

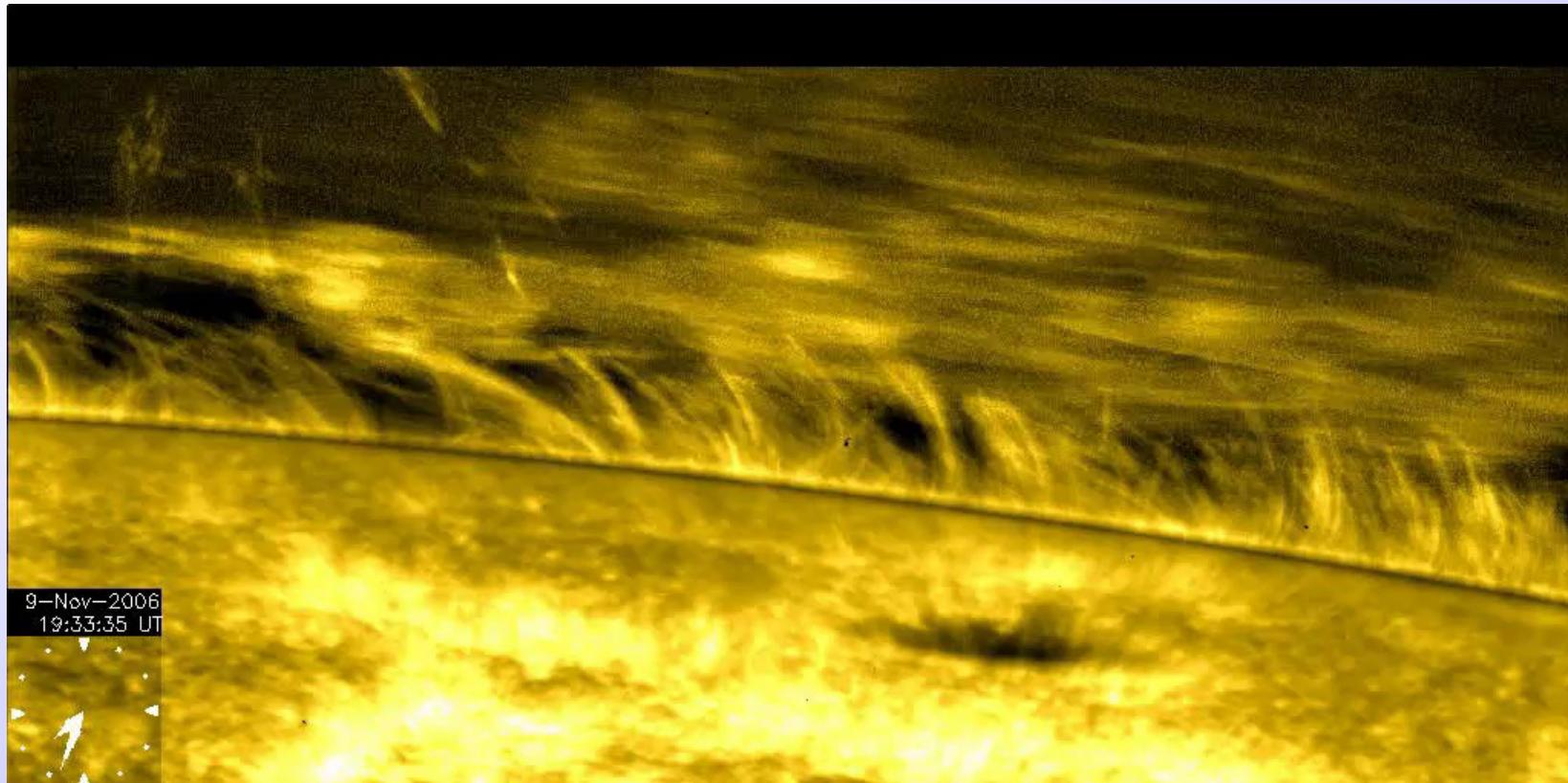
Observations of the uncoupling of ionized and neutral species in solar prominences: A science case for



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Instituto de Astrofísica de Canarias

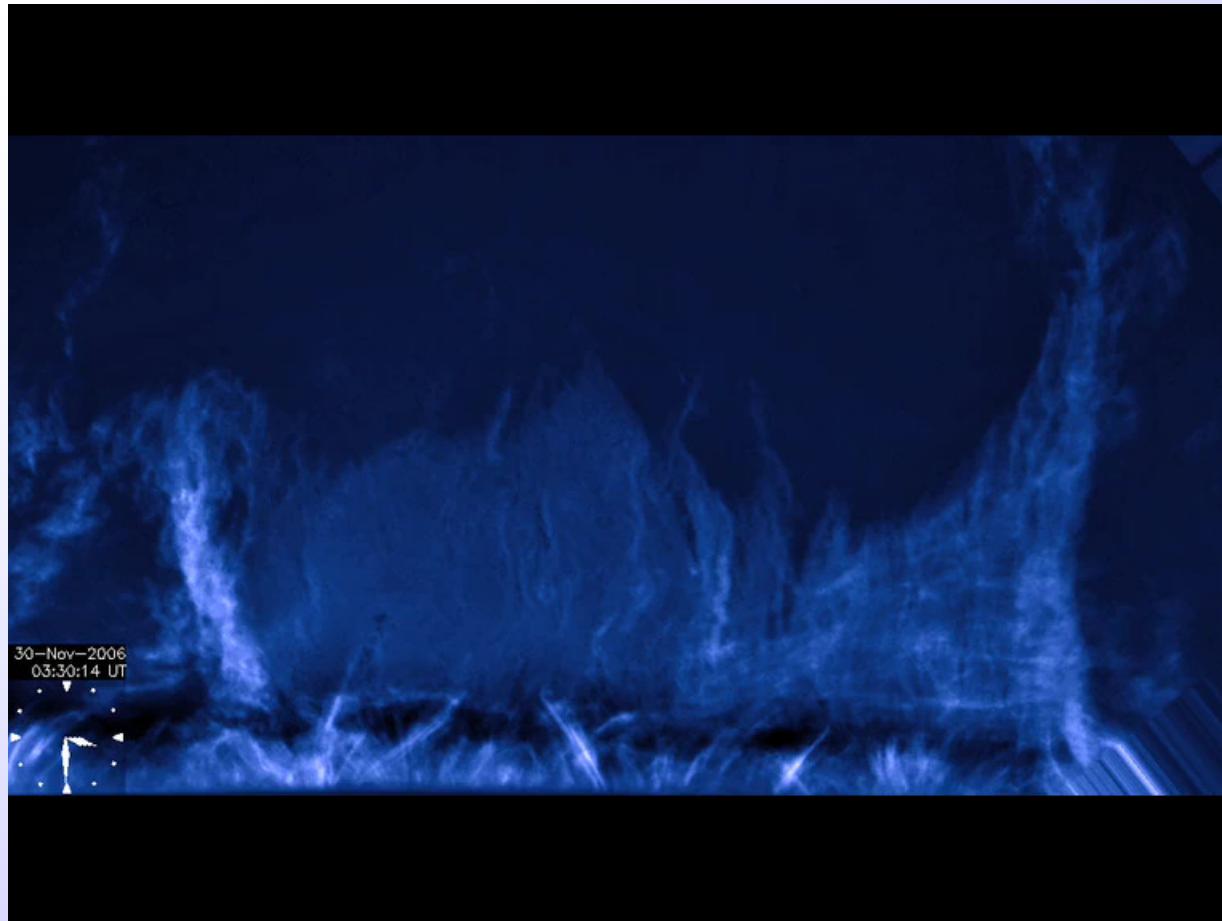
Solar prominence dynamics

Hinode observations of solar prominences



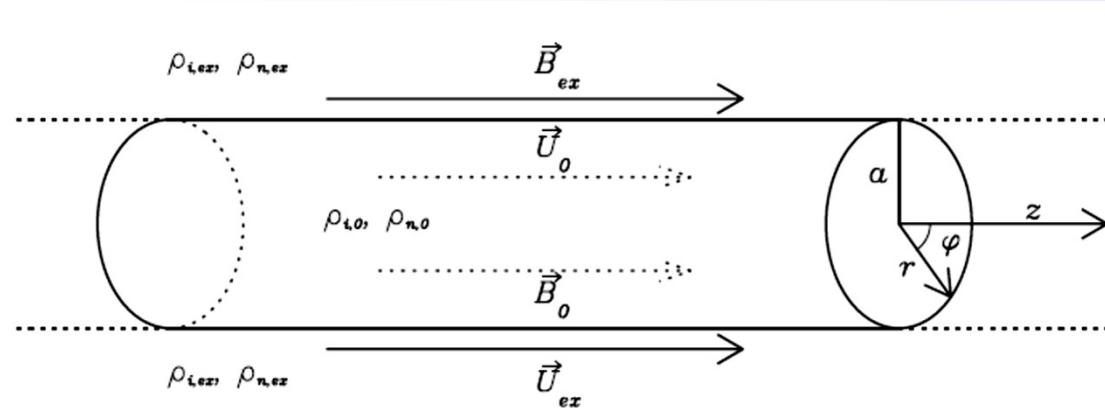
Solar prominence dynamics

Hinode observations of solar prominences



Berger et al. 2008

Magnetic KHI in prominences



The presence of neutrals contribute to the onset of the KHI.
Collisions between ions and neutrals reduce the growth of unstable
modes but cannot completely suppress the instability

Ballai et al (2015)
Martínez-Gómez et al (2015)

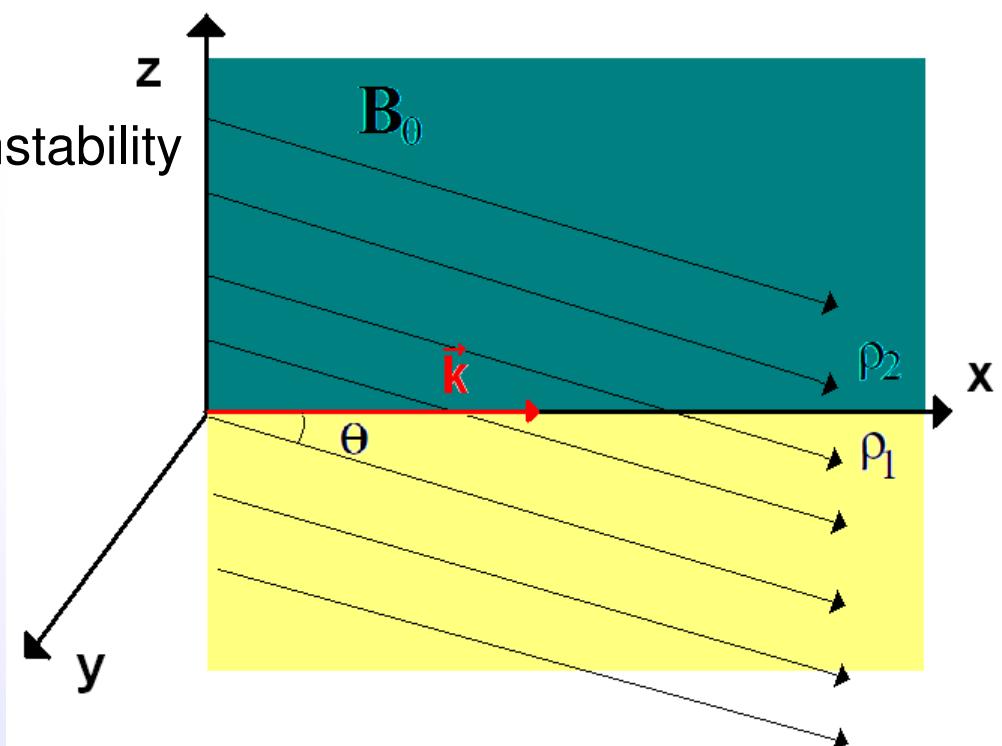
Magnetic RTI in prominences

Linear growth rate (Chandrasekhar 1961)

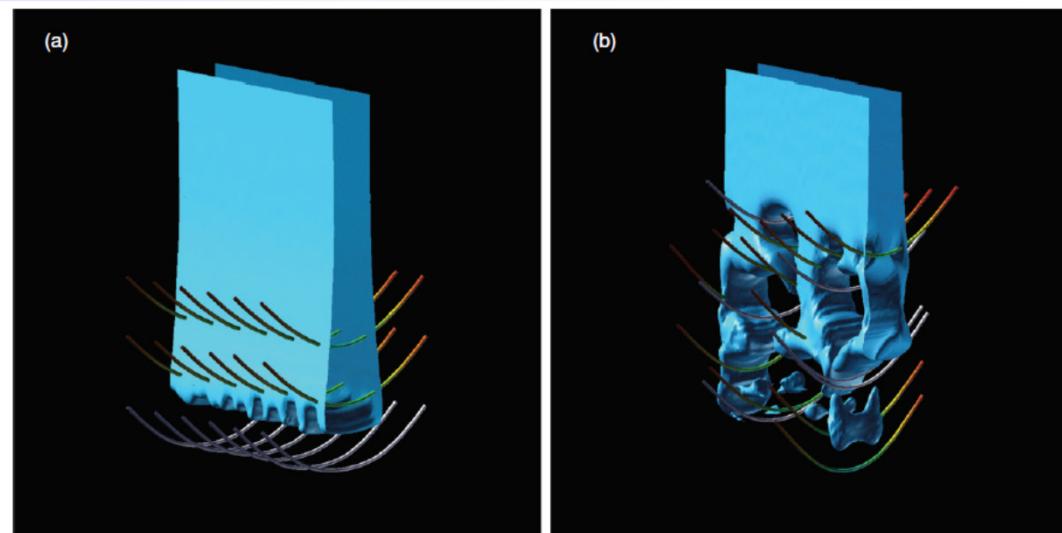
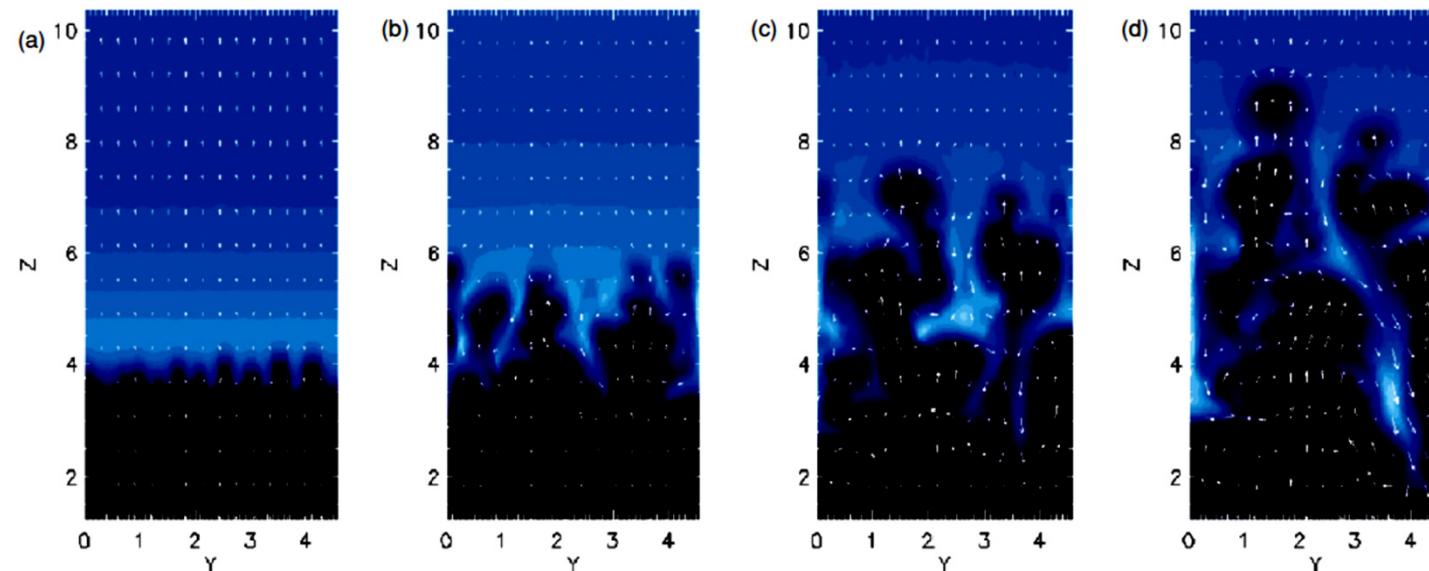
$$\omega^2 = -gk \frac{\rho_2 - \rho_1}{\rho_2 + \rho_1} + \frac{2(B_0 k)^2}{\mu(\rho_2 + \rho_1)}$$

Critical wavelength below which instability is completely suppressed

$$\lambda_c = \frac{B_0^2 \cos^2 \theta}{(\rho_2 - \rho_1)g}$$



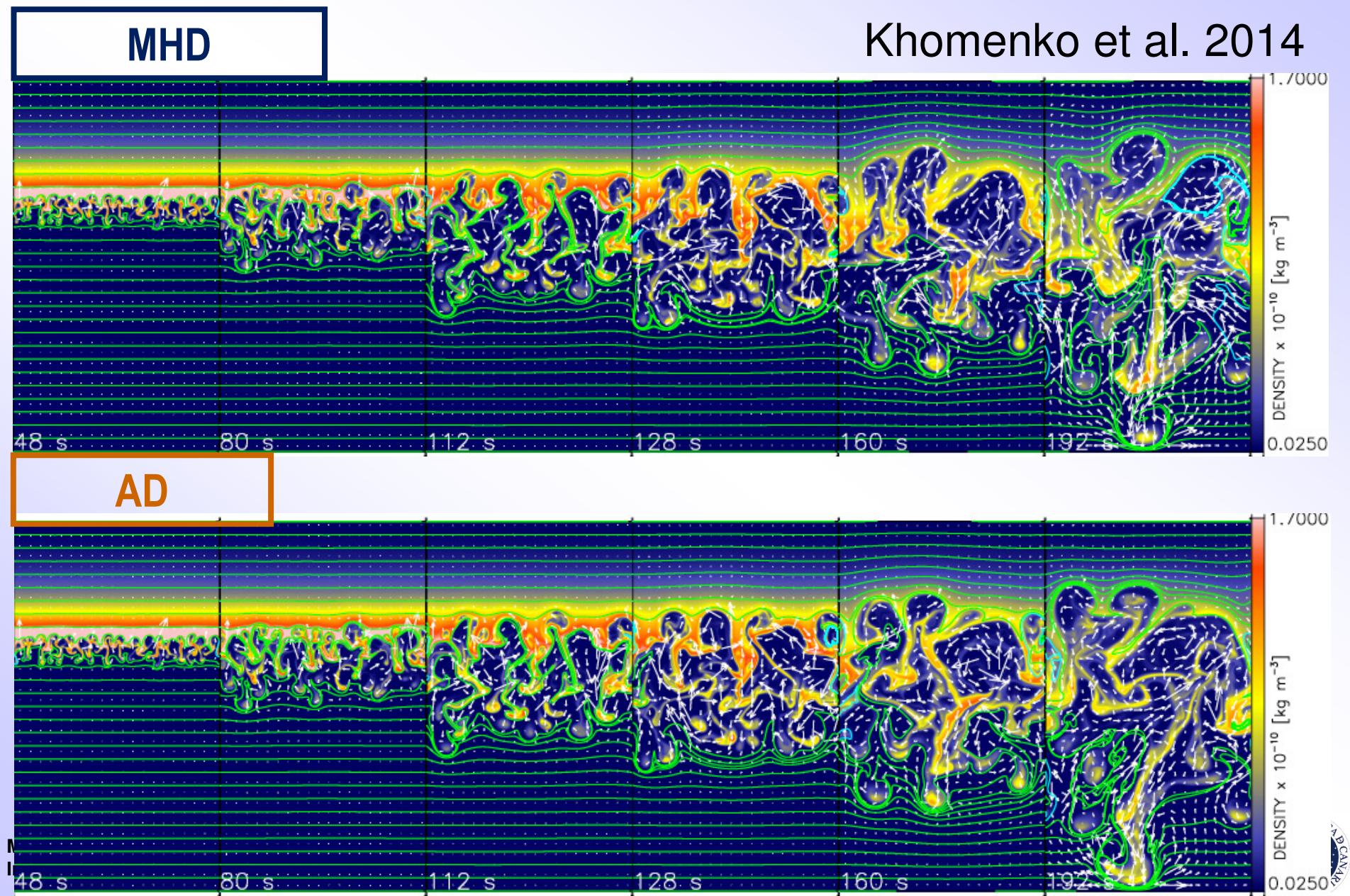
Magnetic RTI in prominences



Hillier et al. 2011, 2012

Terradas et al 2015

Magnetic RTI in prominences



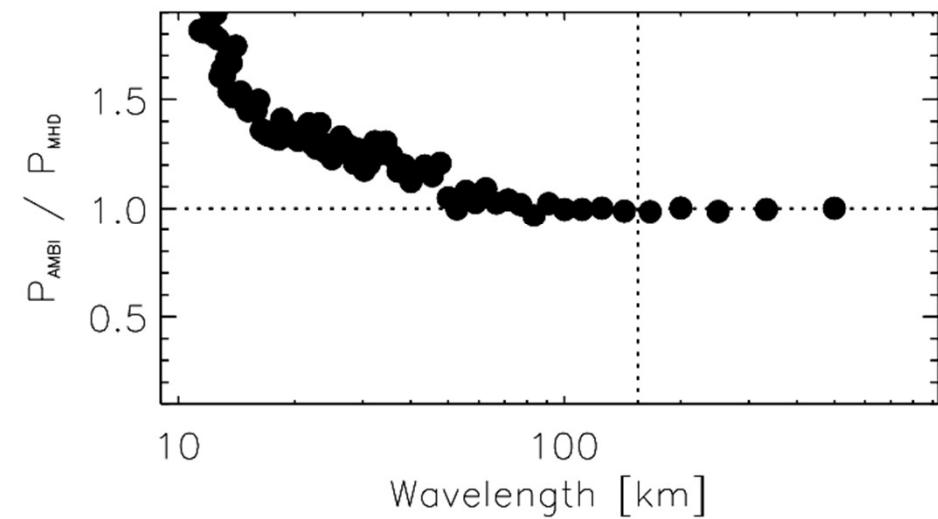
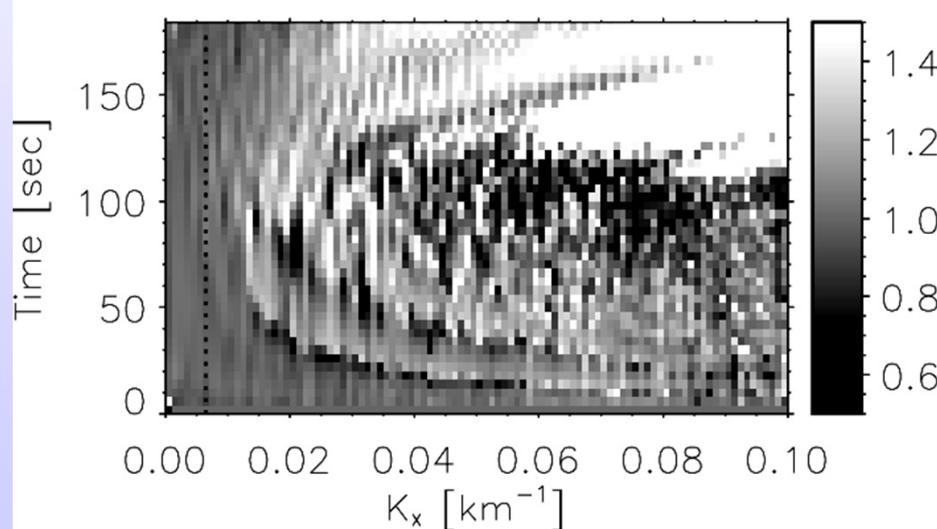
Magnetic RTI in prominences

“ambipolar” model shows larger growth rate at small scales, compared to “mhd” model

Change of behavior at $\lambda \sim \lambda_c$

$$\lambda_c = \frac{B_0^2 \cos^2 \theta}{(\rho_2 - \rho_1)g}$$

Power (ambipolar) / Power (mhd)



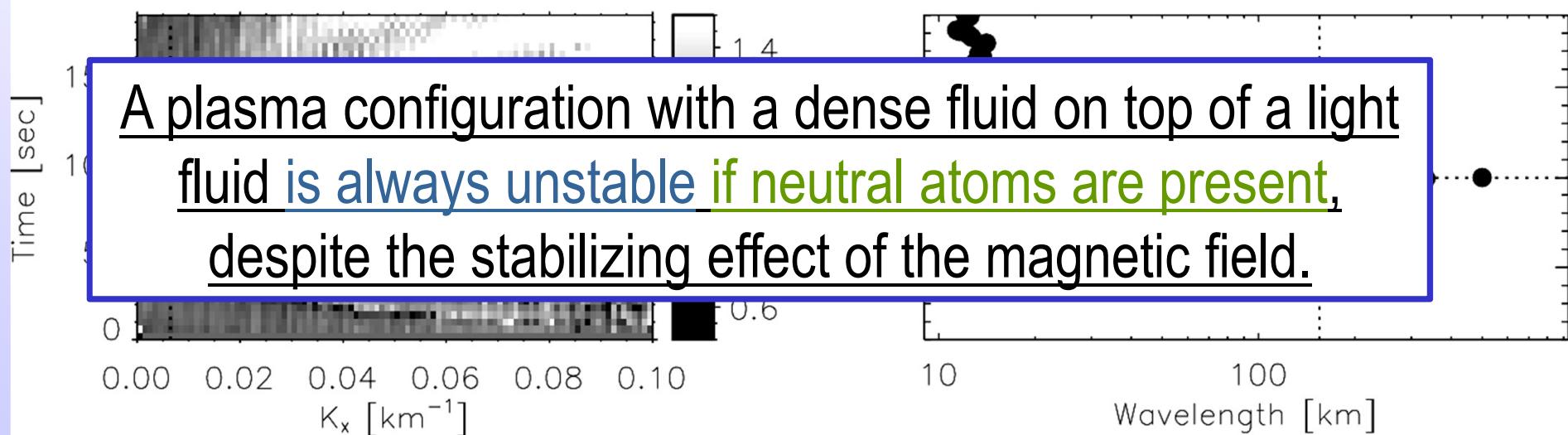
Magnetic RTI in prominences

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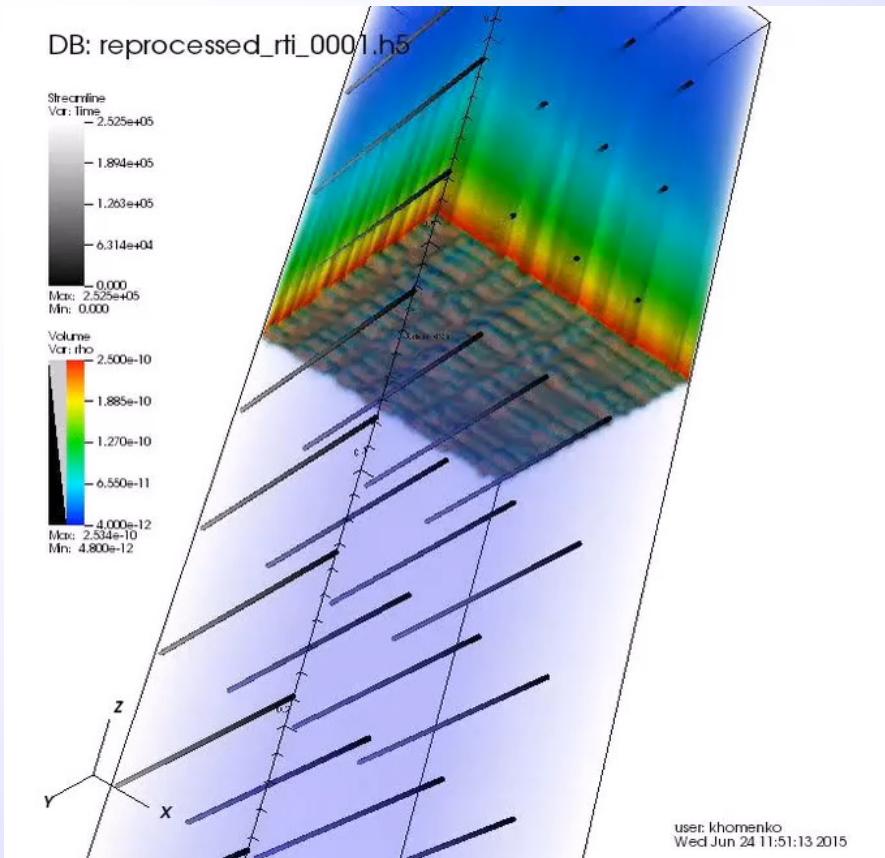
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Magnetic RTI in prominences

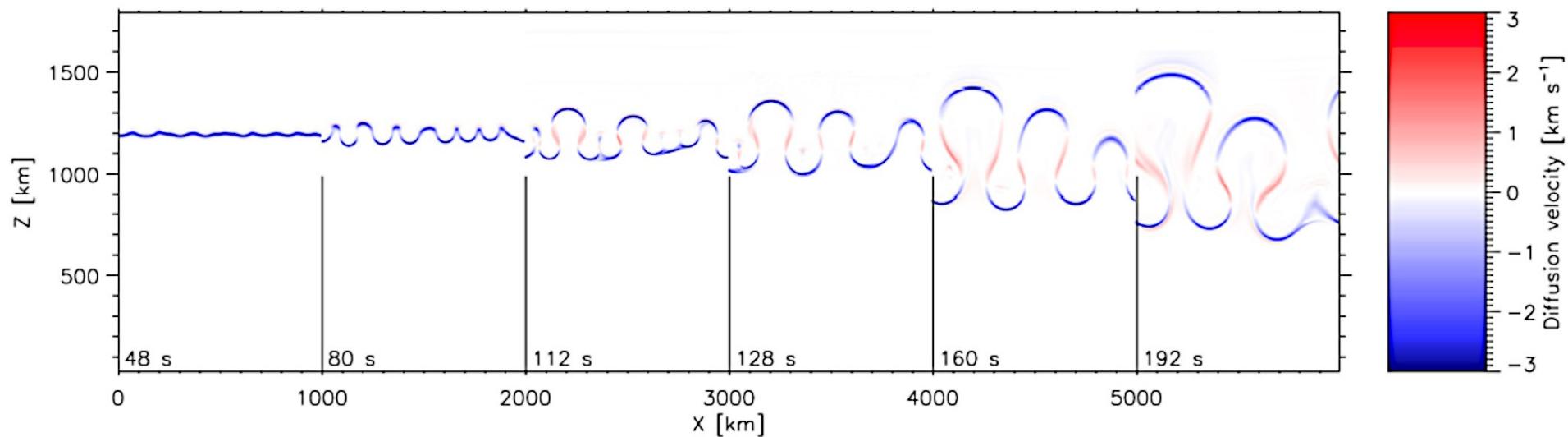


Diffusion velocity $w = u_i - u_n$

$$w = \frac{\xi_n}{\alpha_n} [\mathbf{J} \times \mathbf{B}] - \frac{(2\xi_n \nabla p_e - \xi_i \nabla p_n)}{\alpha_n}$$

Currents Gradients of partial pressures

Negative values: neutrals fall faster than ions by a few km s^{-1}

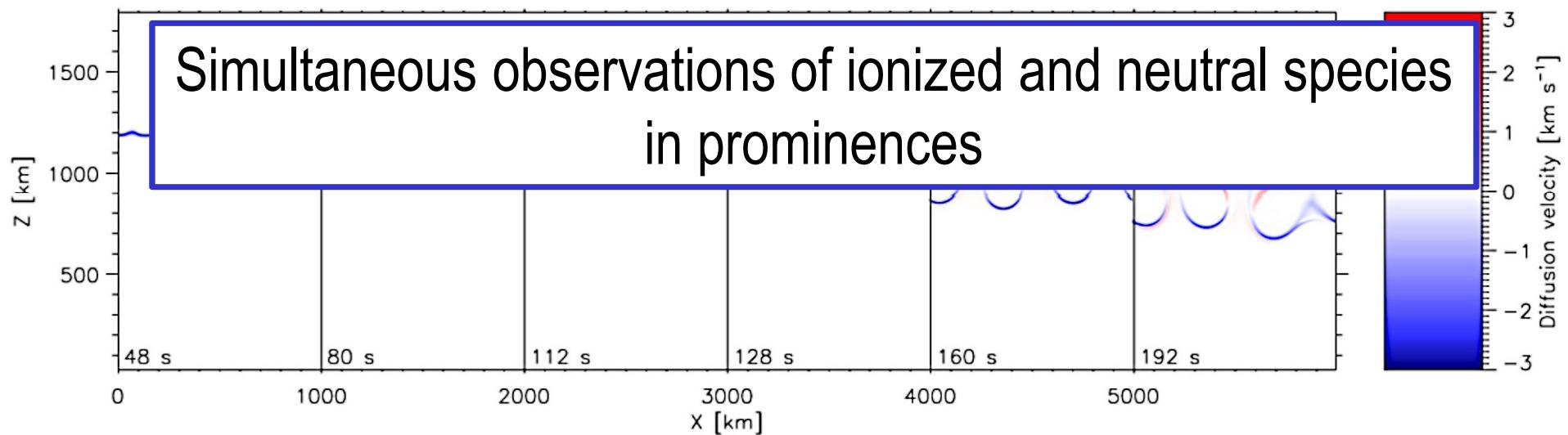


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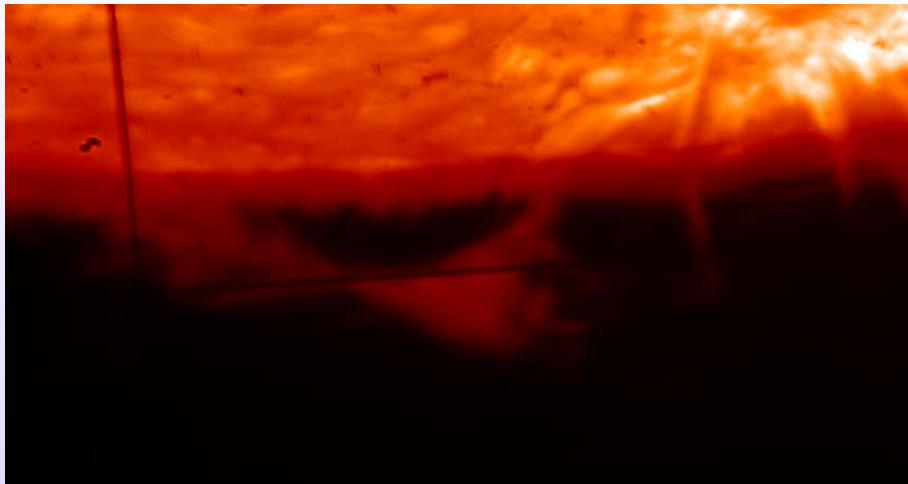
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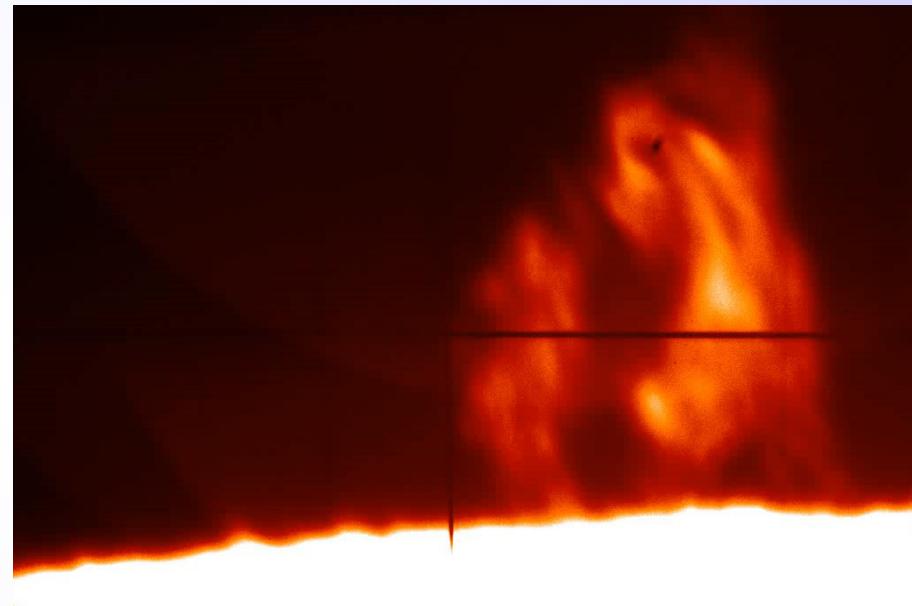


Observations of PI effects in prominences

11/Sep/2012



17/Jun/2017

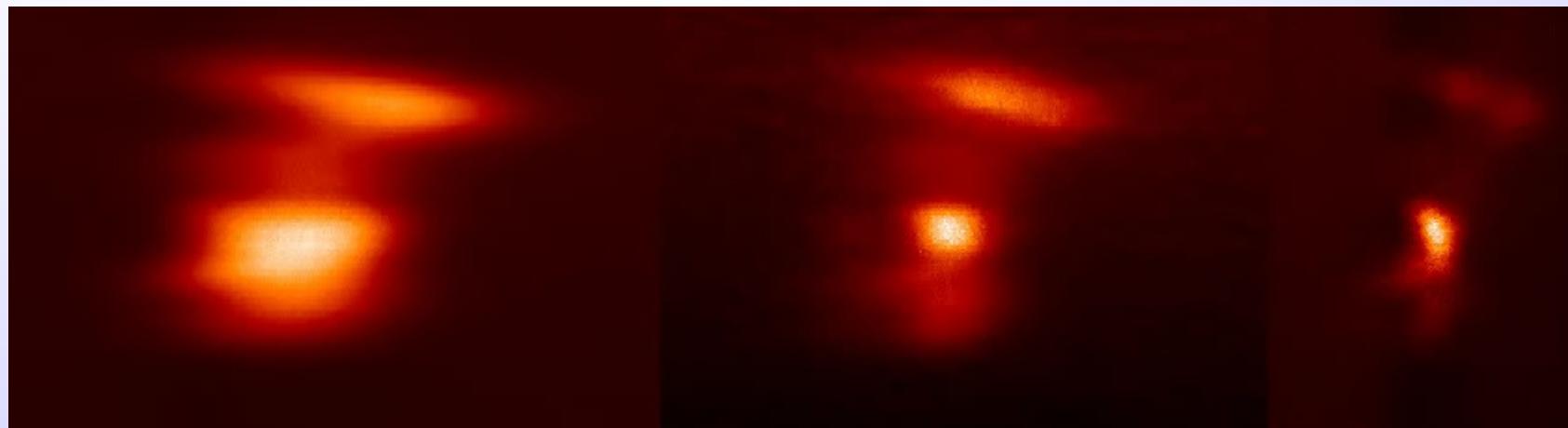


Khomenko, Collados, Diaz 2016, ApJ 823, 132

Spectroscopy in Ca II IR + He 10830
at German VTT

Spectroscopy in H α + He I D3 + Ca II 8542
at German VTT

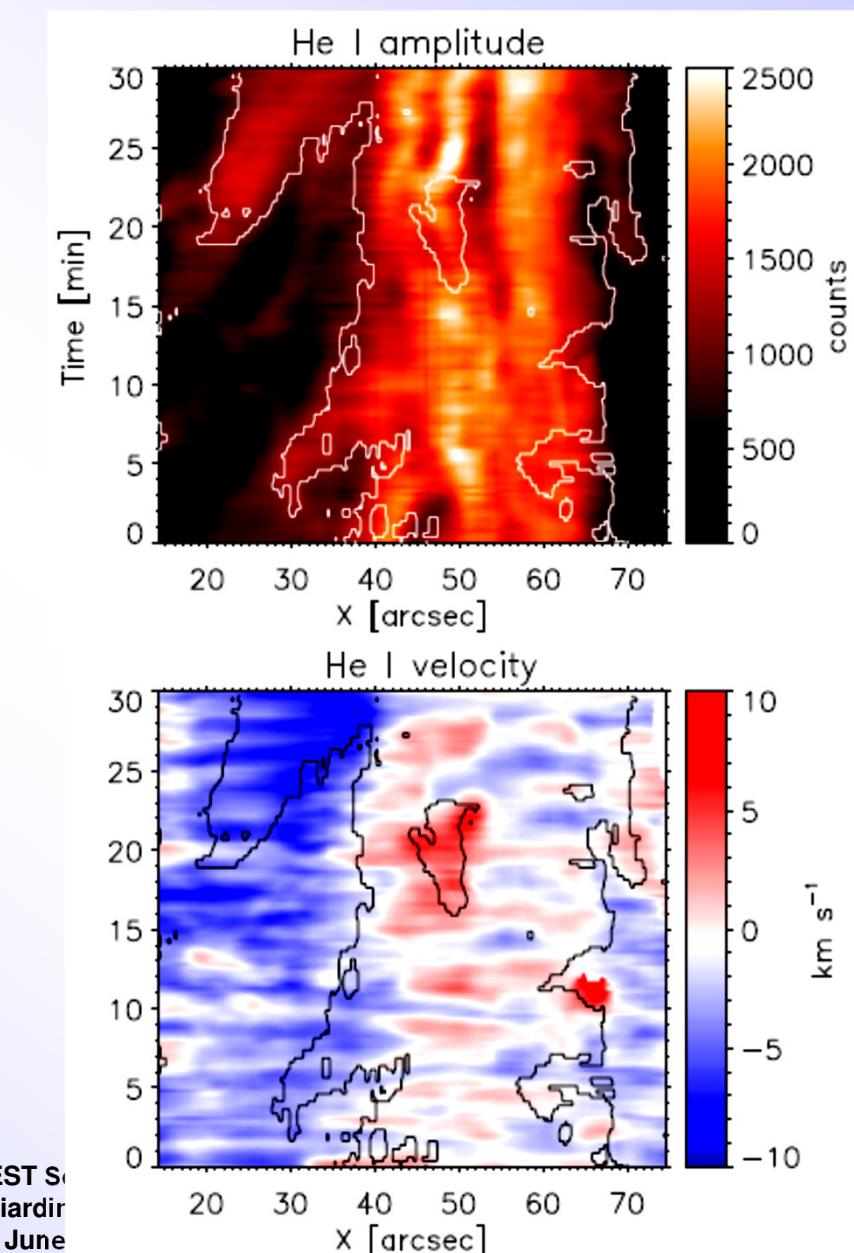
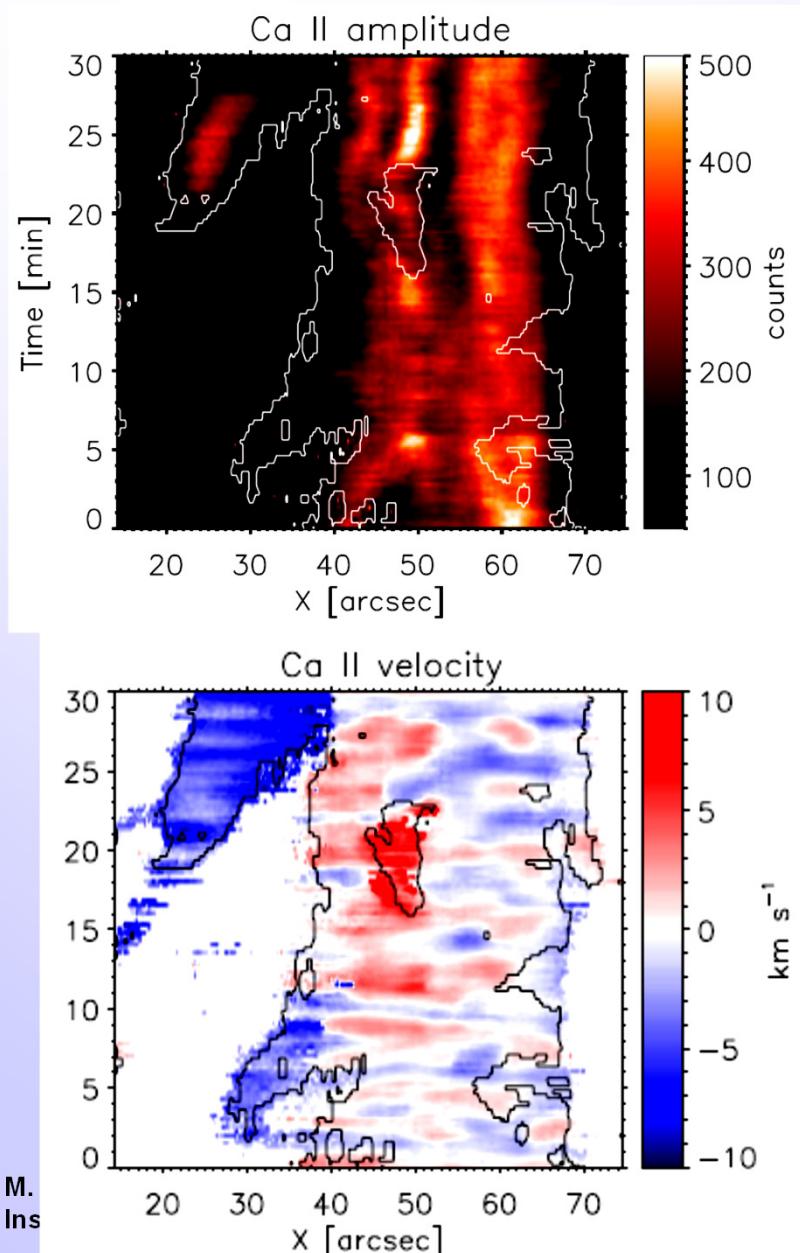
H α



He I D3

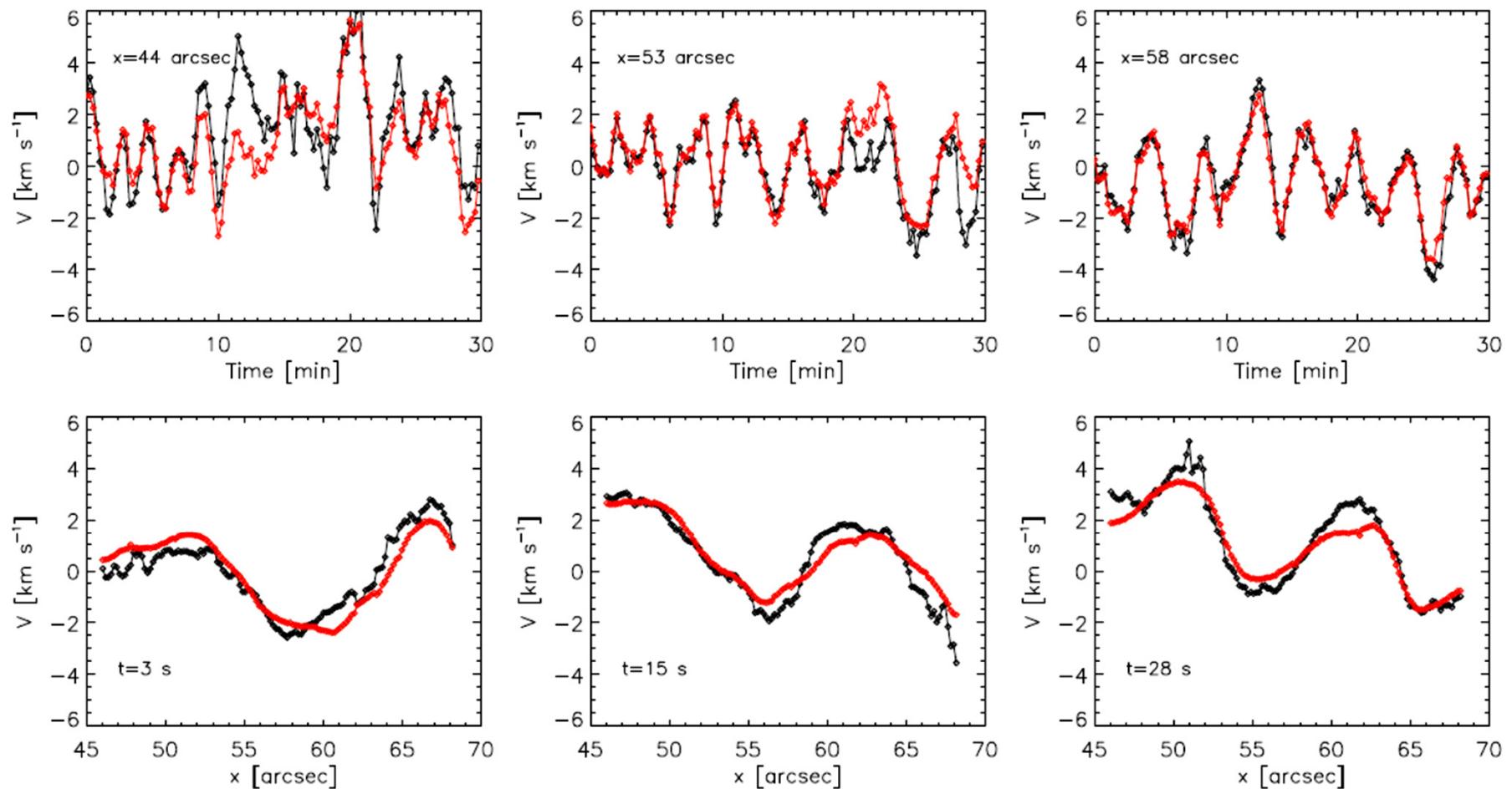
Ca II IR

Observations of PI effects in prominences

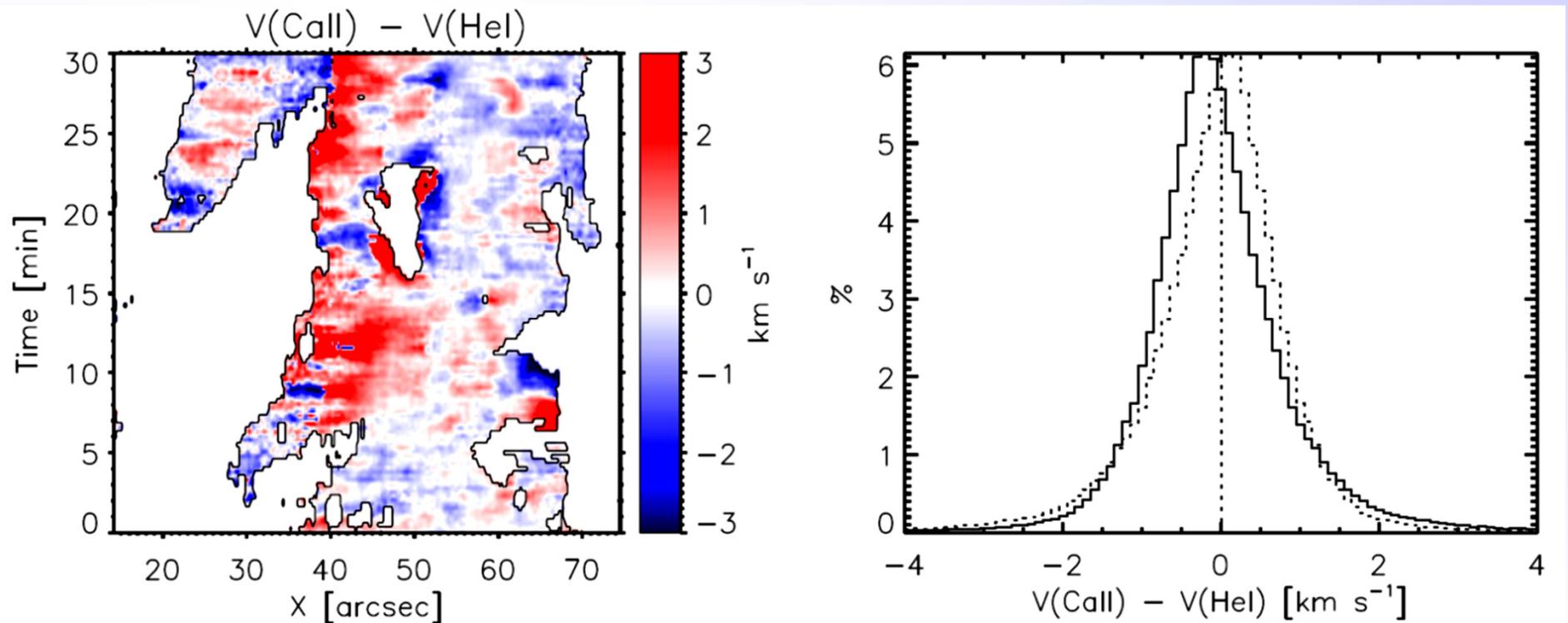


Velocity comparison Ca II - He I 10830

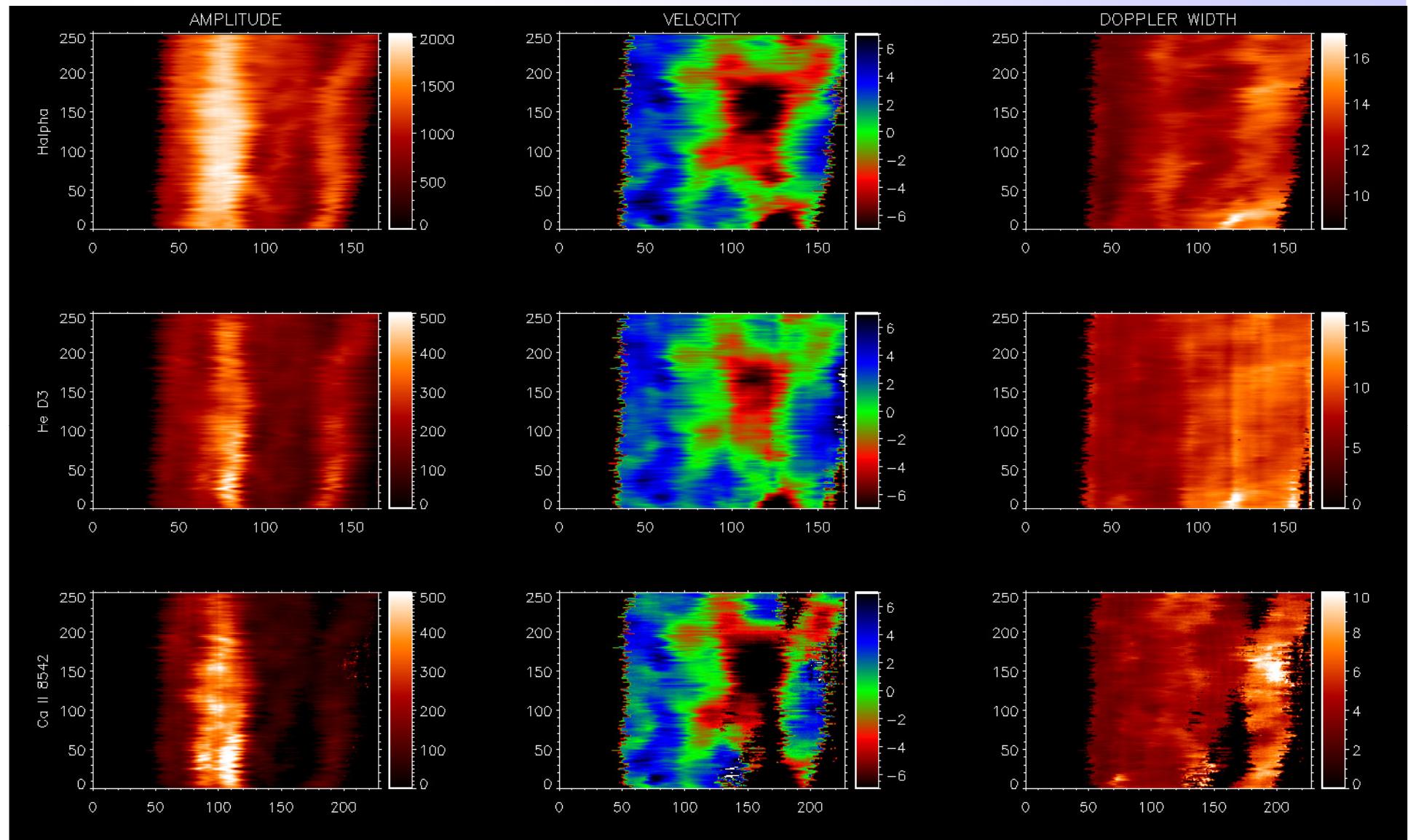
Black: Ca II ----- Red: He I 10830



Velocity comparison Ca II - He I 10830



Maps H α - He I D3 – Ca II 8542



Science case for EST:

Observational requirements

- ✓ High temporal cadence to detect quick changes in velocities
- ✓ High spatial resolution to detect small spatial-scale changes at PCTR
- ✓ Magnetic field vector in the prominence
- ✓ AO needed with capabilities to lock at the limb (or at the prominence)
- ✓ IFUs better suited to avoid scanning (differential refraction)
- ✓ Simultaneous spectral lines: H α , He I D3 and 10830, Ca II IR, ...