15.1 What fraction of the energy is in Rayleigh waves in a solid chunk of aluminum of volume 1000 cm$^3$ and surface area 800 cm$^2$ at frequency $f = 500$ kHz? at 1 MHz?

15.2 What is the Heisenberg time in a solid chunk of aluminum of volume 1000 cm$^3$ at frequency $f = 500$ kHz? at 1 MHz?

15.3 I will soon send you an email with a data file (in text) representing voltage versus time from an ultrasonic measurement following a wide band transient excitation. It has 100,000 data points, separated by $\delta t = 0.2 \mu$ sec… for a total record of 20 msec. Plot the log$_e$ of the "energy" in this signal versus time, for each of eight frequency bands with central frequencies from 250 to 950 kHz. Choose $\Delta t = 0.8192$ msec (so that the number of points in each time window is 4096 – it is convenient to have it be power of 2) There will be 24 different time windows. Choose $\Delta f = 100$ kHz.

Is the decay exponential $E \sim \exp(-\sigma t)$? Does the rate $\sigma$ of decay vary with frequency? Does the energy fluctuate randomly to the expected degree?

15.4 Retrieval in 1-d

Consider a string with random waves moving leftwards and rightwards

\[ \psi(x,t) = R(x-ct) + P(x+ct) \]

where $R$ and $P$ are delta-correlated white noise random processes, uncorrelated with each other….maybe due to noise sources at plus and minus infinity.

\[ <R(a)R(b)> = r \delta(a-b); \quad <P(a)P(b)> = p \delta(a-b); \quad <R(a)P(b)> = 0 \]

Notice I allow as how the left going and right-going noise may have different intensities $r$ and $p$.

Construct the cross correlation

\[ C = <\psi(x,t) \psi(y,t+\tau)> \]

and see to what extent it is (within a time derivative etc) the Green's function for the string (p 43)

\[ G_{\text{string}} = (1/2) H(|x-y|-c\tau) H(\tau) \]