Standing Alfvén Waves at the Magnetopause

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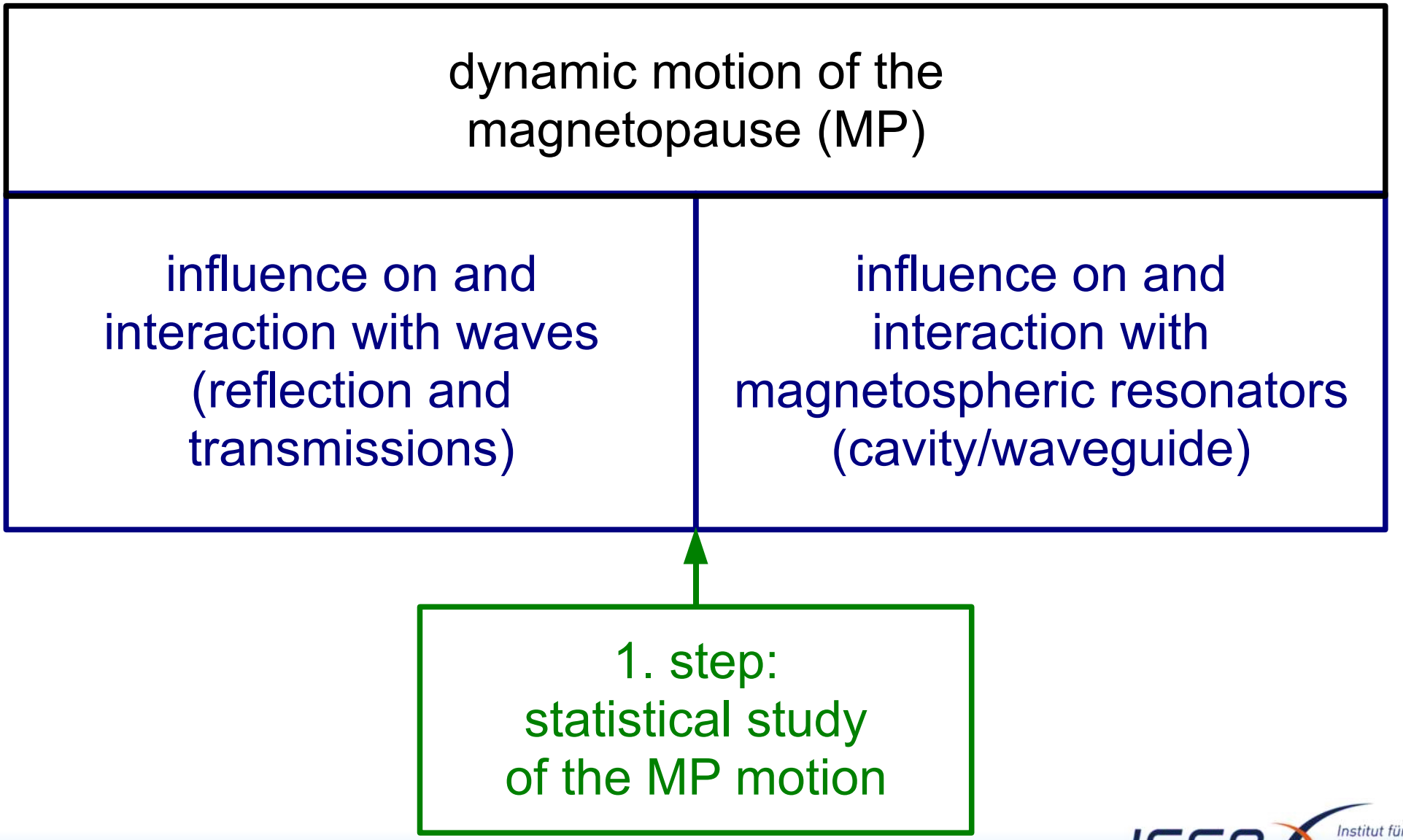
Motivation



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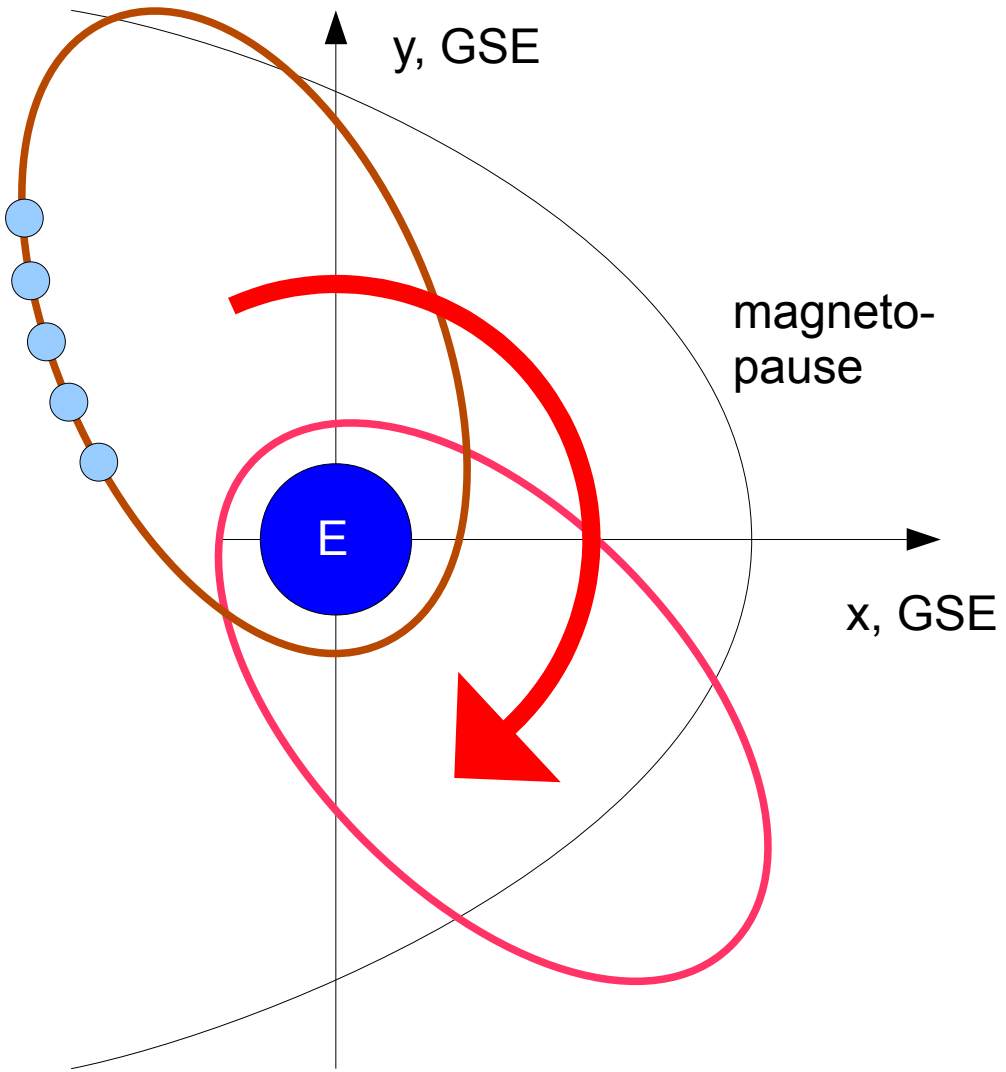
THEMIS Coast Phase Configuration

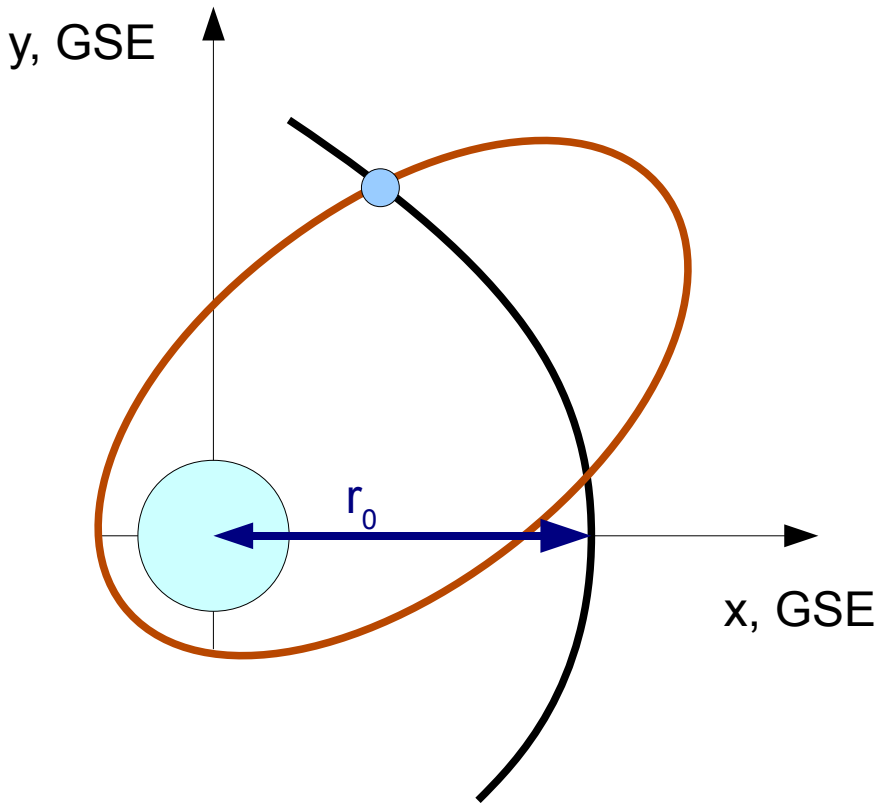
- THEMIS coast phase
  - string of pearls configuration
  - Febr. to Sept. 2007
  - several thousand MP crossings detected
  - characteristic probe distance equals MP flapping distance
  - configuration ideal for study of MP motion



Statistical Study of MP Motion

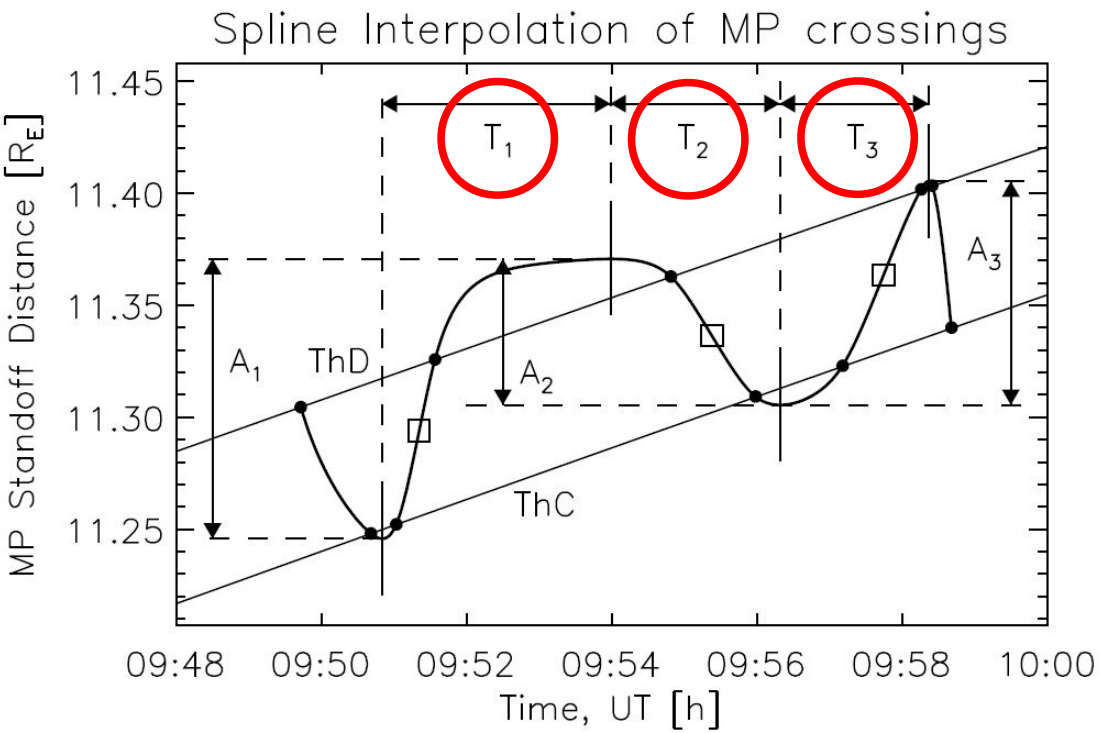
- estimation of MP motion:
  - spline interpolation between crossing positions and times
- MP model from Shue et al. (1997)
  - equivalent MP standoff distance

$$r_0 = r \left(\frac{2}{1 + \cos \vartheta} \right)^{-\alpha}$$



Shue (1997) model approx. magnetopause

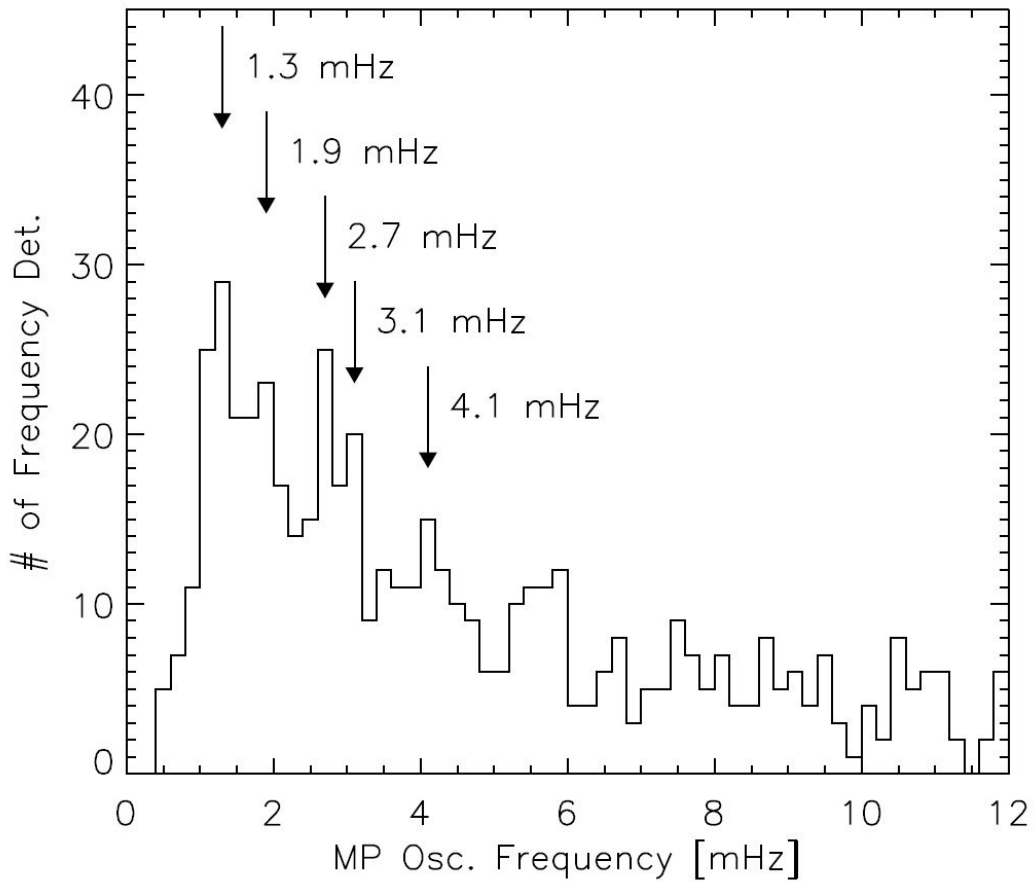
Spline Interpolation of Model Standoff Distance



one group of crossings

- Spline Interpolation
  - standoff distance r_0
  - filling of temporal gaps
  - full spatio-temporal analysis of MP motion.
- Output:
  - amplitudes
  - velocities
  - frequencies, (half periods: T)

Frequency Distribution

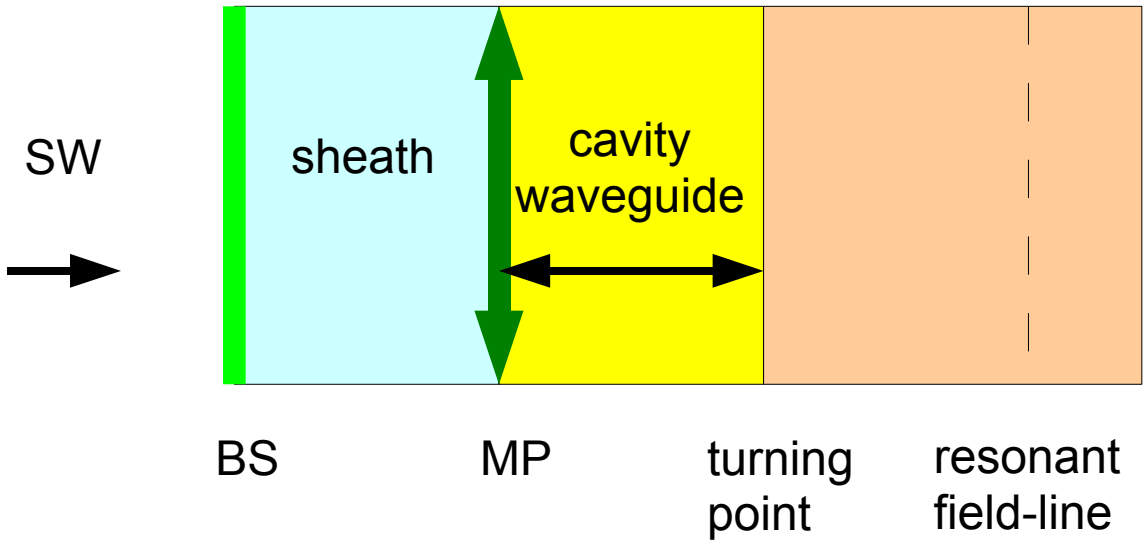


- frequency:

$$f = \frac{1}{2T}$$

- distribution:
  - maximizes at stable and recurrent “magic” FLR frequencies (Samson et al., 1992)
  - 1.3, 1.9, 2.65, 3.3 and 4.2 mHz

Stable Frequencies: Explanations



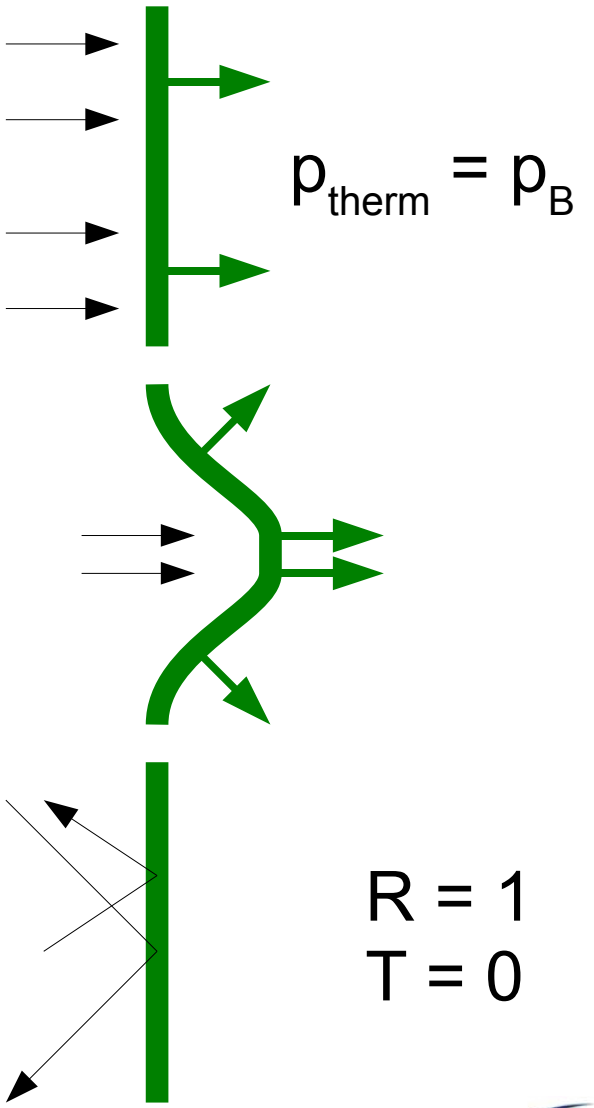
- Proposed drivers:
  - cavity or waveguide modes
  - solar wind directly drives pulsations
  - magnetopause
    - surface: membrane under tension
    - capable of supporting eigenmodes

MP Motion Characterization

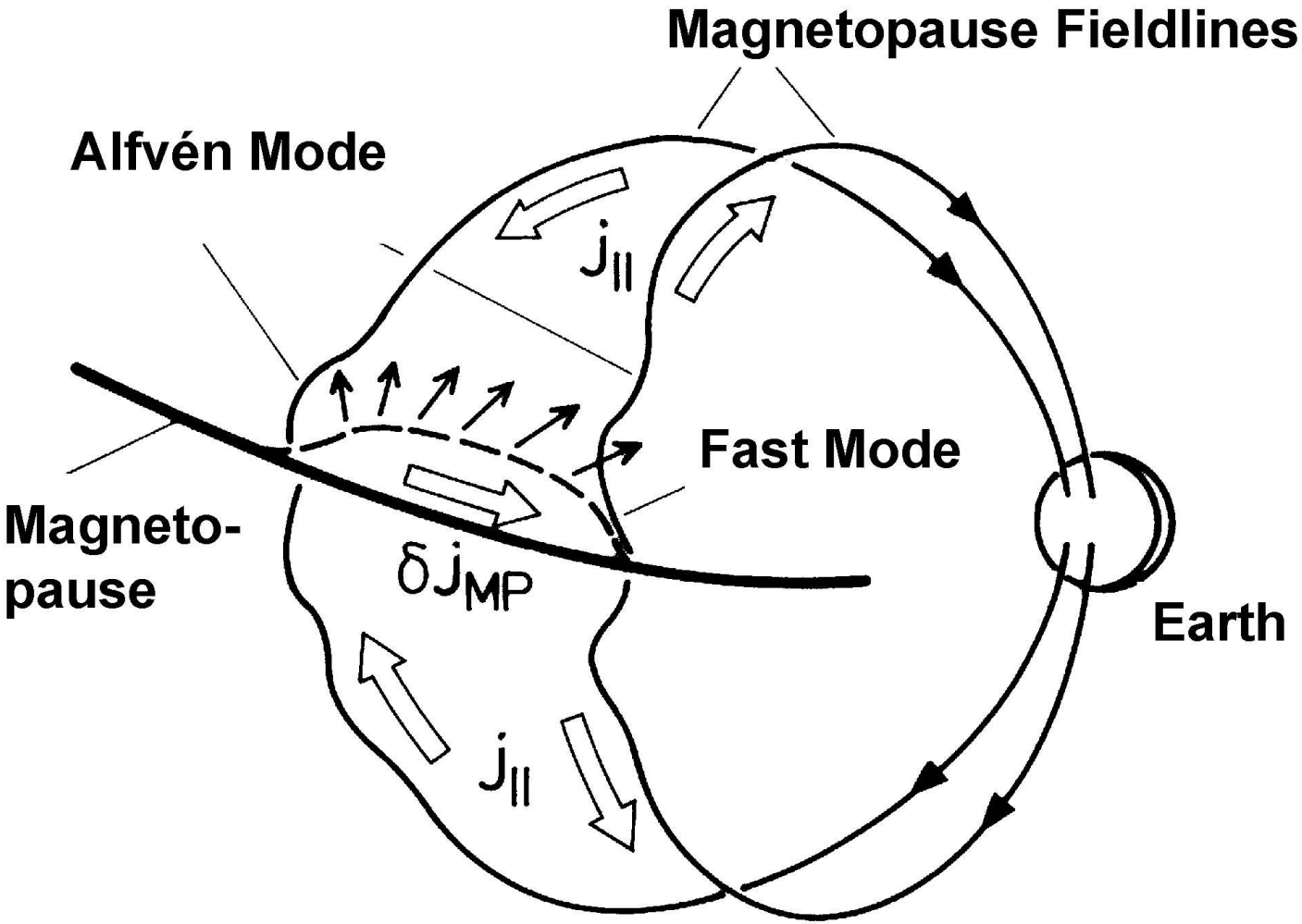
global low frequency driver
quasi-static motion

local low frequency driver
surface wave generation
interaction driving wave and MP

local high frequency driver
no motion



Mode Coupling at the MP



after Glassmeier, JGR, 97, A4, 1992

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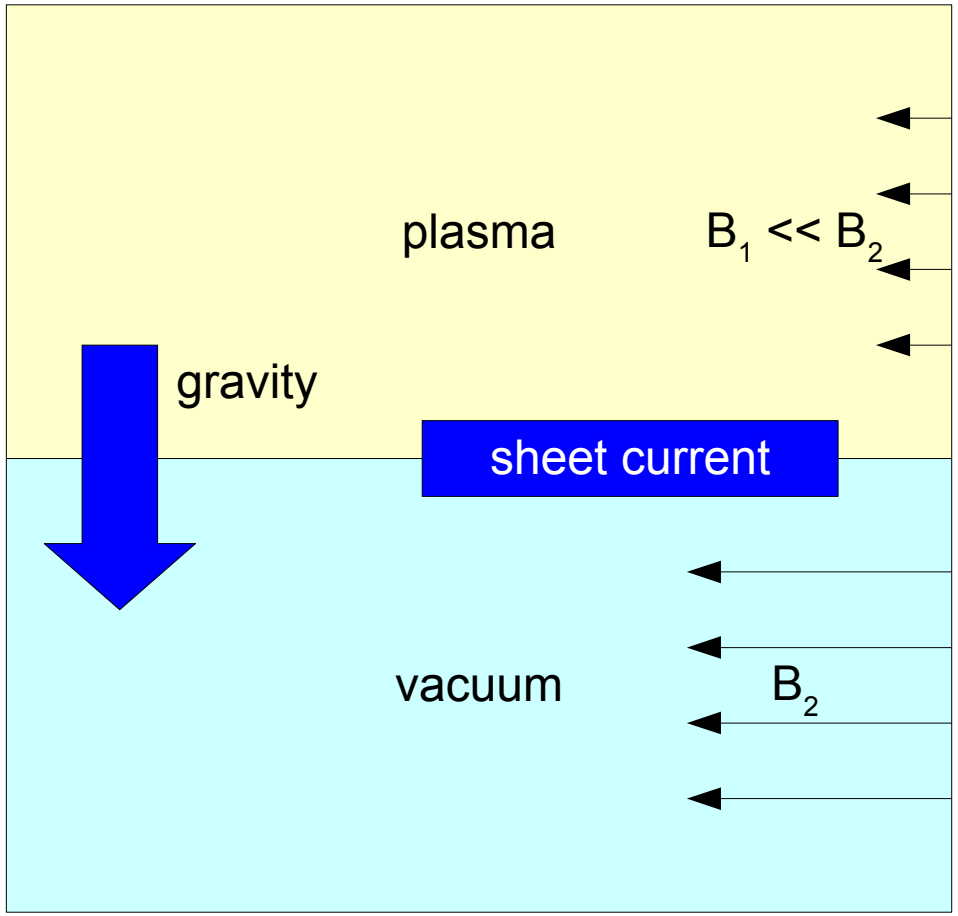
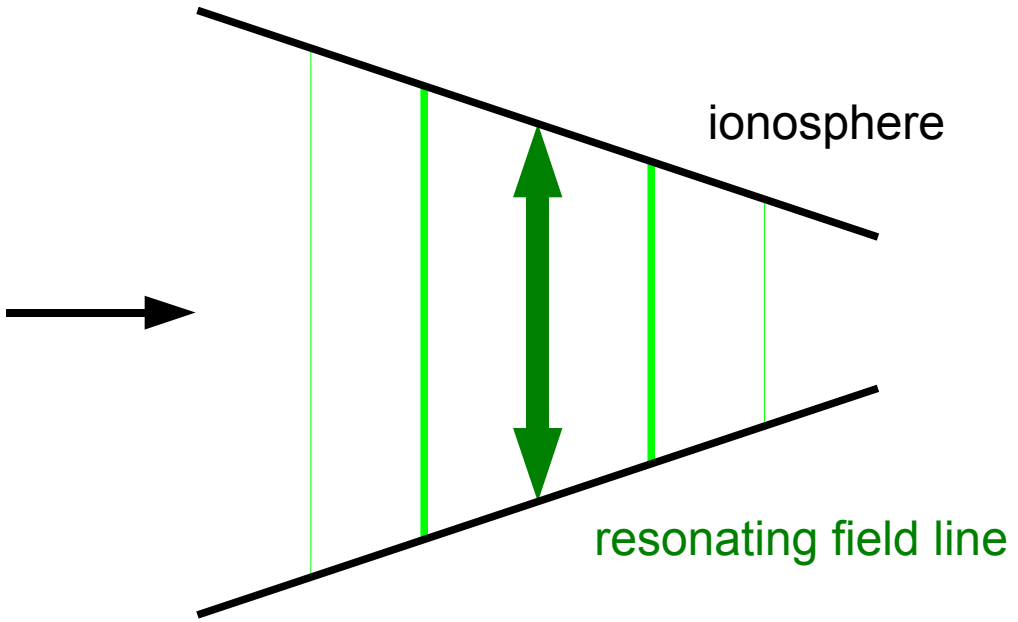
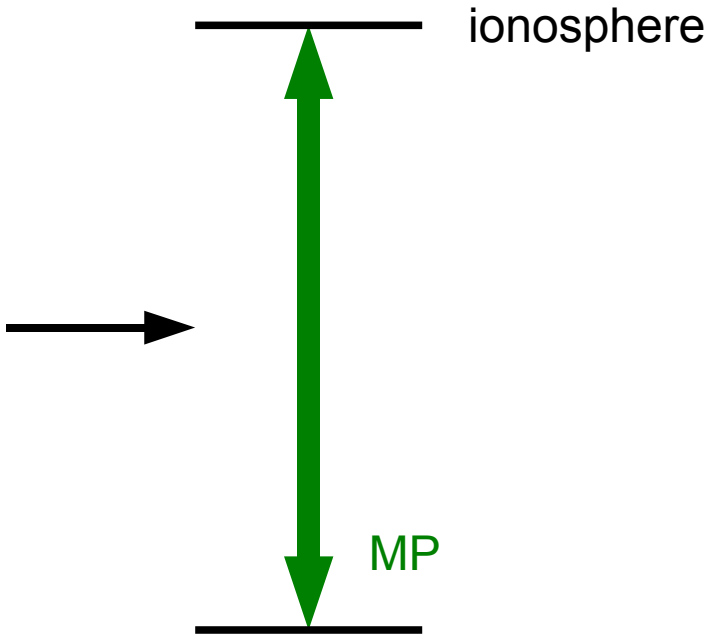
Alfvén Wave Propagation at the MP

- Kruskal-Schwarzschild (1953)
  - plasma
    - gravitational force: pressure on boundary
    - steep magnetic field gradient
  - surface wave solution
    - restoring force: magnetic tension



Surface Wave and FLRs





- Field Line Resonance
  - coupling maximizes where $v_A = v_{ph,||}$
  - resonance location depends on field line length
- MP surface wave
  - coupling at steep gradient
  - field line length defines set of frequencies
  - fundamental freq: 0.65 mHz

Thank you for your attention!

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