Instabilities Homework.

- Robinson damping (or anti-damping) is a longitudinal collective effect driven by the fundamental mode of the accelerating cavity in a storage ring.
  - Qualitatively describe the effect in the frequency domain for the mode tuned above and below the RF frequency above transition.
  - Describe the effect in the time domain.
  - What happens below transition?

Instabilities Homework #2

- The Boussard criterion gives the threshold for a single bunch microwave instability
- Calculate the threshold bunch current for the ALS for Z/n=0.1 Ohm.
- Above the instability threshold, assume the peak current stays just at threshold, derive a relative for the bunch length vs. bunch current.

ALS Parameters

- F_{rf}=499.654 MHz
- h=328
- E=1.9 GeV
- V_{rf}=1.2 MV
- U_0=150 kV
- Alpha=1.6e-3
- σ_p/p=1e-3

$$\frac{eI_p|Z(n)/n|}{2\pi\alpha E_o\sigma_E^2}=1$$

Extra Credit Instabilities Research

- Ion instabilities affect negatively charged beams (i.e. electrons). Positive ions are trapped and oscillate in the potential well of the beam.
  - What is the ion oscillation frequency for ALS parameters at a given current for CO (carbon monoxide)?
- Note that you will need to look up some papers to get this information. Use references:
  - T. Raubenheimer and F. Zimmermann, Phys. Rev. E, 52 5487 (1995)
  - G. Stupakov, T. Raubenheimer and F. Zimmermann, Phys. Rev. E, 52, 5499 (1995)
  - J. Byrd et al., PRL, **79** (1997) 79)