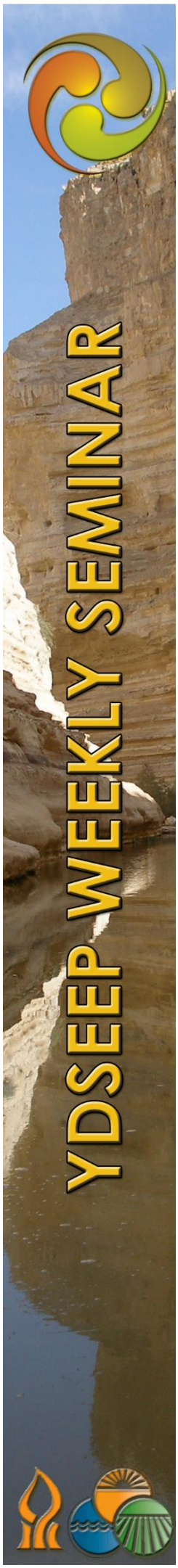

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A steady-state physics-based rock-friction constitutive law: predicting friction dependence on temperature, stress and slip rate

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Abstract

Experiments measuring friction at a variety of sliding velocities find that the value of the friction coefficient varies widely: friction is high and behaves according to the rate and state constitutive law during slow sliding, yet markedly weakens as the sliding velocity approaches seismic slip speeds.

We introduce a physics-based theory to explain this behavior. Using conventional microphysics of creep, we calculate the velocity and temperature dependence of contact stresses during sliding, including the thermal effects of shear heating. Contacts are assumed to reach a coupled thermal and mechanical steady- state, and friction is calculated for steady-state sliding.

Results from theory provide good fits to the reported experimental results for quartz and granite friction at all velocity ranges and at varying confining stresses and ambient temperatures. Finally, we discuss the implications of our new model to frictional instabilities, earthquakes and the brittle ductile transition in the Earth.

Date & Location:

Tuesday, March 13, 2018, 11:00
Lecture room, Physics Building (ground floor)