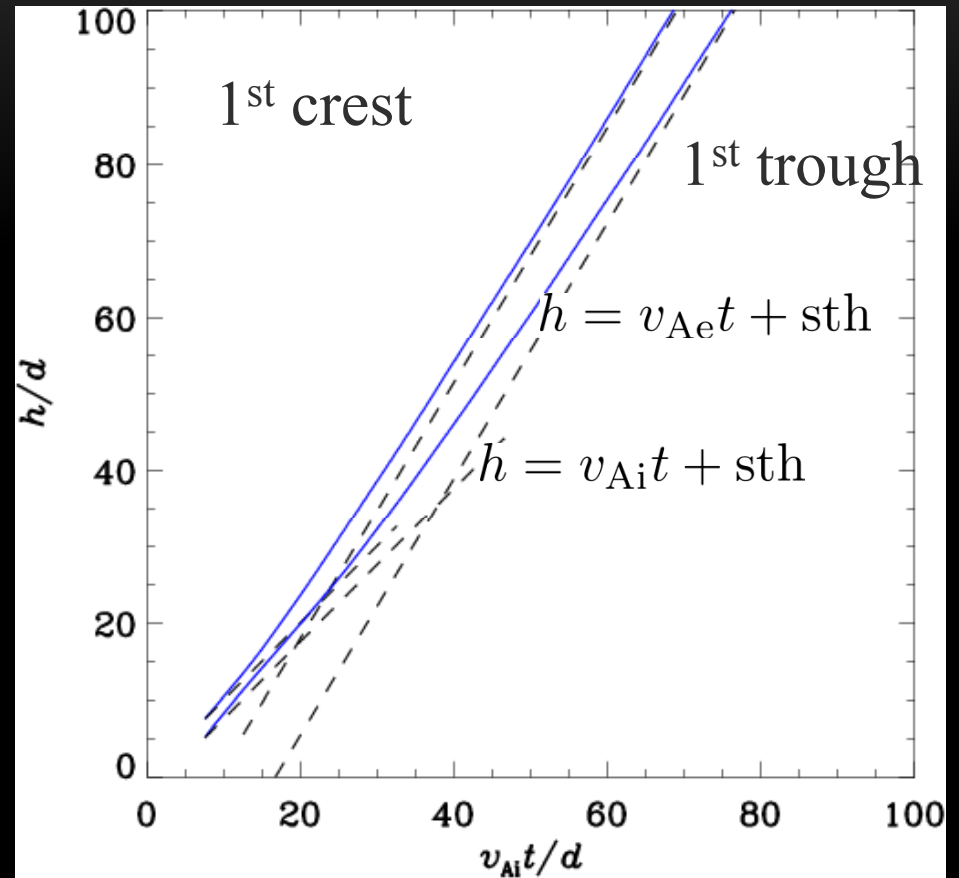
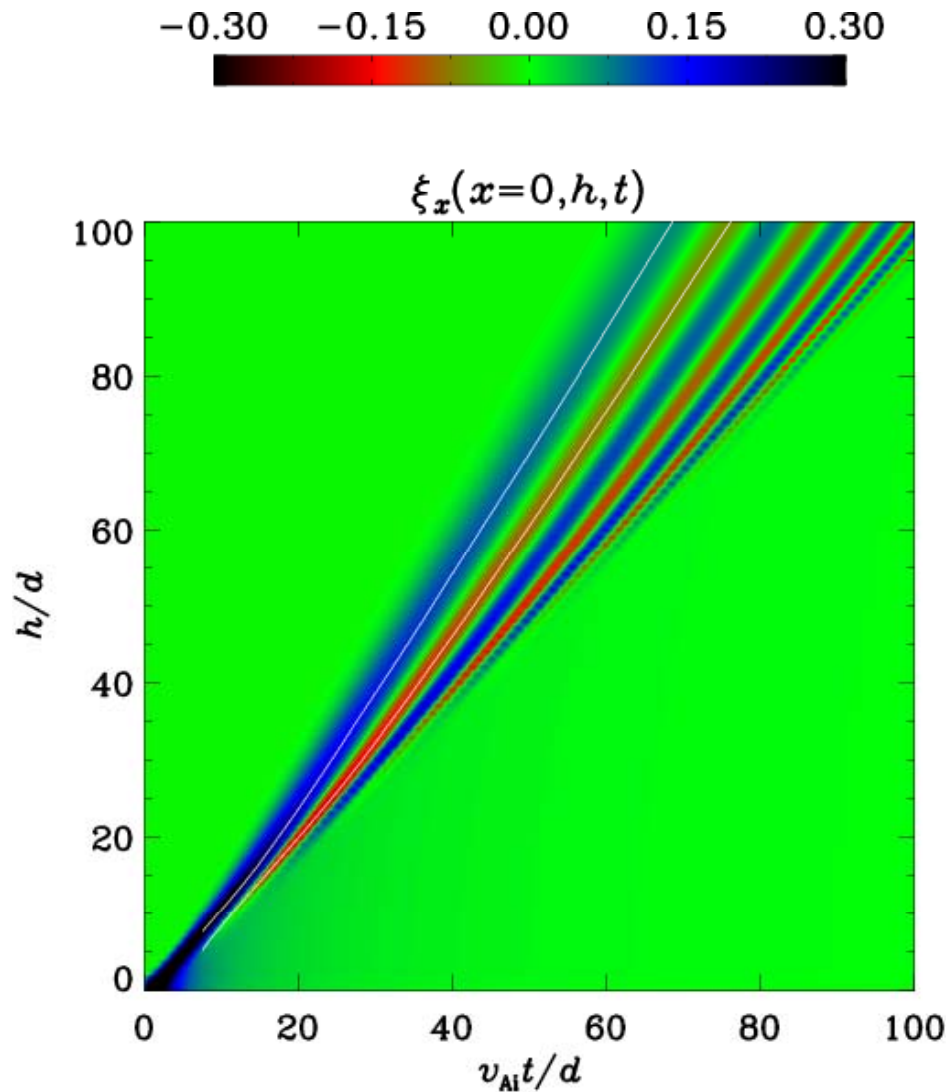


- Time  $\nearrow$ , more wavy patterns appear
- Distance  $\nearrow$ , apparent wavelength  $\nearrow$



STEREO/COR1,  
Kown+13

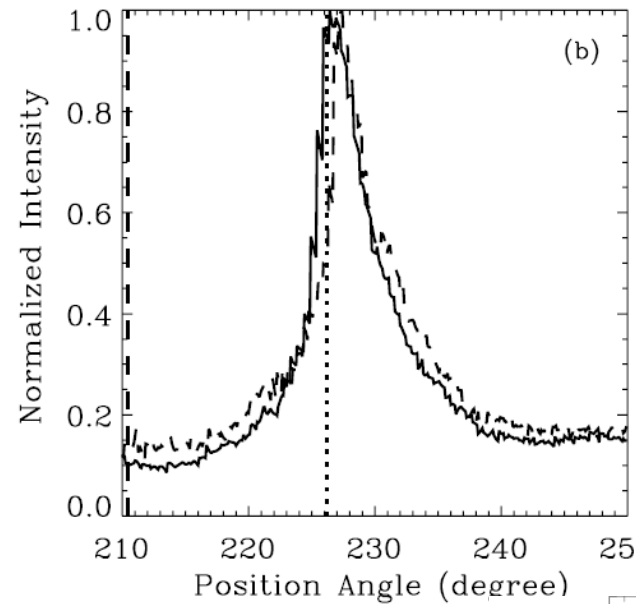
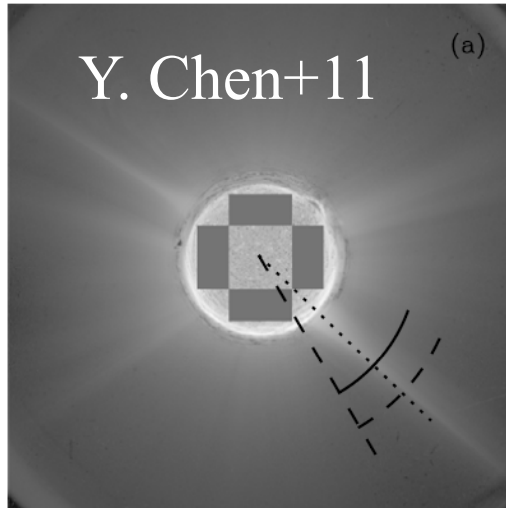
- Apparent rapid damping of transverse displacement



- “prop. Speed in rest frame” = “external Alfvén speed”?
  - OK at large distances

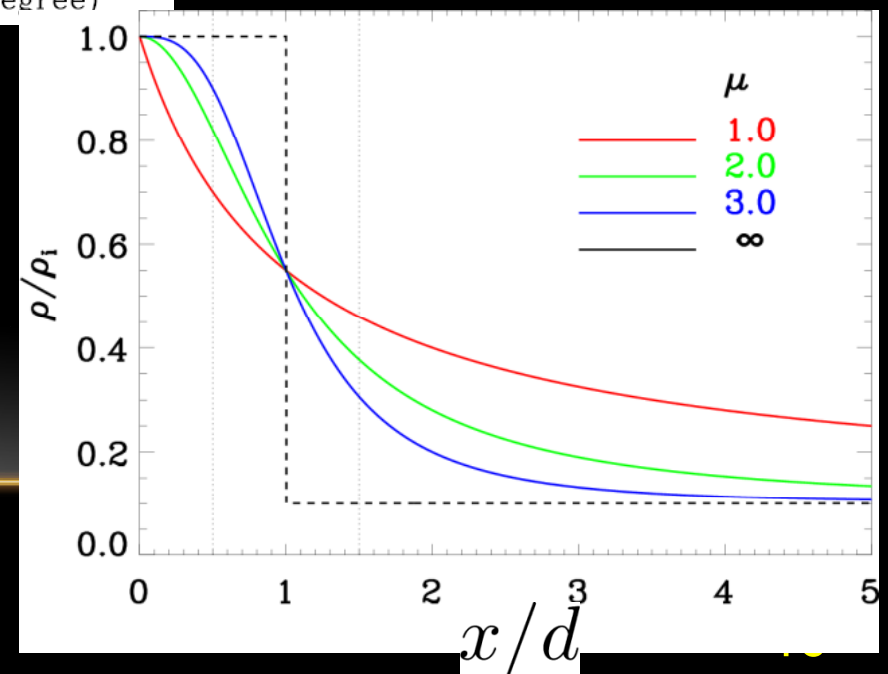
# What if density dist. not discontinuous?

SOHO LASCO C2 5-Jul-2004 21:00:27.158 UT



$$\rho(x) = \rho_e + (\rho_i - \rho_e)f(x)$$

$$f(x) = \frac{1}{1 + (x/d)^\mu}$$

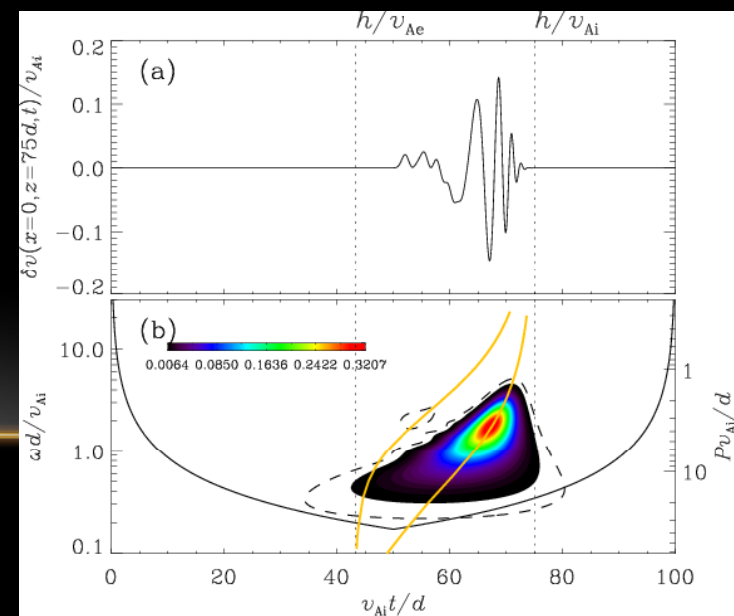
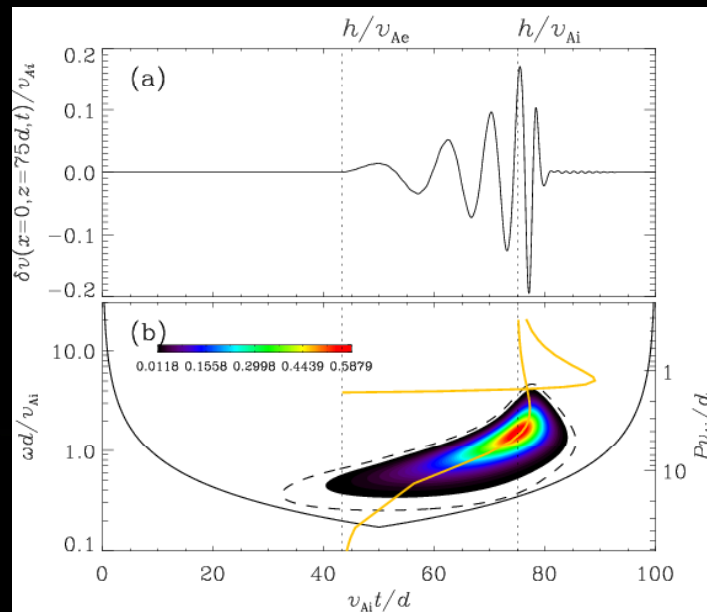
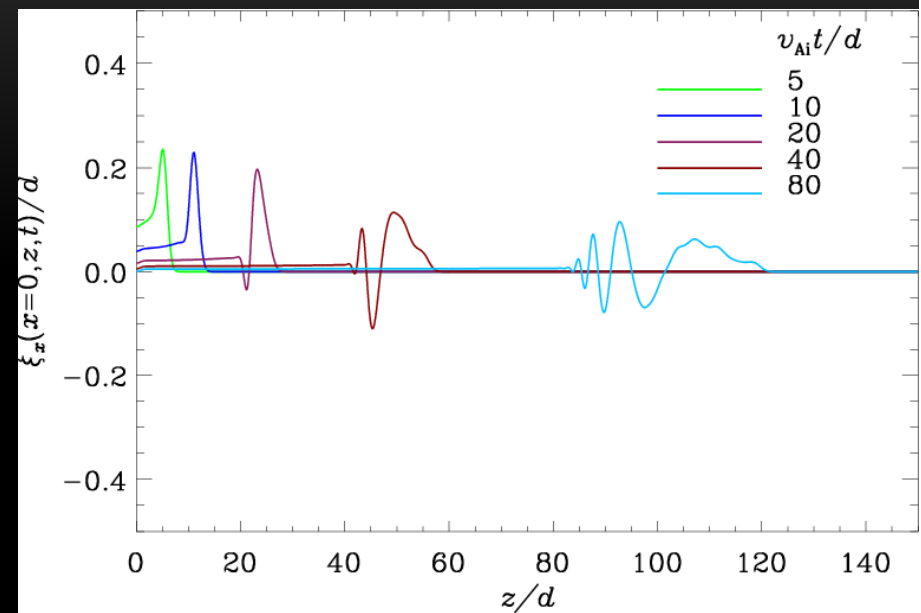
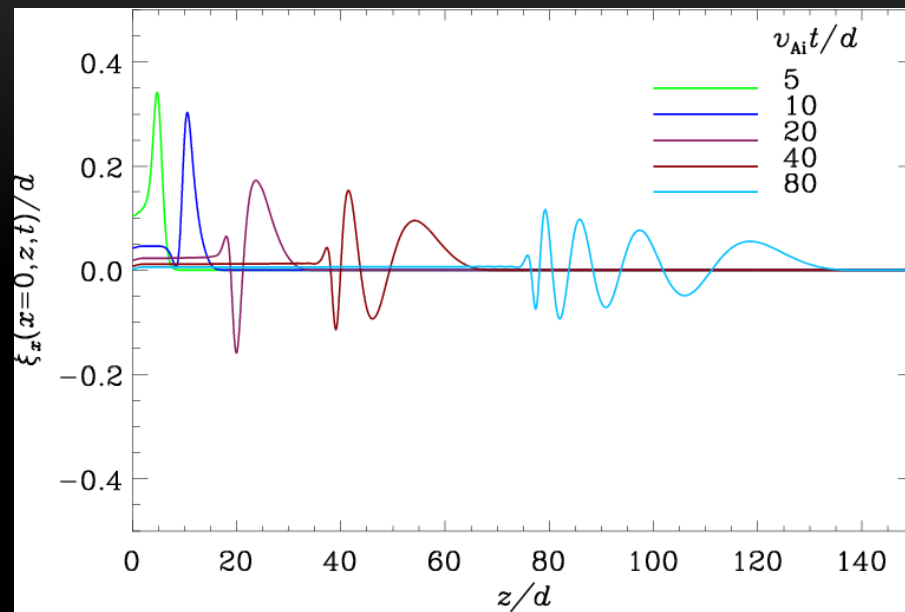




	$\mu = \infty$ (tophat)	$\mu \geq 2$	$\mu < 2$
Time $\nearrow$ , more wavy patterns appear	✓	✓	✓?
Distance $\nearrow$ , apparent wavelength $\nearrow$	✓	✓	✓?
Apparent rapid damping of transverse displacement	✓	✓	✓
“prop. Speed in rest frame” = “external Alfvén speed” ? OK at large distances	✓	✓	✓

$\rho_i/\rho_e = 3 \quad \mu = \infty$  (tophat)

$\rho_i/\rho_e = 3 \quad \mu = 1$



# Summary

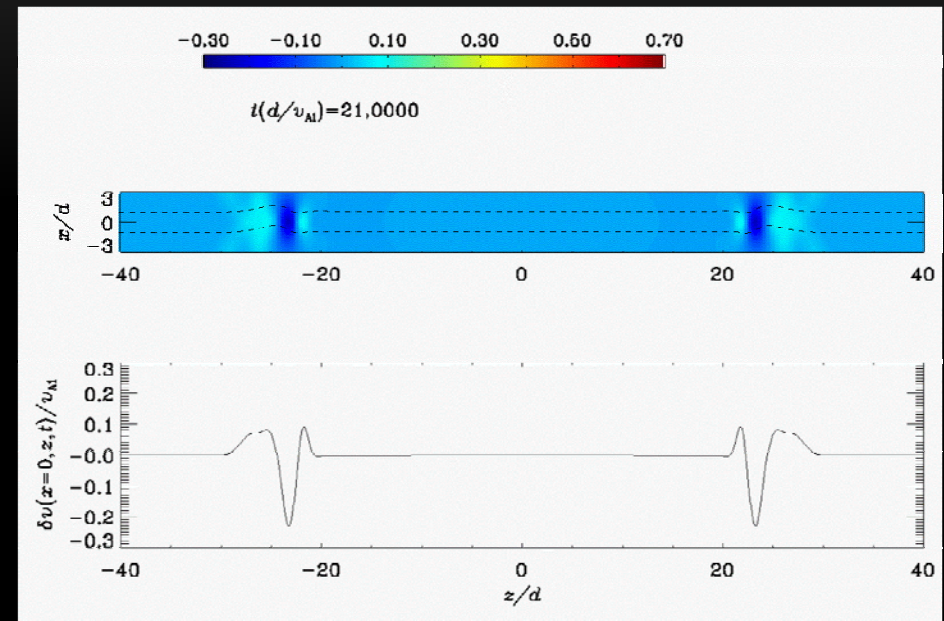
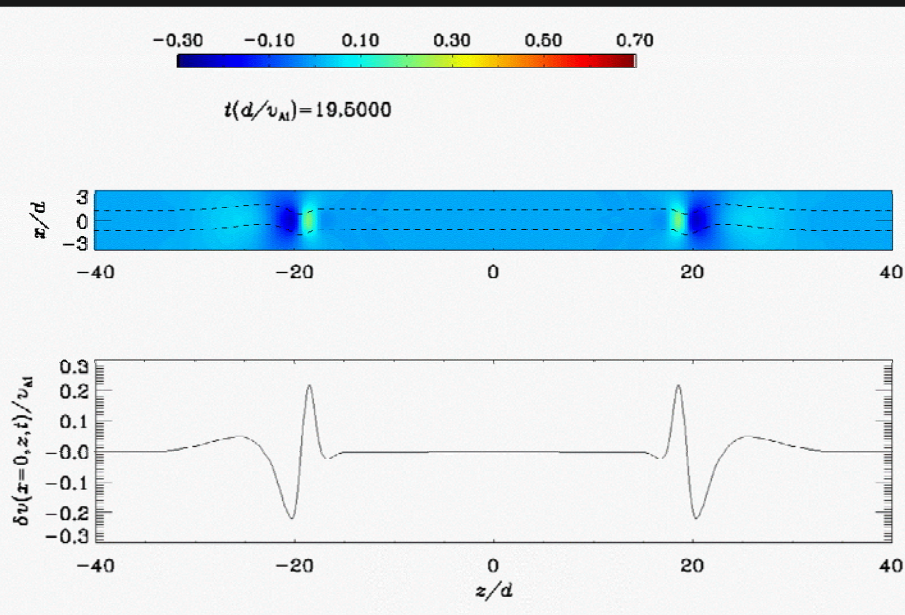
- Streamer waves: propagating transverse motions in streamer stalks
- Qualitative agreement between measurements and impulsively generated kink wave trains
  - Time ↗ , more wavy patterns appear
  - Distance ↗ , apparent wavelength ↗
  - Apparent rapid damping of transverse displacement
- Behavior of wave trains not too sensitive to transverse density structuring
  - Difficult to discriminate between forms of this structuring, at least with LASCO/C3
- Quantitative agreement likely, if the equilibrium is made more realistic

**BACKUP SLIDES**

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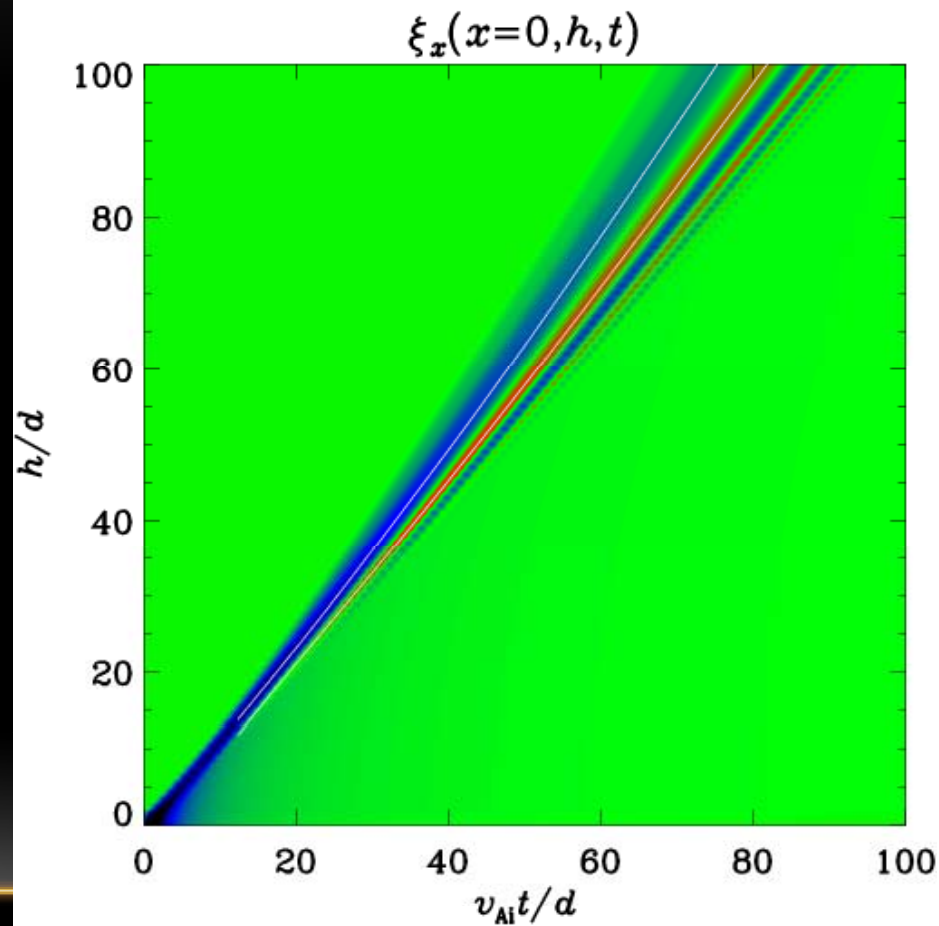
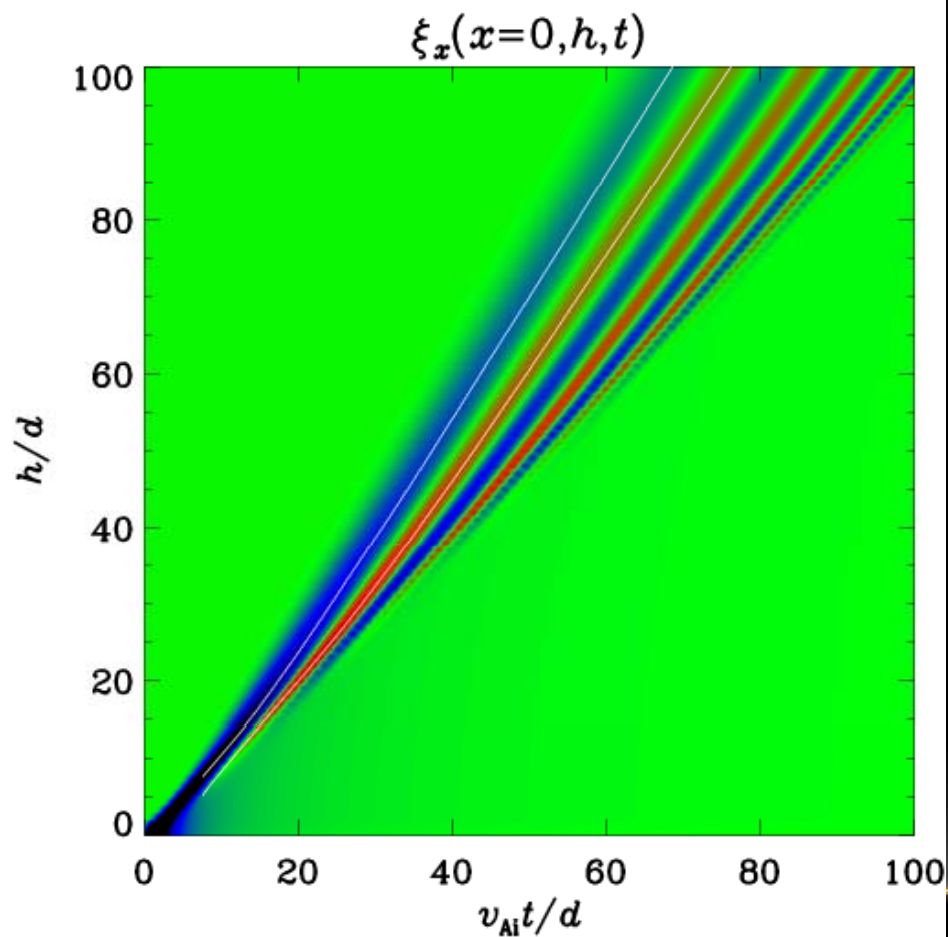
$$\rho_i/\rho_e = 3 \quad \mu = \infty \text{ (tophat)}$$

$$\rho_i/\rho_e = 3 \quad \mu = 1$$



$$\rho_i/\rho_e = 3 \quad \mu = \infty \text{ (tophat)}$$

$$\rho_i/\rho_e = 3 \quad \mu = 1$$



$$\rho_i/\rho_e = 3 \quad \mu = \infty \text{ (tophat)}$$

$$\rho_i/\rho_e = 3 \quad \mu = 1$$

