Magneto-acoustic waves in an asymmetric magnetic slab

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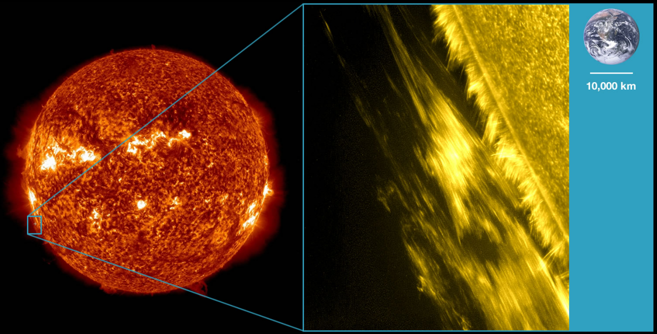
Research Centre

Motivation



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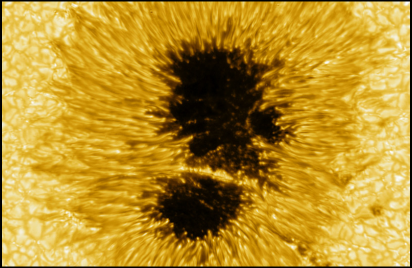
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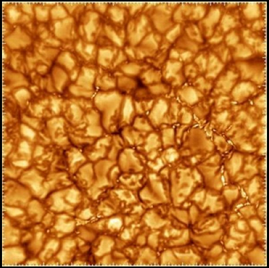
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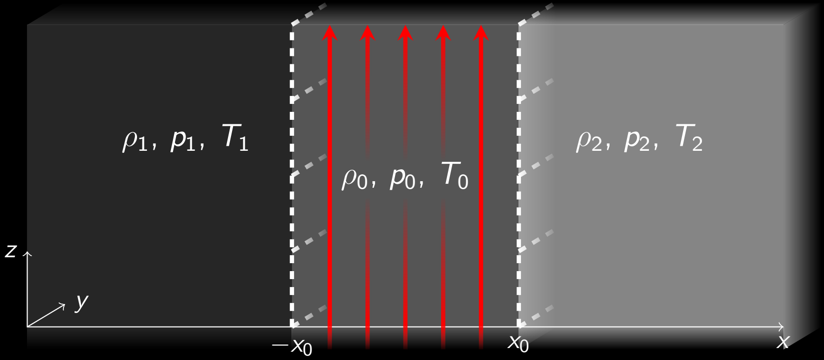
Equilibrium conditions - Asymmetric slab



- Uniform magnetic field in the slab.
- Field-free plasma outside.
- Different density and pressure on each side.

Asymmetric eigenmodes

Slow **quasi-kink** surface mode

Red tubes: magnetic fieldlines,
Direction field: velocity perturbation,

$v_A = 0.9c_0$
$c_2 = 1.2c_0$
$c_1 = c_2\sqrt{\rho_2/\rho_1} = 1.231c_0$

$\rho_2/\rho_0 = 2$
$\rho_1/\rho_0 = 1.9$

Asymmetric slab modes

Slow **quasi-sausage** surface mode

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Asymmetric slab modes

Fast **quasi-kink** body mode

Number of nodes: 1
Red tubes: magnetic fieldlines,
Red/blue contours: high/low density perturbation,
Direction field: velocity perturbation,

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Fast **quasi-kink** body mode

Number of nodes: 2
Red tubes: magnetic fieldlines,
Red/blue contours: high/low density perturbation,
Direction field: velocity perturbation,

$v_A = 0.9c_0$
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$c_1 = c_2\sqrt{\rho_2/\rho_1} = 1.231c_0$

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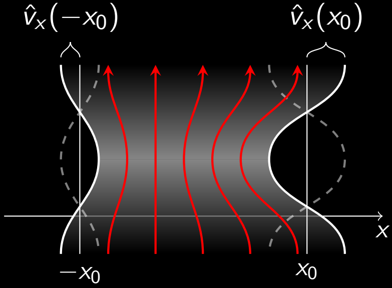
Amplitude ratio

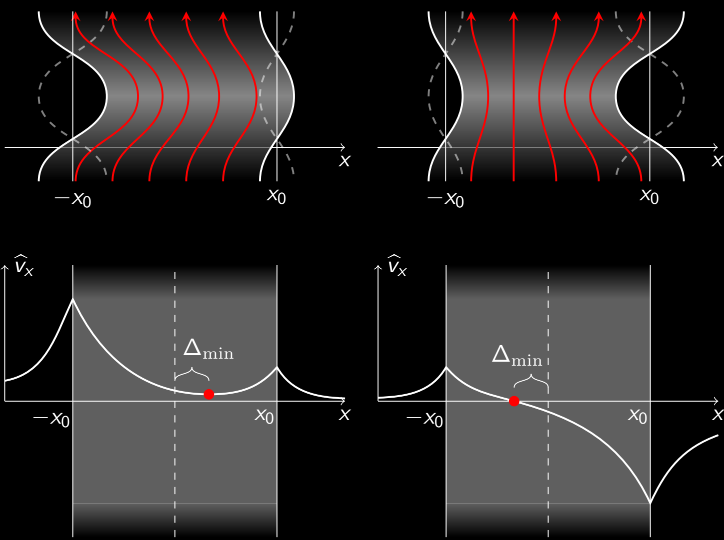


Amplitude ratio

$$R_A := \frac{\hat{v}_x(x_0)}{\hat{v}_x(-x_0)} \qquad \left(\begin{matrix}\text{Top} = \text{quasi-kink} \\ \text{Bottom} = \text{quasi-sausage}\end{matrix}\right)$$

$$= \left(\begin{matrix}+ \\ -\end{matrix}\right) \frac{\rho_1 m_2}{\rho_2 m_1} \frac{(k^2 {v_A}^2 - \omega^2) m_1 \frac{\rho_0}{\rho_1} - \omega^2 m_0 \left(\begin{matrix}\tanh \\ \coth\end{matrix}\right)(m_0 x_0)}{(k^2 {v_A}^2 - \omega^2) m_2 \frac{\rho_0}{\rho_2} - \omega^2 m_0 \left(\begin{matrix}\tanh \\ \coth\end{matrix}\right)(m_0 x_0)}$$

Minimum perturbation shift



Minimum perturbation shift

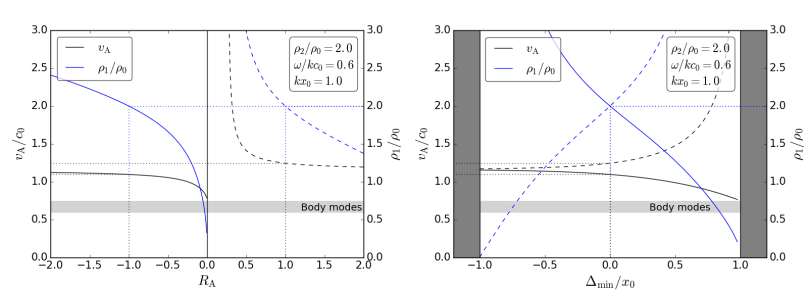
Quasi-sausage:	**Quasi-kink:**
$\Delta_{\min} = \frac{1}{m_0} \tanh^{-1}\left(\frac{1}{D}\right)$	$\Delta_{\min} = \frac{1}{m_0} \tanh^{-1}(D)$

where $$D = \frac{(k^2 {v_A}^2 - \omega^2) m_2 \frac{\rho_0}{\rho_2} \tanh(m_0 x_0) - \omega^2 m_0}{(k^2 {v_A}^2 - \omega^2) m_2 \frac{\rho_0}{\rho_2} - \omega^2 m_0 \tanh(m_0 x_0)}$$

Solar magneto-seismology

Parameter inversion

- **Observe**: ω, k, x_0, T_i, and R_{A} or $\Delta_{\min}$.
- **Solve** to find: v_A and hence B_0.



"a day without the Sun is, you know, night"

matthew_allcock

The University Of Sheffield.

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