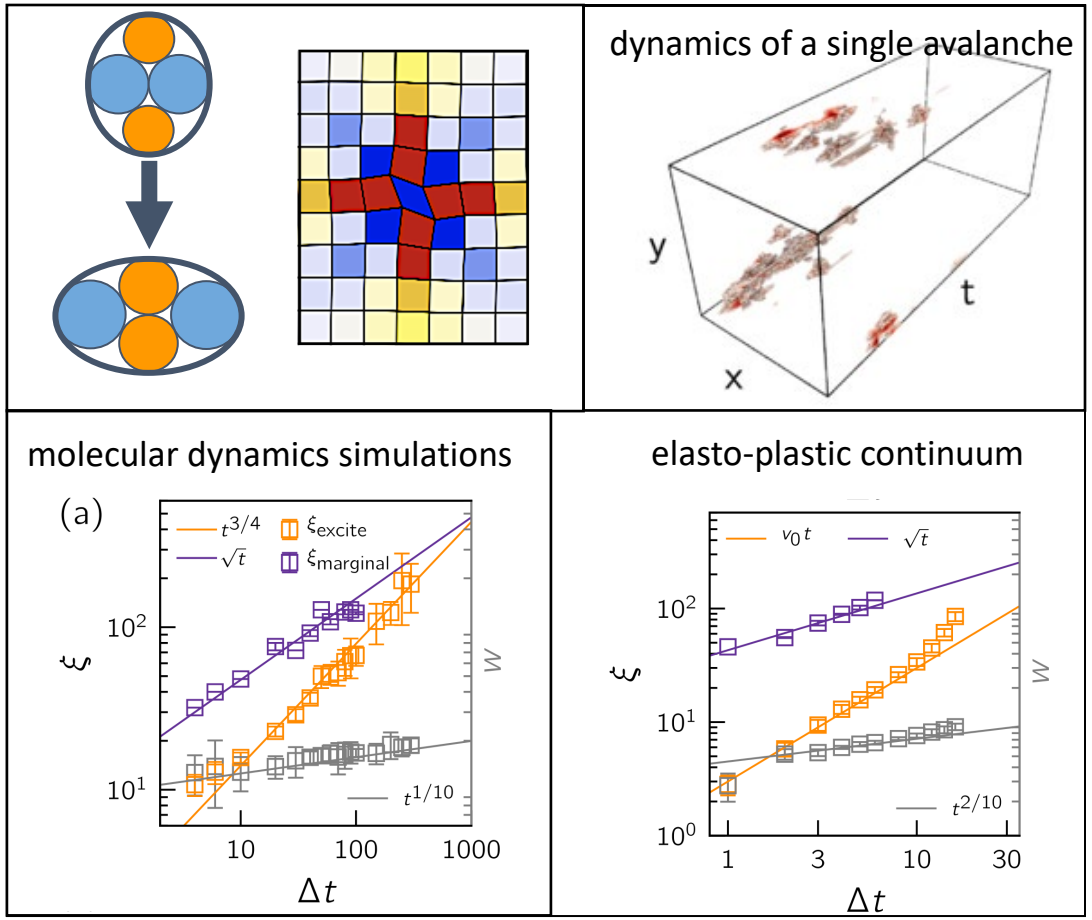
Unexpected dynamics of avalanches challenges continuum models

Lisa M. Manning, Syracuse University

- We lack a continuum model that can predict failure in disordered materials (glasses, granular materials, dense colloids, foams)
- The best existing candidate continuum model is an “elasto-plastic model”, which suggests that when particles in a glass rearrange, they release a quadrupolar stress field with four lobes (*top left panel*).
- We compared the full spatio-temporal dynamics of avalanches in both molecular dynamic’s simulations of glasses and in elastoplastic models. In both cases, avalanches could be decomposed into localized bursts of deformation in both space (x,y) and time (t). (*top right panel*)
- We discovered two length scales in these avalanches, a longer, ”marginal” scale (purple) and a smaller “excited” scale (orange). (*bottom panels*)
- The marginal length scales behaved the same in both, but the excited length scale in particle simulations scales surprisingly different in time!
- This indicates elastoplastic models are missing necessary physics and suggests ways to fix them in the future.



David Richard, Ahmed Elgailani, Damien Vandembroucq, **M. Lisa Manning**, Craig E Maloney. (2023). “Mechanical excitation and marginal triggering during avalanches in sheared amorphous solids”, *Phys. Rev. E* **107**, 034902, https://doi.org/10.1103/PhysRevE.107.034902

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Broadening Participation via materials research with undergraduates

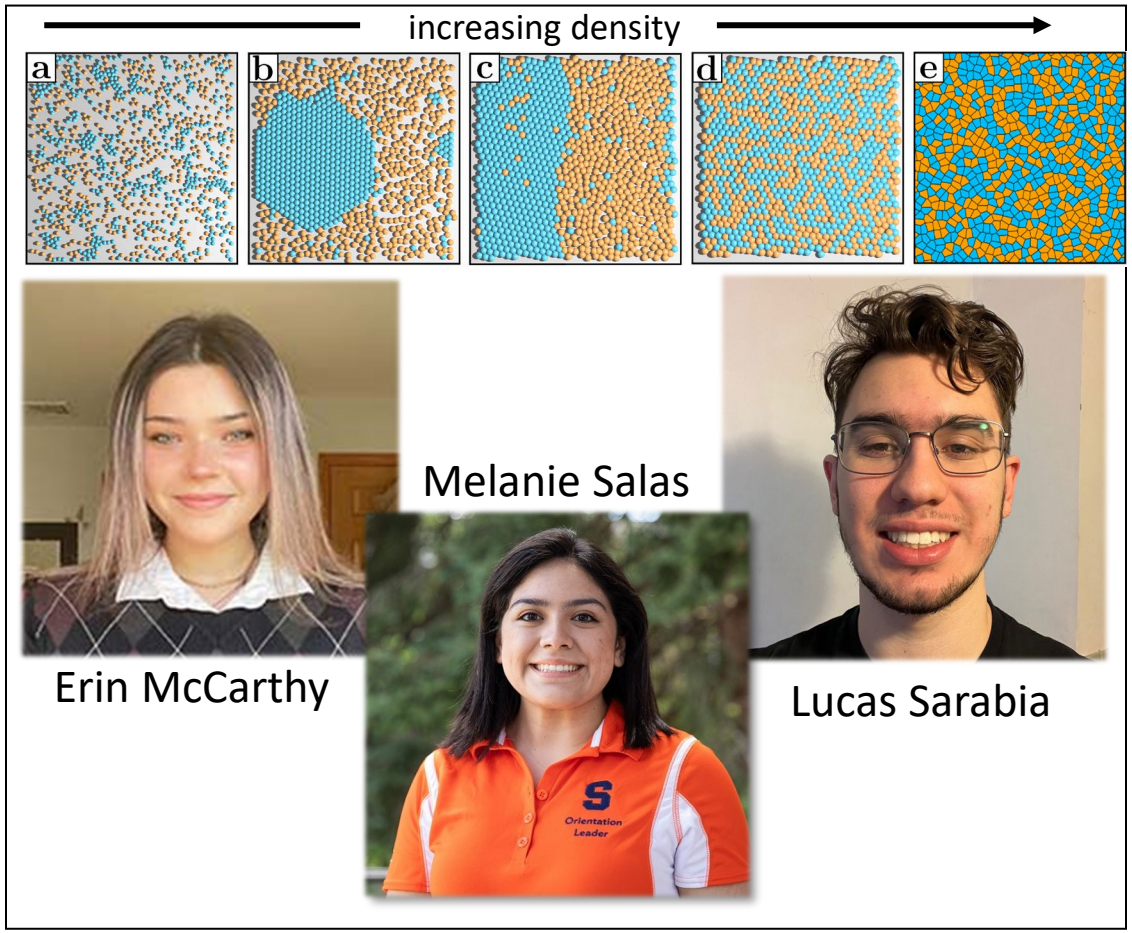
Lisa M. Manning, Syracuse University

Broadening Participation: *Recruiting and retaining diverse students in the materials science pipeline via targeted research training opportunities*

In the past year, the Manning group has focused on creating research experiences for three undergraduate students, all under-represented (UR) in STEM. Erin and Melanie identify as women, and Melanie and Luca are Latinx.

Melanie Salas and Lucas Sarabia participated in an undergraduate research program created at Syracuse University's BioInspired Institute for UR groups, and then they rotated in my lab for several weeks in Summer/Fall 2022 to learn about computational modeling of materials.

Erin McCarthy has been an undergraduate researcher in my lab for 4 years and graduated with a degree in physics this past spring. She is sole first author of a manuscript that identifies a novel reentrant transition (from unmixed to mixed and back again as a function of density, *top row in image*) in dense active mixtures, which is currently out for review at *Phys. Rev. Letters*



Erin McCarthy, Ojan Damavandi, Raj Kumar Manna, M. Lisa Manning, Demixing in binary mixtures with differential diffusivity at high density, https://doi.org/10.48550/arXiv.2307.03303