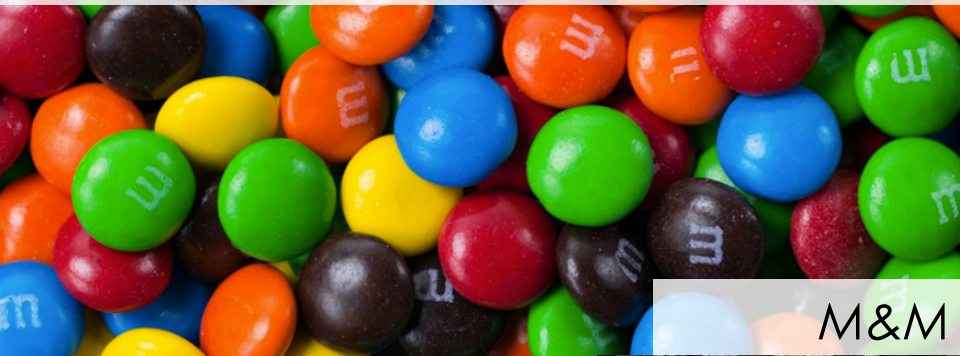


Experimental physics research with Cacey Bester



**Experiments with grains:
a far-from-equilibrium system**

What are granular materials?



M&M



Logs



Stones on a
mountain



Coal



Flowing
corn



Sand dune



Sand in hourglass

Describing systems of grains

Sand departs from standard thermal physics:

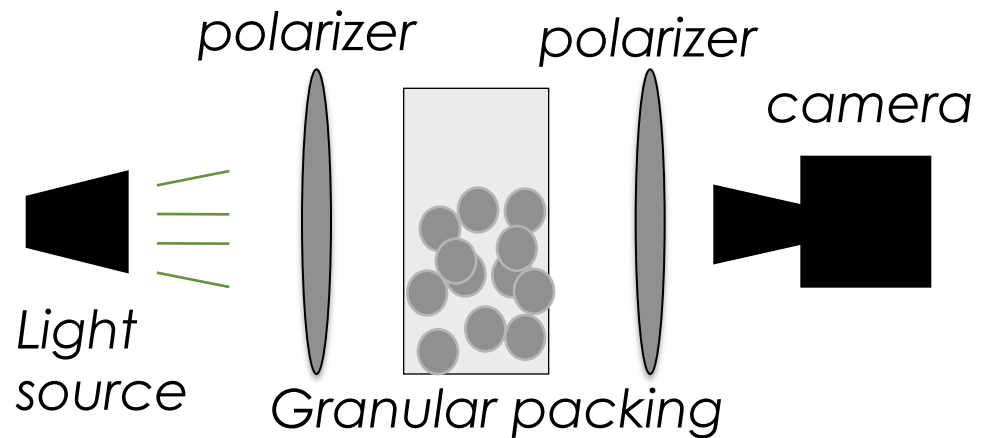
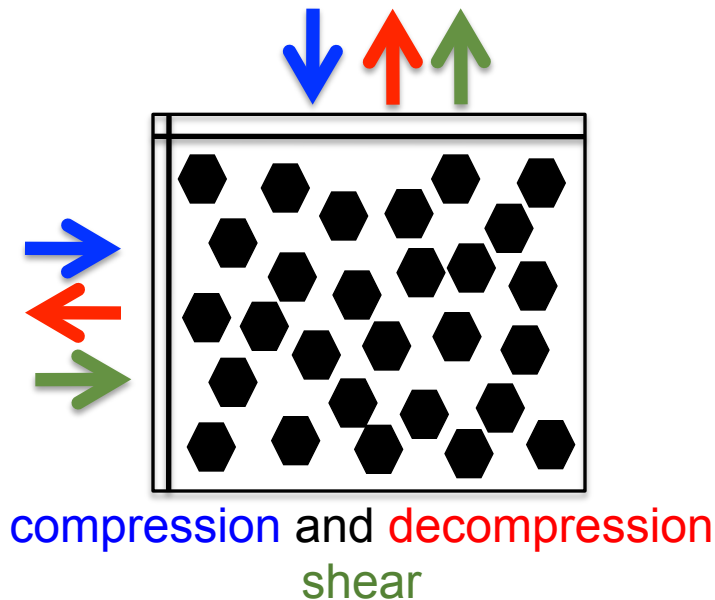
1. Grains are large → thermal fluctuations negligible ($k_B T \ll mgd$)
2. Grains contact, lose energy
3. Grains can be rigid like a **solid** or flow like a **fluid**



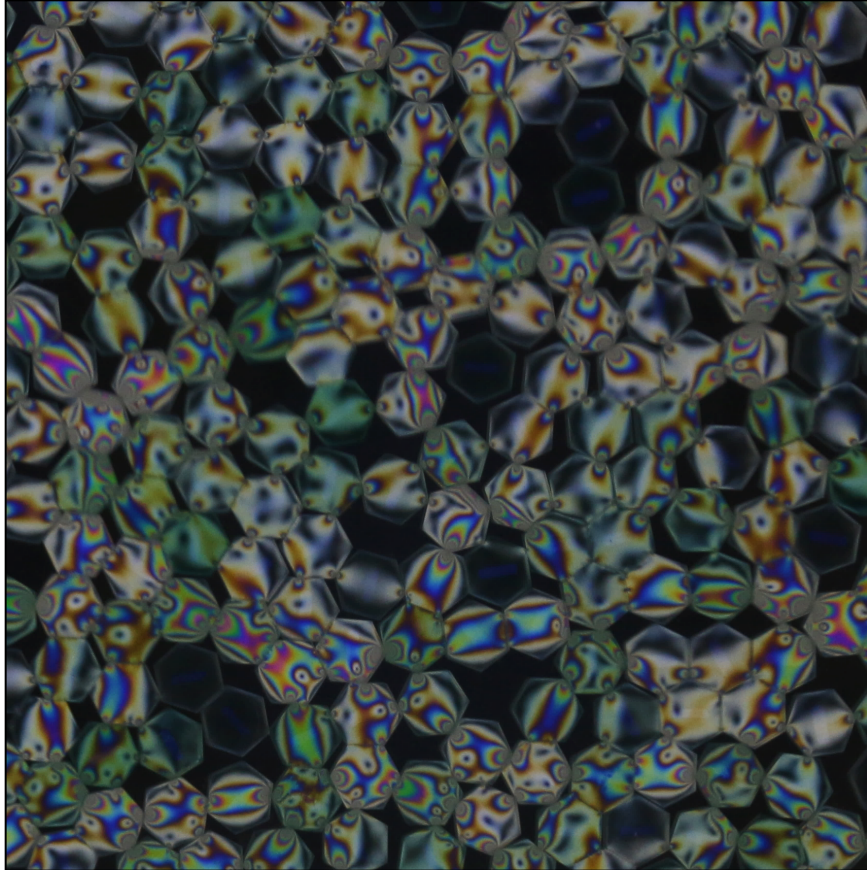
Ripples in sand dune in CA

Visualizing granular response

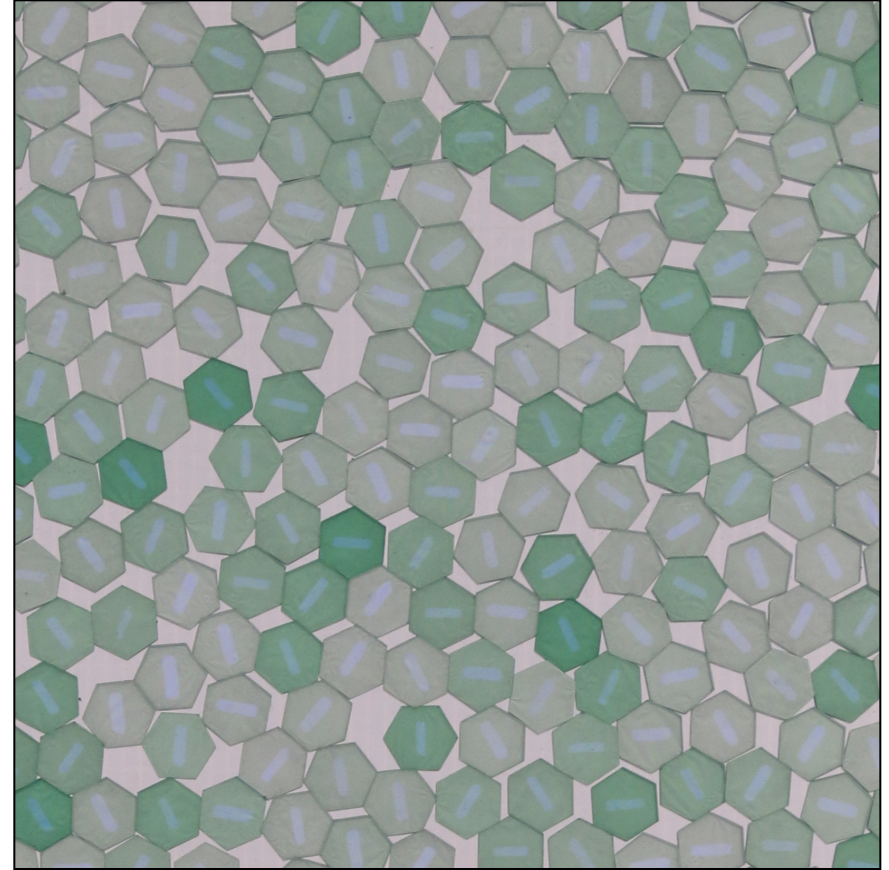
Use **birefringent material** to show response of grains to applied stress



Visualizing granular response



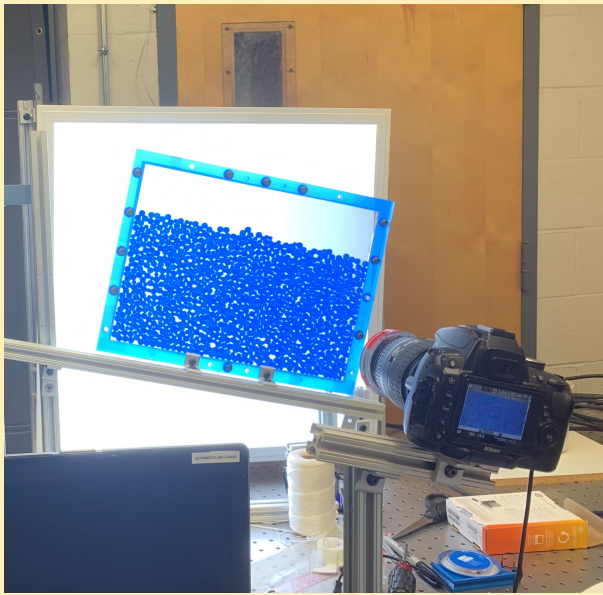
Forces
Polarized light +
photoelastic grains



Arrangement
White light

Project I

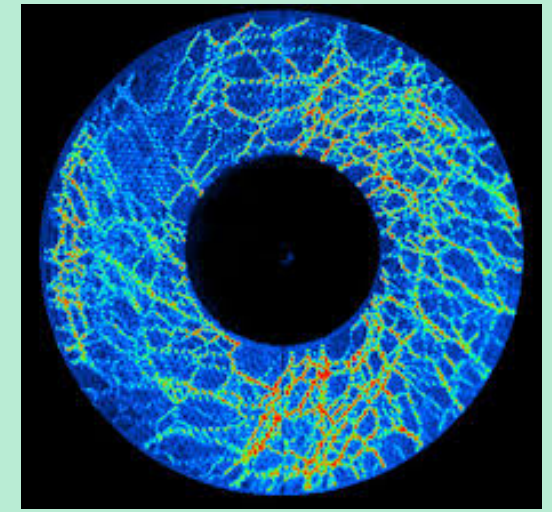
*Signatures
of creep*



Data Analysis: determining rearrangements in a marginal granular system

Electronics and coding: automating data acquisition and image analysis

Project II



Grains under confinement

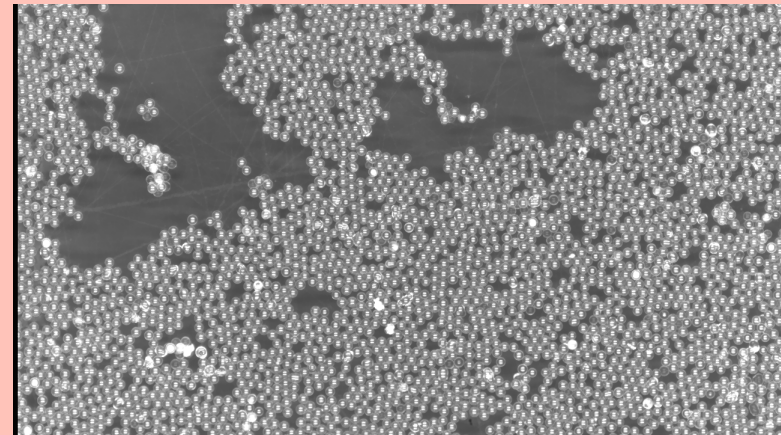
Experiment construction: displacements and stresses of grains among “pins”

With Prof. Amy Graves

Project III

Deformations of sheared granular material

**Research at the University
of Pennsylvania**



Interested? Questions?
cbester1@swarthmore.edu

Experimental physics of granular systems
Experimental design and construction
Imaging methods of granular physics
Interdisciplinary research

Research opportunities
Summer 2020 – 10 weeks
Positions also available Spring 2020