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Friction is Fracture: a new paradigm for the onset of frictional motion[1]

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Friction is generally described by a single degree of freedom, a 'friction coefficient'. We experimentally study the space-time dynamics of the onset of dry and lubricated frictional motion when two contacting bodies start to slide. We first show that the transition from static to dynamic sliding is governed by rupture fronts (closely analogous to earthquakes) that break the contacts along the interface separating the two bodies. Moreover, the structure of these "laboratory earthquakes" is quantitatively described by singular solutions originally derived to describe the motion of rapid cracks under applied shear. We demonstrate that this framework quantitatively describes both earthquake motion and arrest. This framework also providing a new window into the hidden properties of the micron thick interface that governs a body's frictional properties. Using this window we show that lubricated interfaces, although "slippery", actually becomes tougher; lubricants significantly increase dissipated energy during rupture. The results establish a new (and fruitful) paradigm for describing friction.

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