"The Mechanics of Slow Earthquakes and Lab Earthquake Prediction"

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4:00 P.M.

Sharp Lecture Hall, 155 Arms

3:45 P.M. Refreshments, Buwalda Room, 151 Arms

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Abstract:

Earthquake science is in the midst of a revolution. Our understanding of tectonic faulting has been shaken to the core by discoveries of seismic tremor, low frequency earthquakes, slow slip events, and other modes of fault slip. These phenomena represent modes of failure that were thought to be non-existent and theoretically impossible not long ago. Despite the growing number of observations of slow earthquakes and the fact that they can trigger catastrophic large earthquakes their origin remains unresolved. Basic questions remain regarding how slow ruptures can propagate quasi-dynamically, at speeds far below the Rayleigh wave speed, and how tectonic faults can host both slow slip and dynamic earthquake rupture. Our lab work now includes the ability to reproduce the full spectrum of failure modes from stable creep to elastodynamic rupture. Remarkably, this range of events can be predicted using machine learning (ML) techniques to analyze acoustic emissions emanating from the fault. The labquakes are preceded by a cascade of micro-failure events that radiate elastic energy in a manner that foretells catastrophic failure. The ML methods predict the time of failure, the slip duration, and for some events the magnitude of slip. These predictions demonstrate a mapping between fault strength and statistical attributes of the fault zone elastic radiation that it is valid throughout the duration of the lab seismic cycle. They also correctly describe both dynamic rupture and

slow slip events. Here, I summarize laboratory results on the mechanics of slow earthquakes and our work on lab earthquake prediction.