Week 37

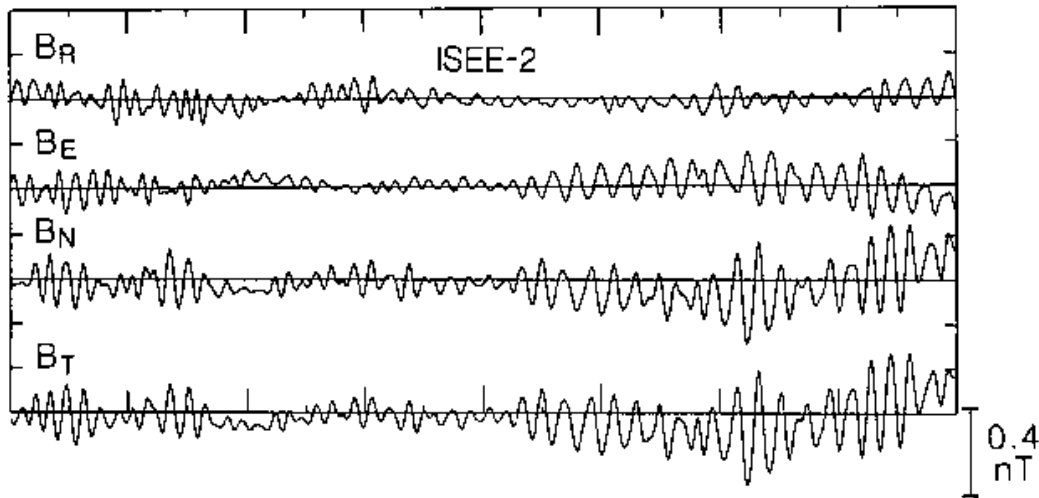**Lecture 7:**

- MHD : 14 equations/14 unknowns
- R_m: Reynold magnetic number
- Ideal MHD : Frozen in flux
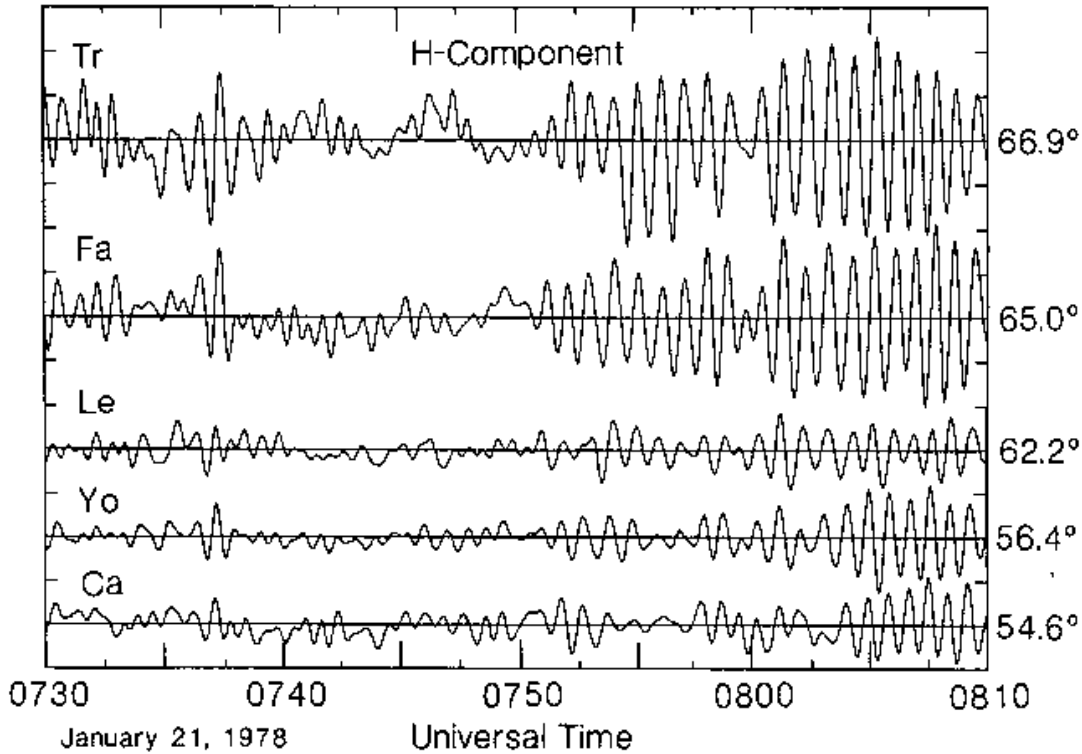
Lecture 8:

MHD – waves:
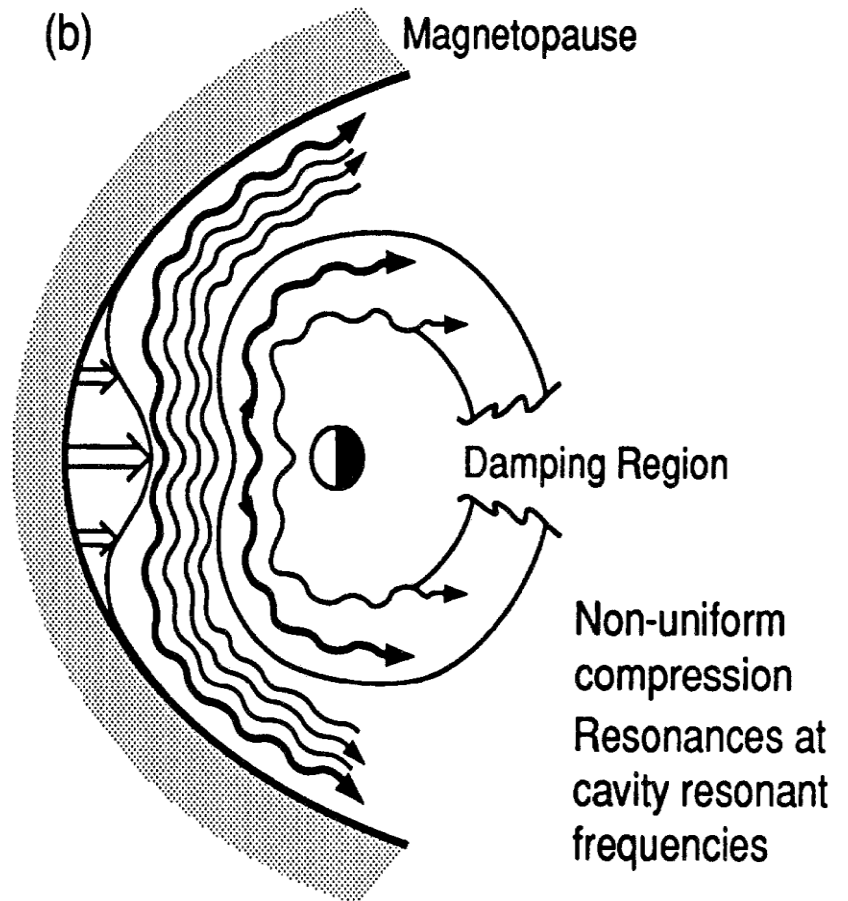
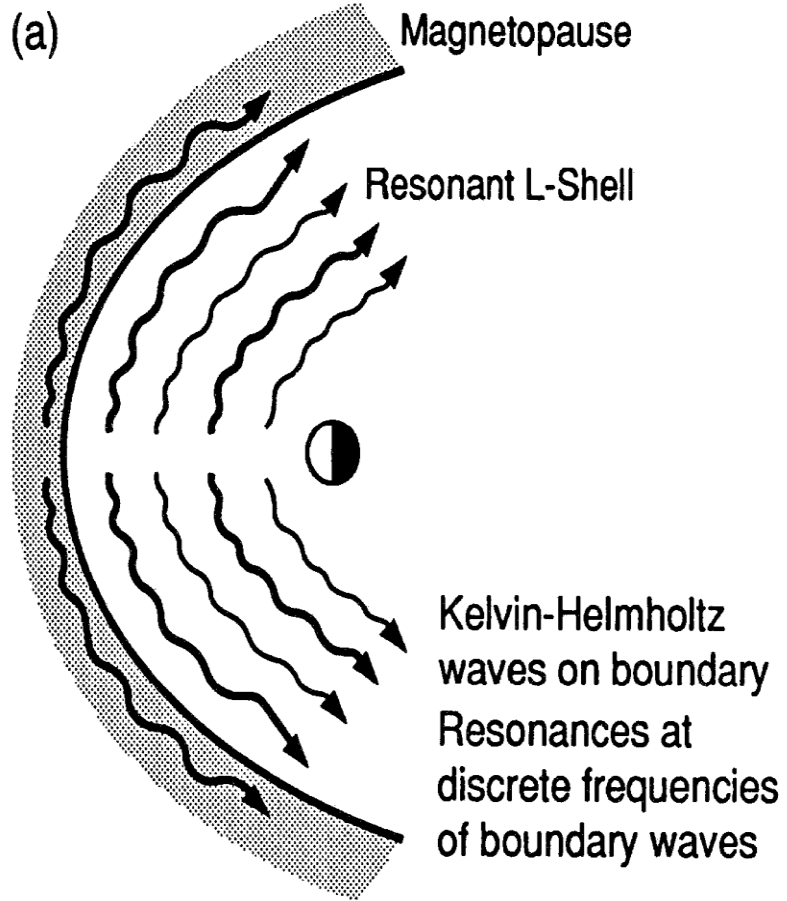- Dispersion relation
- Plasma accoustic
- Alfvén
- Magnetosonic

ISEE-2

B_R

B_E

B_N

B_T

0.4 nT

Waves in solar wind

Tr

H-Component

66.9°

Fa

65.0°

Le

62.2°

Yo

56.4°

Ca

54.6°

Corresponding waves in the Earth's magnetic field

0730   0740   0750   0800   0810

January 21, 1978   Universal Time

(a) Magnetopause

Resonant L-Shell

Kelvin-Helmholtz
waves on boundary
Resonances at
discrete frequencies
of boundary waves

(b) Magnetopause

Damping Region

Non-uniform
compression
Resonances at
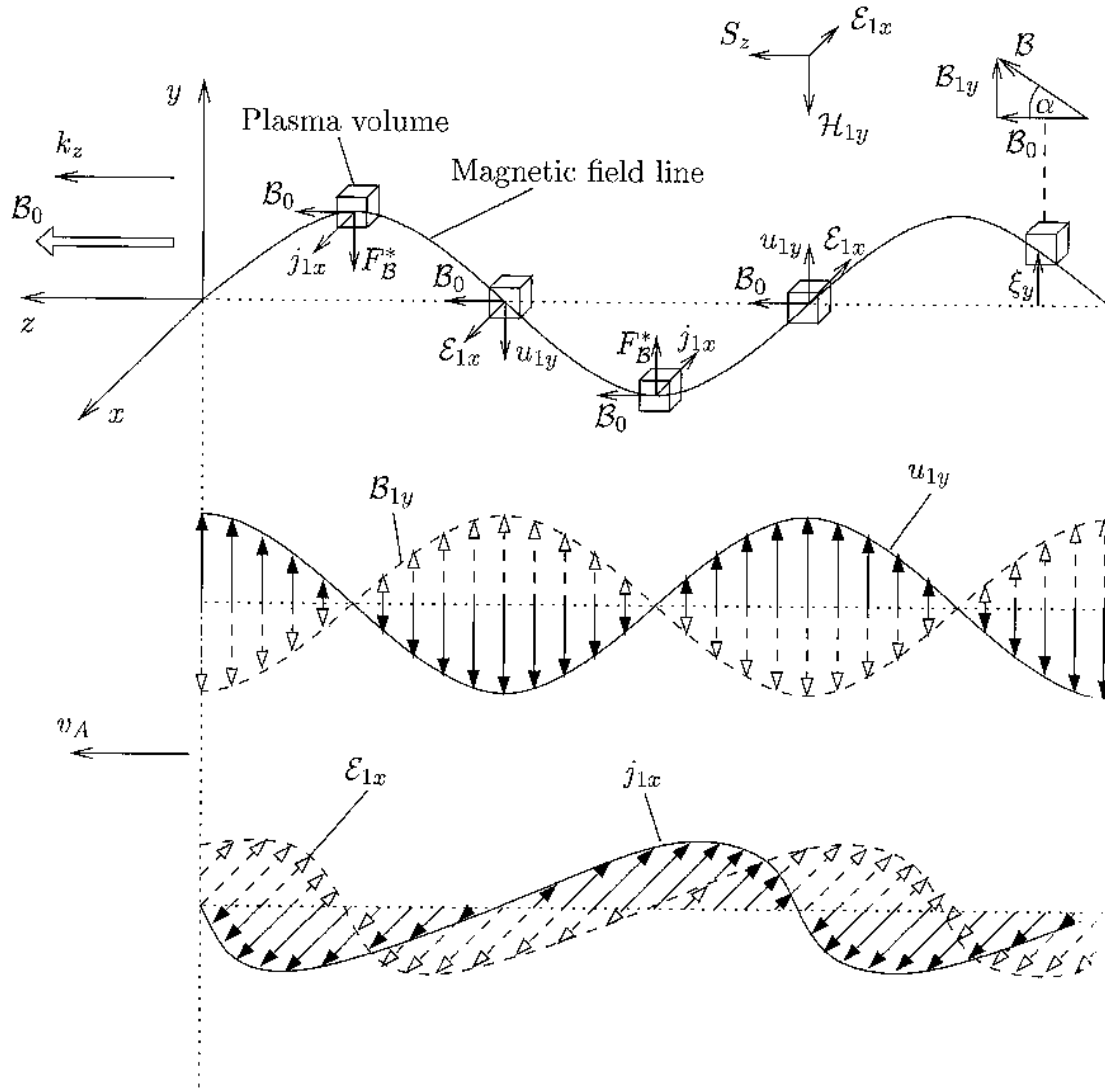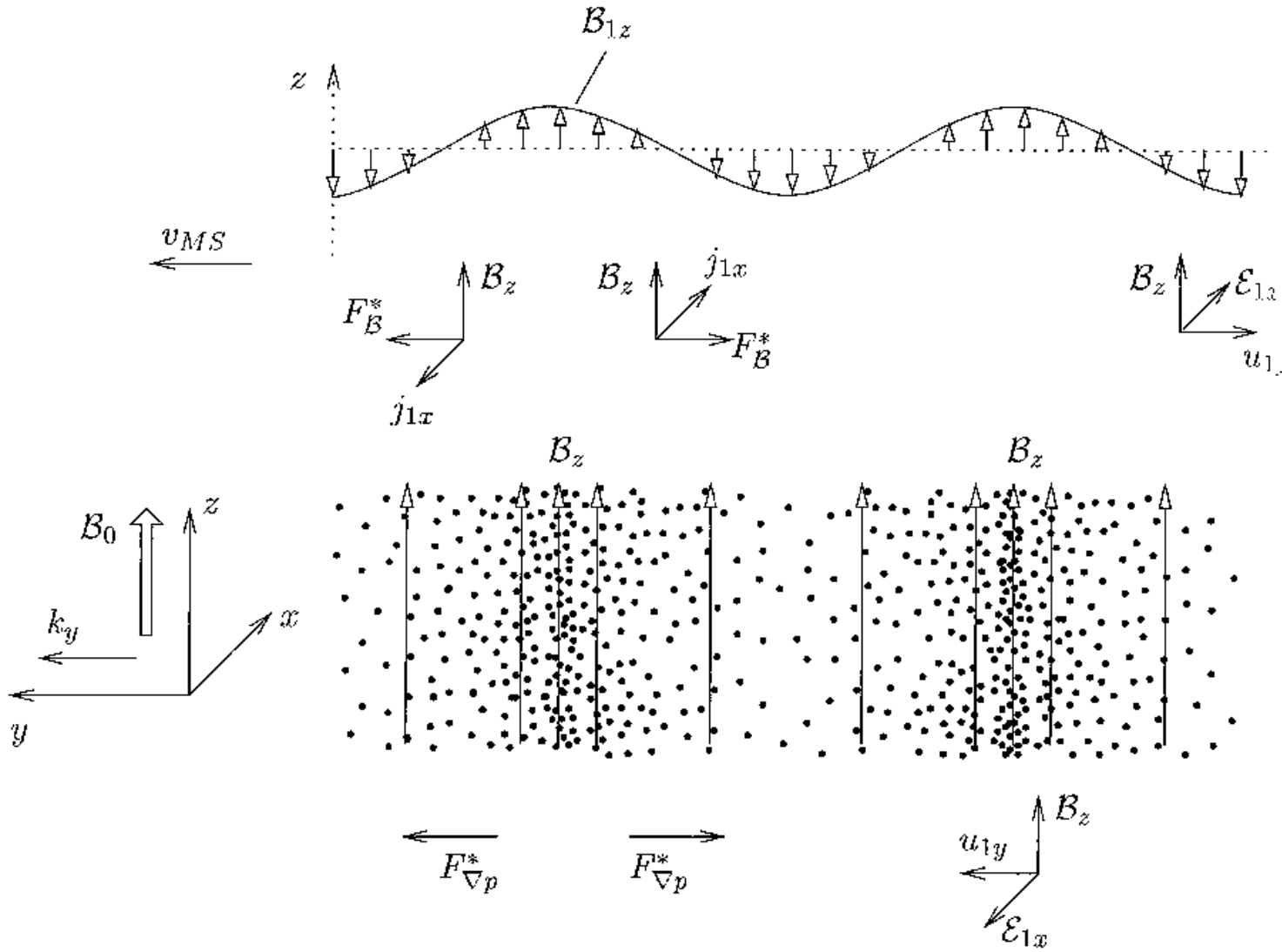cavity resonant
frequencies

*(Note that this model explains
peak amplitudes near noon)*

Plasma Acoustic Waves
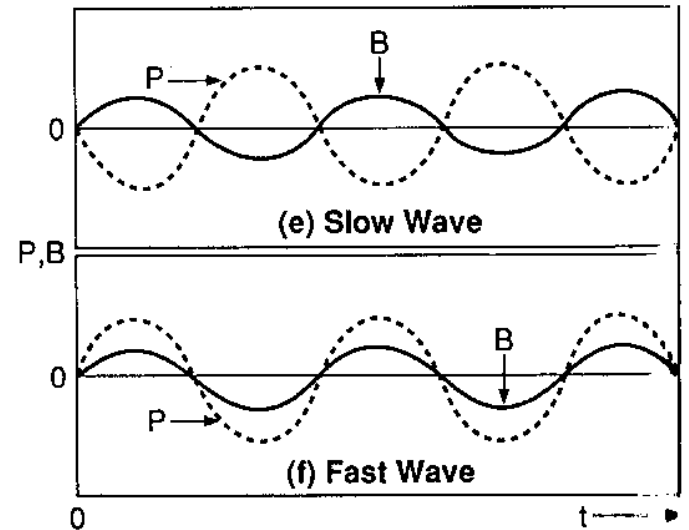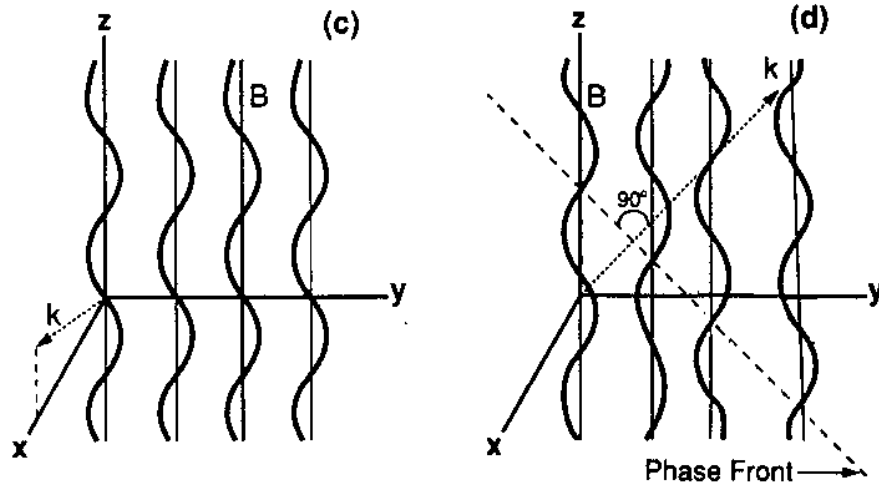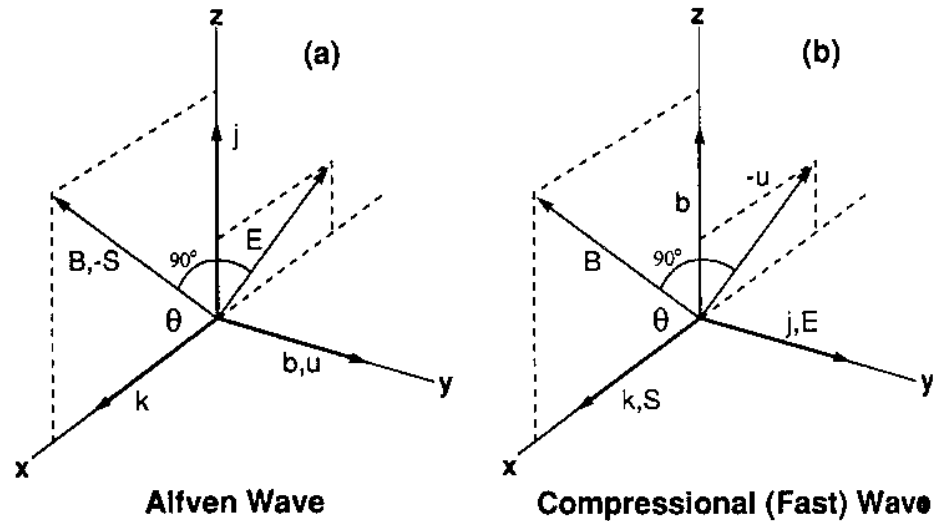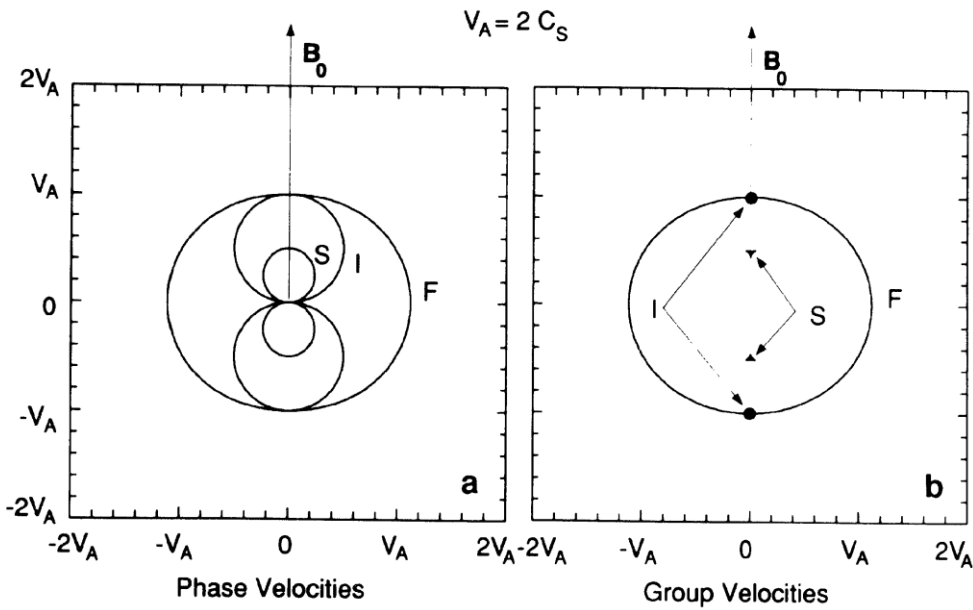
Alfvén waves

Magnetosonic waves

FIG.11.2. Schematic of wave polarizations for (a) the Alfvén wave and (b) the fast compressional wave. Displacements of the field lines (thick curves) at maximum displacement for (c) the Alfvén wave and (d) the fast compressional wave. The thin lines represent the unperturbed field. Plasma-pressure and magnetic-pressure perturbations versus time for (e) the slow compressional wave and (f) the fast compressional wave.
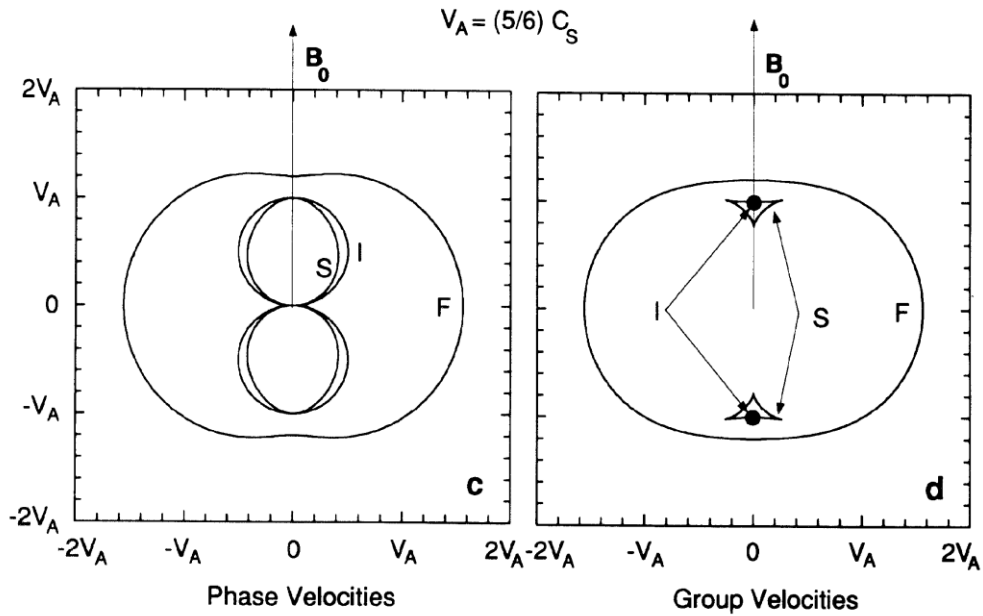
(a)

Alfven Wave

(b)

Compressional (Fast) Wave

(c)

(d)

Phase Front

(e) Slow Wave

(f) Fast Wave

$V_A = 2\, C_S$

a Phase Velocities

b Group Velocities

$V_A = (5/6)\, C_S$

c Phase Velocities

d Group Velocities

I = Alfven wave

F(ast) and S(low) magnetosonic

V_A = Alfven velocity
C_S = Speed of sound

Energy propagation