Acoustics of Earth Materials

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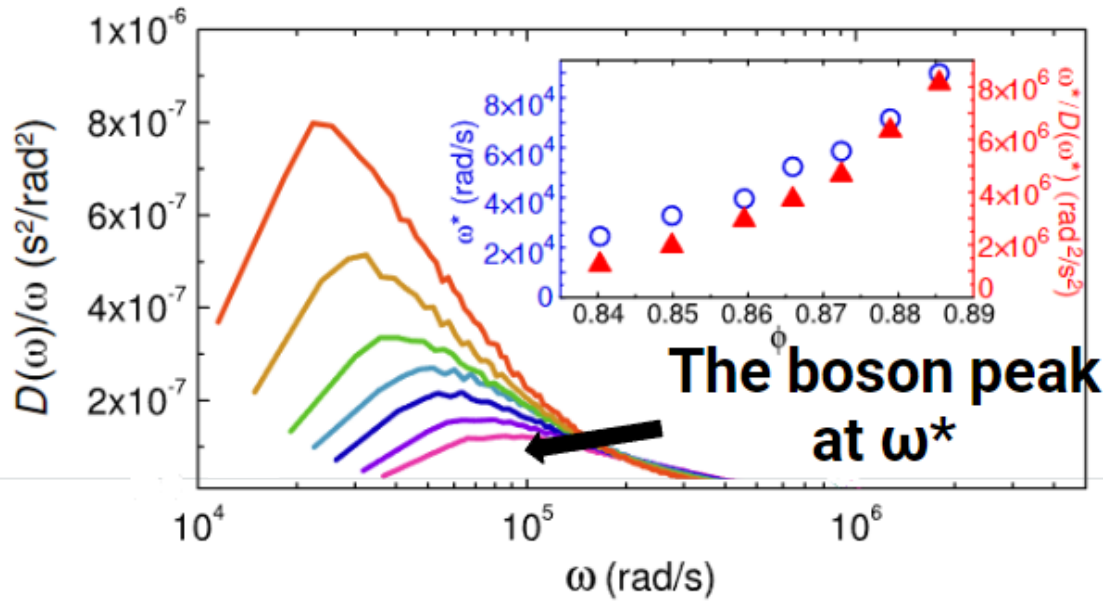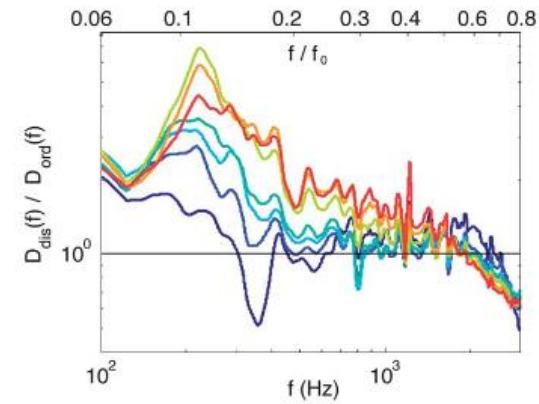nanderman@haverford.edu
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The Boson Peak and Jamming

Low Frequency Vibrations of Soft-Colloidal Glasses- Chen et al, Physical Review Letters 105, 025501 (2010)

As a jammed system approaches unjamming, the boson peak shifts to the left. The boson peak can inform us about when a material is about to unjam.

Measuring the Density of Modes in Granular Materials

$$C_v(\tau) = \frac{\sum_i \langle v_i(\tau + t) \cdot v_i(\tau) \rangle_\tau}{\sum_i \langle v_i(\tau) \cdot v_i(\tau) \rangle_\tau}$$

$$D(\omega) = \int_0^\infty C_v(\tau) \cdot \cos(2\pi\omega t)\, d\tau$$

E. T. Owens and K. E. Daniels, Soft Matter 9, 1214 (2013)

Can this forecast unjamming in earth materials?
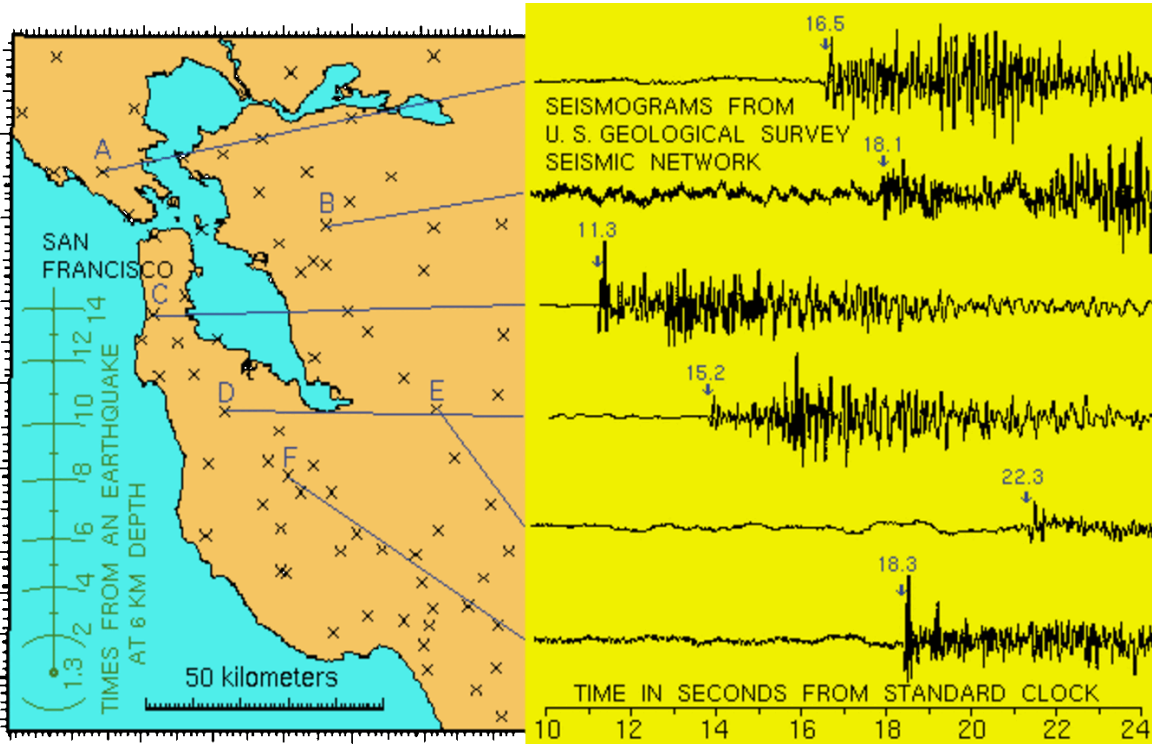
J. M. Dickey and A. Paskin, Physical Review 188, 1407 (1969)

Collaborators

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Collecting grains

Locating Earthquakes in San Francisco - USGS (1997)

Collect samples

- Taking small samples in order to calibrate field measurements of the DoM.

- Using existing geological monitoring infrastructure to measure the DoM in situ.

Calibration System

Piezoelectric ceramics coupled with grains

A sample of soil from a fault

Acoustic Driving + Compression

Using piezoelectric ceramics to measure the acceleration (and DoM) of excited particles.