Spicules Jets

and small-scale activity in the higher atmosphere

Universidad de los Andes

Santiago Vargas Domínguez

3rd International workshop on small scale solar and stellar magnetic fields

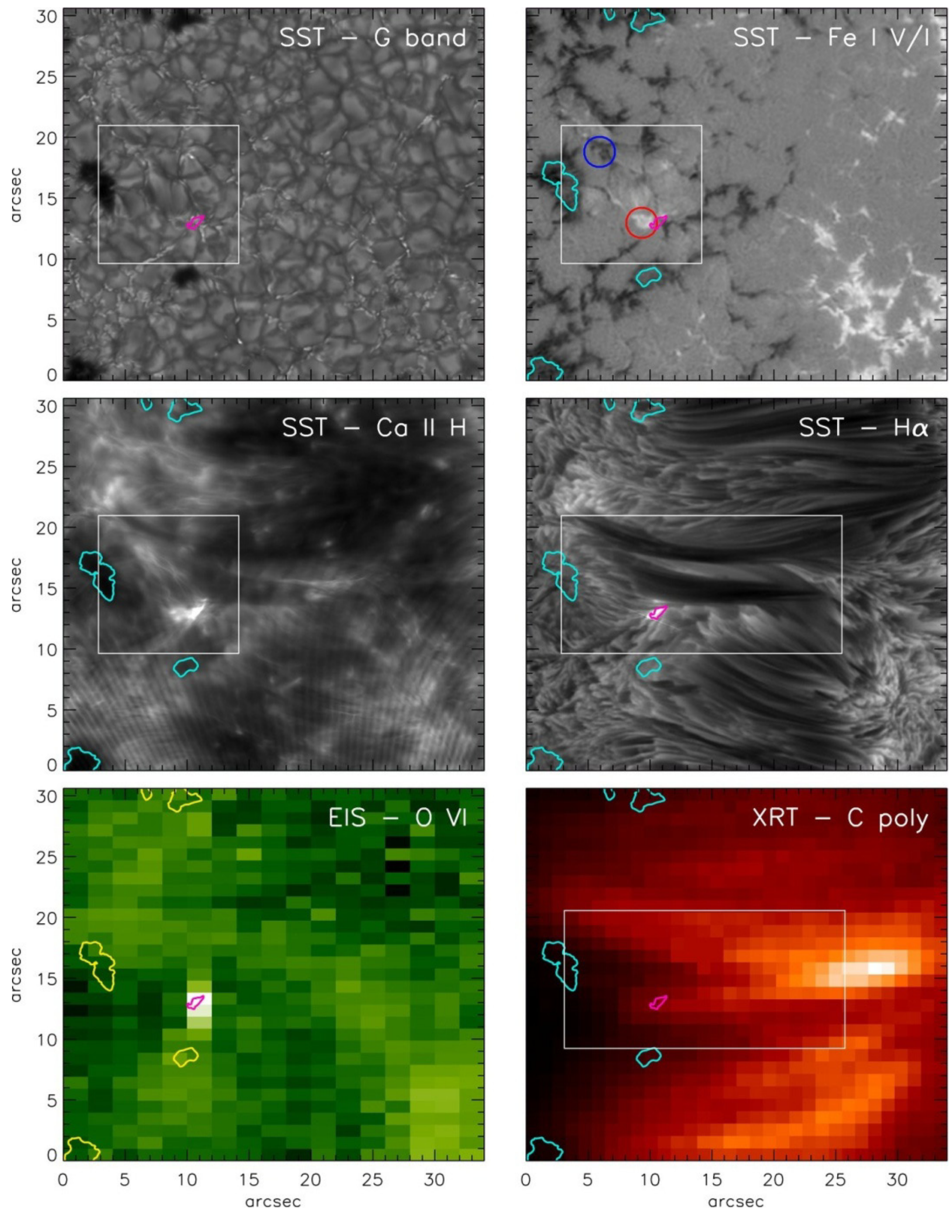
- Santiago Vargas Domínguez
- in the past a support astronomer on DOT: July - December 2008
- 30-min review: 70 slides (too much)

- ADS record: 14 refereed papers:
  - mostly photospheric
  - flux emergence and twisting
  - a co-author of one chromospheric paper (discussed on 6 slides)

Figure 3 from

Multiwavelength Observations of Small-scale Reconnection Events Triggered by Magnetic Flux Emergence in the Solar Atmosphere

S. L. Guglielmino et al. 2010 ApJ 724 1083



I was missing a concise summary of the most important problems and alternative explanations of the chromospheric fine structures

THE ASTROPHYSICAL JOURNAL LETTERS, 755:L11 (5pp), 2012 August 10 doi:10.1088/2041-8205/755/1/L11

EVIDENCE FOR SHEET-LIKE ELEMENTARY STRUCTURES IN THE SUN'S ATMOSPHERE?

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ABSTRACT

Narrow, thread-like structures in the Sun's chromosphere are currently understood to be plasma guided along narrow tubes of magnetic flux. We report on 1 s cadence imaging spectroscopic measurements of the Hα line with the IBIS Fabry–Pérot instrument at the Dunn Solar Telescope, obtained +0.11 nm from line center. Rapid changes grossly exceeding the Alfvén speed are commonly seen along the full extent of many chromospheric threads. We argue that only an optical superposition effect can reasonably explain the data, analogous to striations of curtains blowing in the wind. Other explanations appear to require significant contrivances to avoid contradicting various aspects of the data. We infer that the absorbing plasma exists in two-dimensional sheet-like structures within the three-dimensional magnetofluid, related perhaps to magnetic tangential discontinuities. This interpretation demands a re-evaluation of basic assumptions about low-β solar plasmas, as advocated by Parker, with broader implications in astrophysics and plasma physics. Diverse, high-cadence observations are needed to further define the relationship between magnetic field and thermal fine structure.

Key words: Sun: atmosphere – Sun: chromosphere – Sun: corona – Sun: surface magnetism

Online-only material: animations

Figure 1 from

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Philip G. Judge et al. 2012 ApJ 755 L11

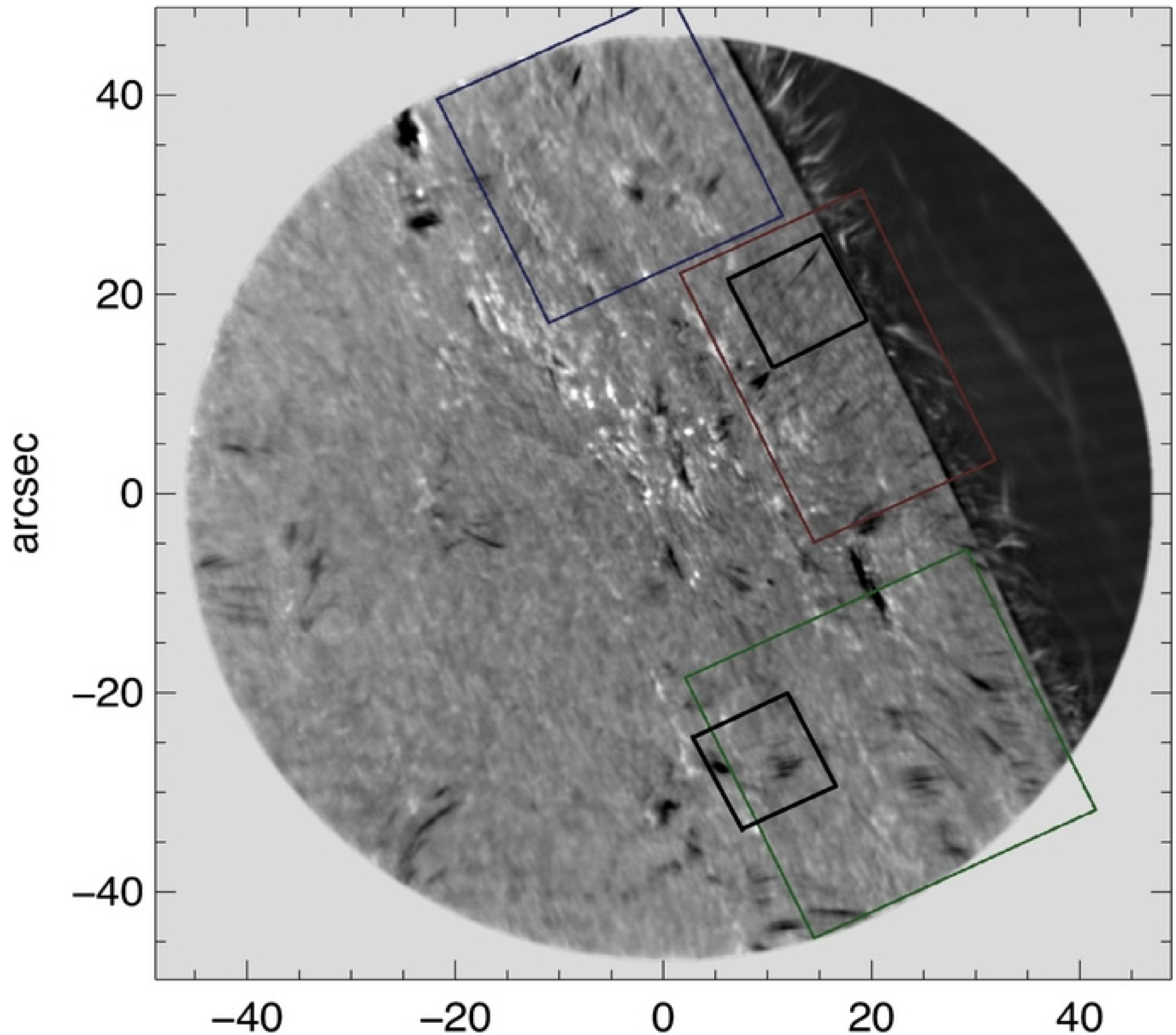

Figure 2 from

Evidence for Sheet-like Elementary Structures in the Sun's Atmosphere?

Philip G. Judge et al. 2012 ApJ 755 L11 doi:10.1088/2041-8205/755/1/L11

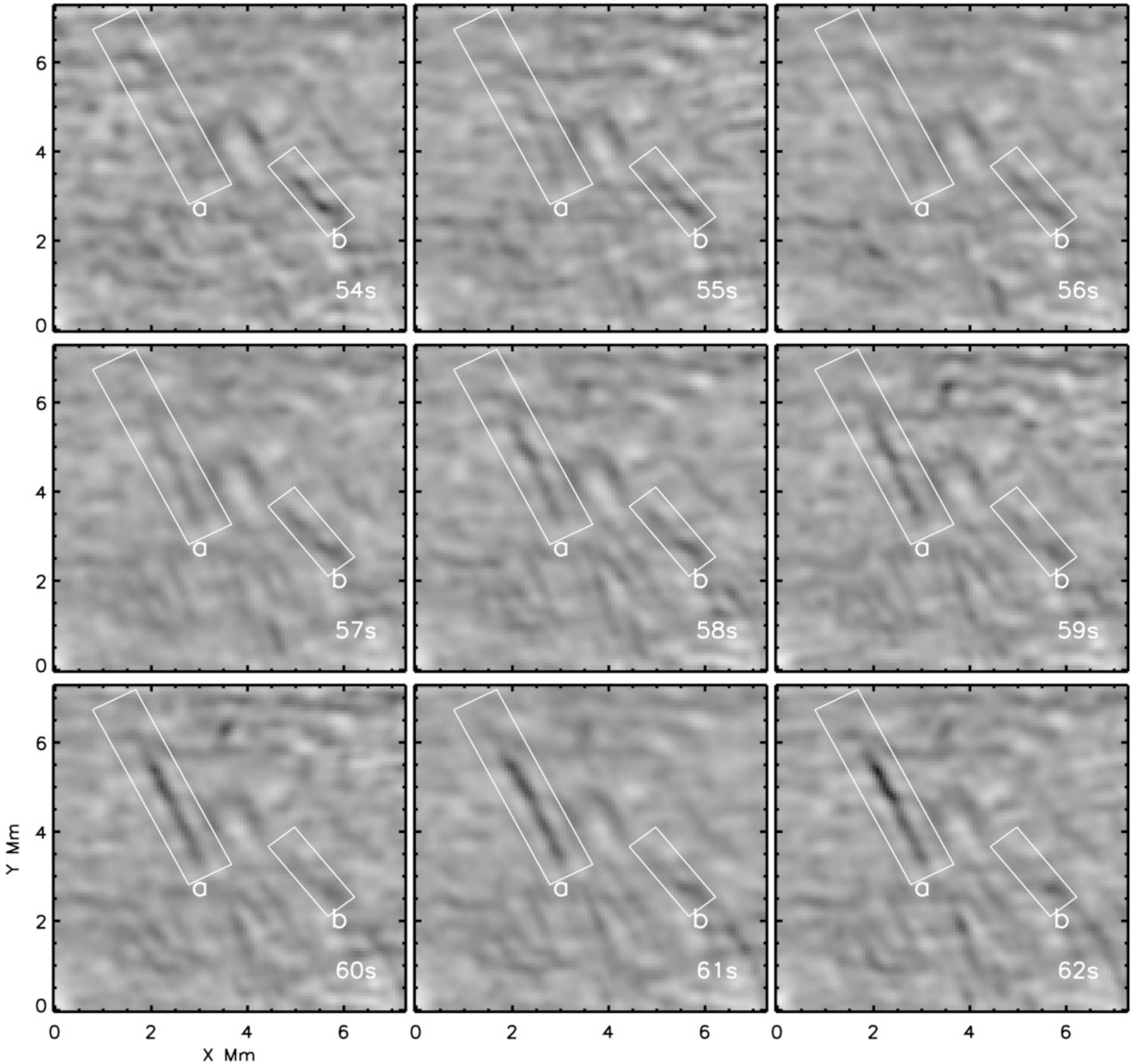

Figure 3 from

Evidence for Sheet-like Elementary Structures in the Sun's Atmosphere?

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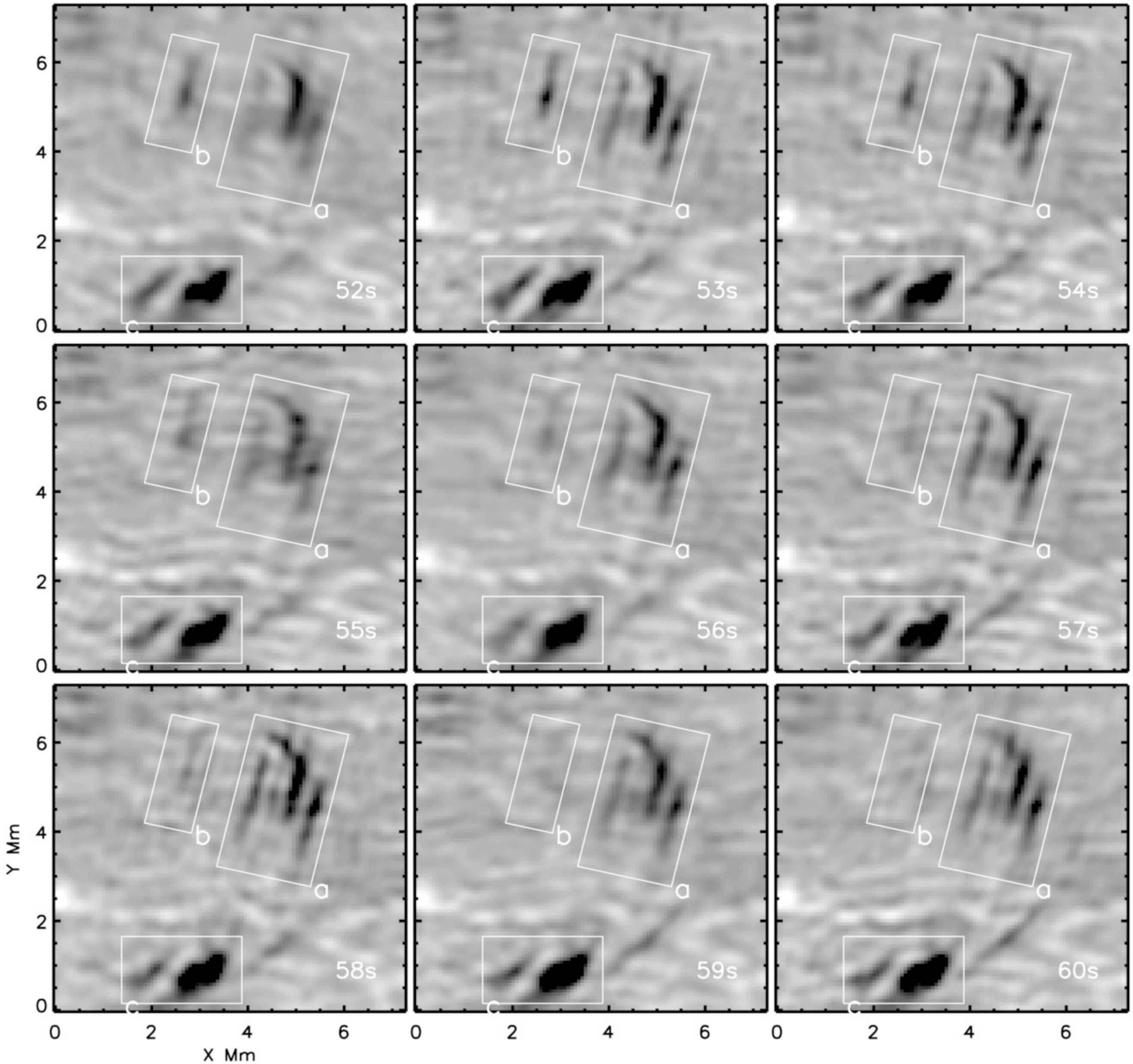

Waves and heating processes in the solar atmosphere

Yoshiaki Kato (NAOJ)

Collaborators

Oskar Steiner (KIS, Germany), Matthias Steffen (AIP, Germany),
Yoshianori Suematsu (NAOJ),
Mats Carlsson, Viggo Hansteen, Boris Gudiksen (ITA, Norway)

National Astronomical Observatory of Japan

- no observations
- the review discusses only the theory in “the equation-by-equation style” and outcomes of numerical simulations
- 7 out of 26 slides of the review present results of the paper:

EXCITATION OF SLOW MODES IN NETWORK MAGNETIC ELEMENTS THROUGH MAGNETIC PUMPING

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ABSTRACT

From radiation magnetohydrodynamic simulations of the solar atmosphere, we find a new mechanism for the excitation of longitudinal slow modes within magnetic flux concentrations. We find that the convective downdrafts in the immediate surroundings of magnetic elements are responsible for the excitation of slow modes. The coupling between the external downdraft and the plasma motion internal to the flux concentration is mediated by the inertial forces of the downdraft that act on the magnetic flux concentration. These forces, in conjunction with the downward movement, pump the internal atmosphere in the downward direction, which entails a fast downdraft in the photospheric and chromospheric layers of the magnetic element. Subsequent to the transient pumping phase, the atmosphere rebounds, causing a slow mode traveling along the magnetic flux concentration in the upward direction. It develops into a shock wave in chromospheric heights, possibly capable of producing some kind of dynamic fibril. We propose an observational detection of this process.

Klein-Gordon equation and its solution
(Rae & Roberts 1982)

$$\frac{\partial^2 Q}{\partial t^2} - c_0^2 \frac{\partial^2 Q}{\partial z^2} + \omega_{\rm a}^2 Q = 0$$

$$\text{where } \omega_{\rm a} \equiv \frac{c_0}{2H}, \; Q(z,t) = e^{-z/2H} v(z,t)$$

Plane-parallel wave solution

$$Q(z,t) \propto e^{i(\omega t - kz)}$$

$$\omega^2 = c_0^2 k^2 + \omega_{\rm a}^2$$

$$k^2 = \frac{\omega^2 - \omega_{\rm a}^2}{c_0^2}, \;\; \omega = \pm\omega(k) = \pm\left(\omega_{\rm a}^2 + k^2 c_0^2\right)^{1/2}$$

$\omega < \omega_{\rm a}$: evanescent $\quad \omega > \omega_{\rm a}$: wave propagation

$\omega_{\rm a} = 2\pi\nu_{\rm a}$: the cutoff frequency for vertically propagating acoustic gravity waves,
$\nu_{\rm a} \sim 5$ mHz around temperature minumum.

$$v_{\rm p} \equiv \frac{\omega}{k} > c_0 \qquad v_{\rm g} \equiv \frac{d\omega}{dk} < c_0$$

Gravity stratification filter out the low-frequency waves.
Magnetic field do much more effect!

- Alfvén waves, linear versus non-linear
- chromospheric soundspeed
- height of bases of dynamic fibrils
- magnetoacoustic shock waves versus slow modes