Colloquium

MAX PLANCK INSTITUTE
FOR DYNAMICS AND
SELF-ORGANIZATION

Universal avalanches across 16 decades in length: From nanocrystals (and neurons) to earthquakes and stars (?)

Prof. Dr. Karin Dahmen

Department of Physics
University of Illinois at Urbana Champaign
Urbana Champaign, Illinois, USA

Slowly-compressed nano-crystals, bulk metallic glasses, rocks, granular materials, and the earth all deform via intermittent slips or "quakes". We find that although these systems span 12 decades in length scale, they all show the same scaling behavior for their slip size distributions and other statistical properties. Remarkably, the size distributions follow the same power law multiplied with the same exponential cutoff. The cutoff grows with applied force for materials spanning length scales from nanometers to kilometers, indicating an underlying nonequilibrium phase transition. A simple mean field model for avalanches of slipping weak spots explains the agreement across scales. It predicts the observed slip-size distributions and the observed stress-dependent cutoff function. The analysis draws on tools from statistical physics and the renormalization group. The results enable extrapolations from one scale to another, and from one force to another, across different materials and structures, from nanocrystals to earthquakes. Connections to neuron avalanches in the brain and recent observations on stars will also be discussed, extending the range of scales to 16 decades in length.

Wednesday, Sept. 21st, 2022 at 2:15 pm

Video conference at www.zoom.us
Meeting ID: 959 2774 3389
Passcode: 651129, direct link

Max Planck Institute for Dynamics and Self-Organization
Living Matter Physics
Prof. Dr. Ramin Golestanian
Email: golestanian-office@ds.mpg.de, Phone: +49-(0)551/5176-101
Am Faßberg 17, 37077 Göttingen, Germany