

# NON-UNIVERSALITY OF JAMMING IN CELLULAR MONOLAYERS

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## WHAT IS JAMMING?

- Cellular jamming refers to **how tissues switch between liquid and solid-like states**
- Crucial in understanding developmental processes and disease progression

## OPEN GAP

- Real space techniques**, e.g PIV and tracking, are limited:
- cell shape variability
  - user dependent
  - unreliable for diffusive dynamics

## OUR GOAL

**Reciprocal space techniques** have probed phase transitions in inert matter but not in cellular tissues. We use **Differential Dynamic Microscopy**<sup>a,b</sup> (DDM) to reveal universal features across cell types.

## THE TWO PATHWAYS OF JAMMING

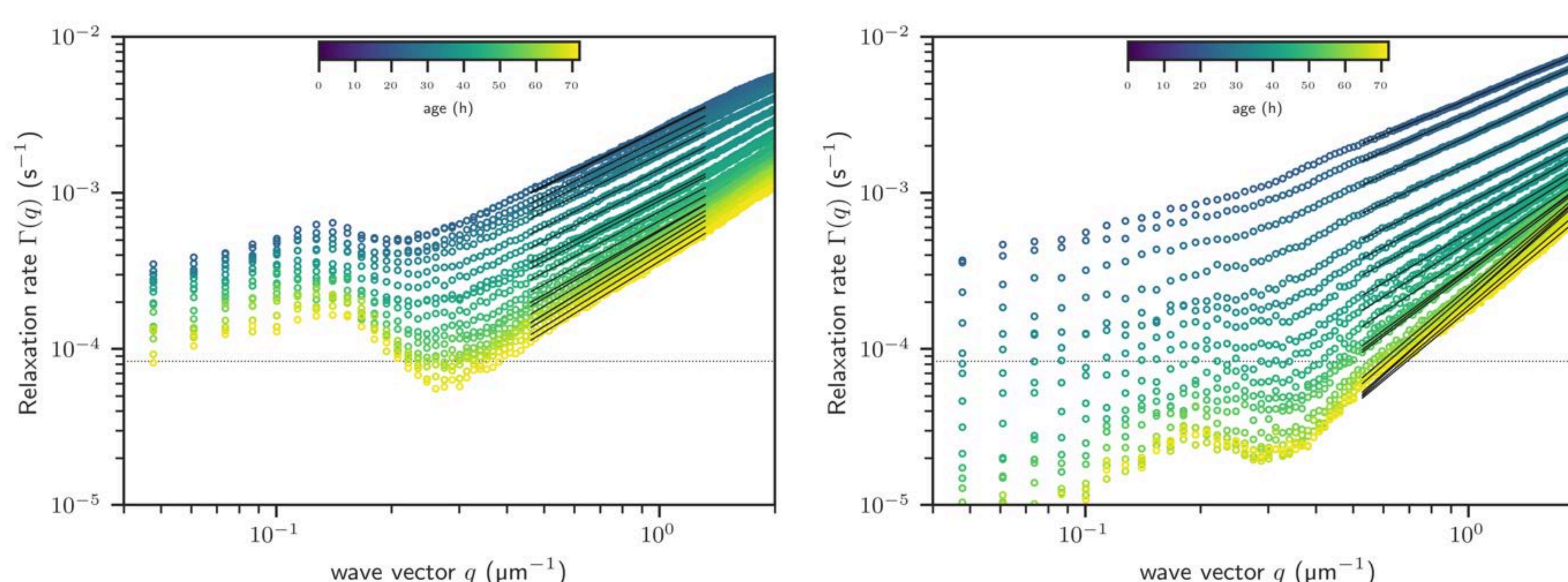
### Jamming via gradual slowdown

e.g. **NIH-3T3** / Mouse fibroblasts

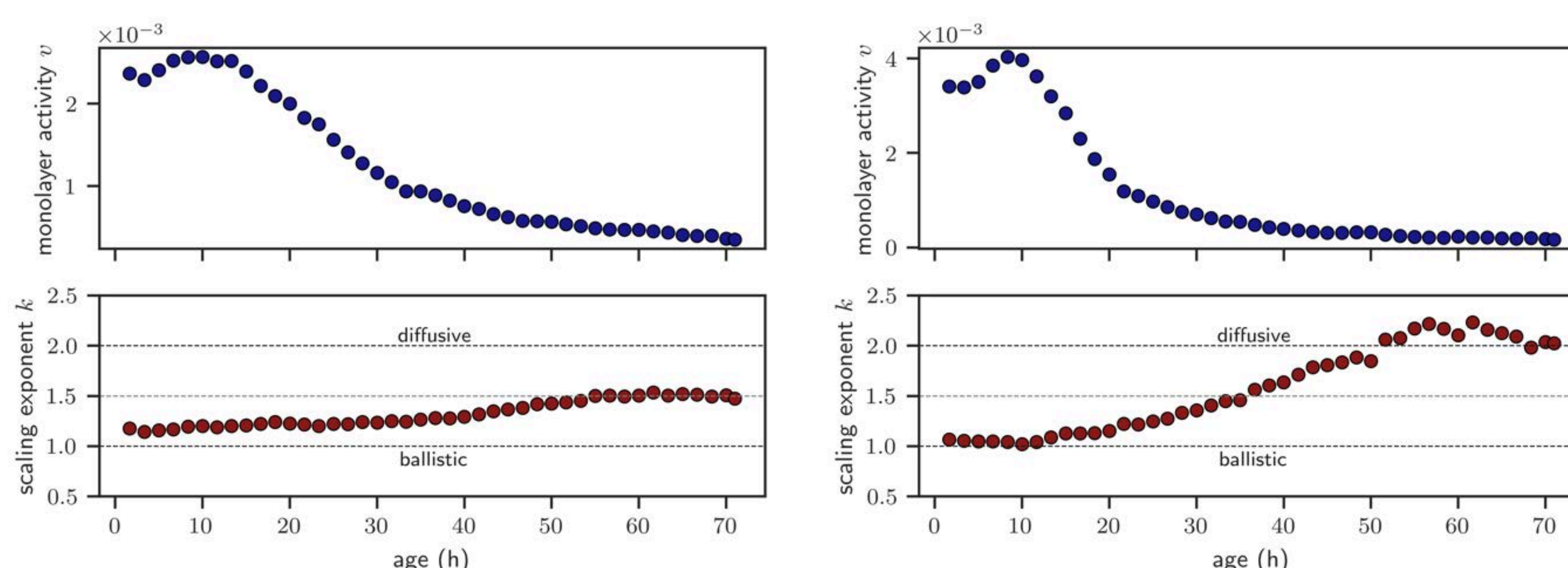
### Jamming via motility transition

e.g. **HaCaT** / Human keratinocytes

### DISPERSION RELATION



### FINGERPRINT OF TISSUE DYNAMICS

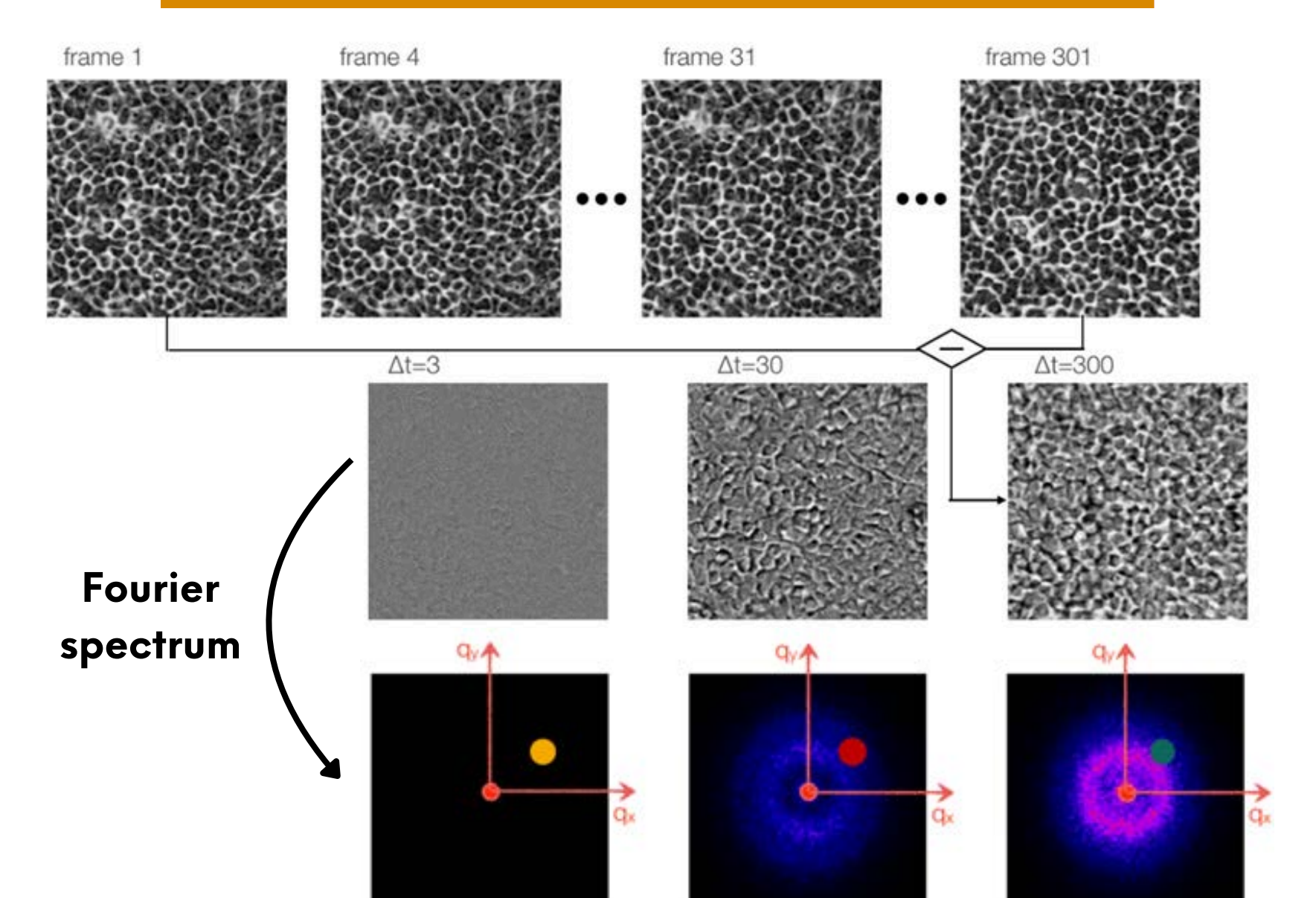


### MONOLAYER AGING AFFECTS ITS DYNAMICS

- Relaxation rate declines with monolayer age, displaying a difference of one order of magnitude between the two cell lines.
- All investigated systems initially exhibit initial ballistic-like motion, but their paths to arrest vary.
- Dynamic differences arise not only between epithelial and mesenchymal cell types but also among cell lines within the same type.

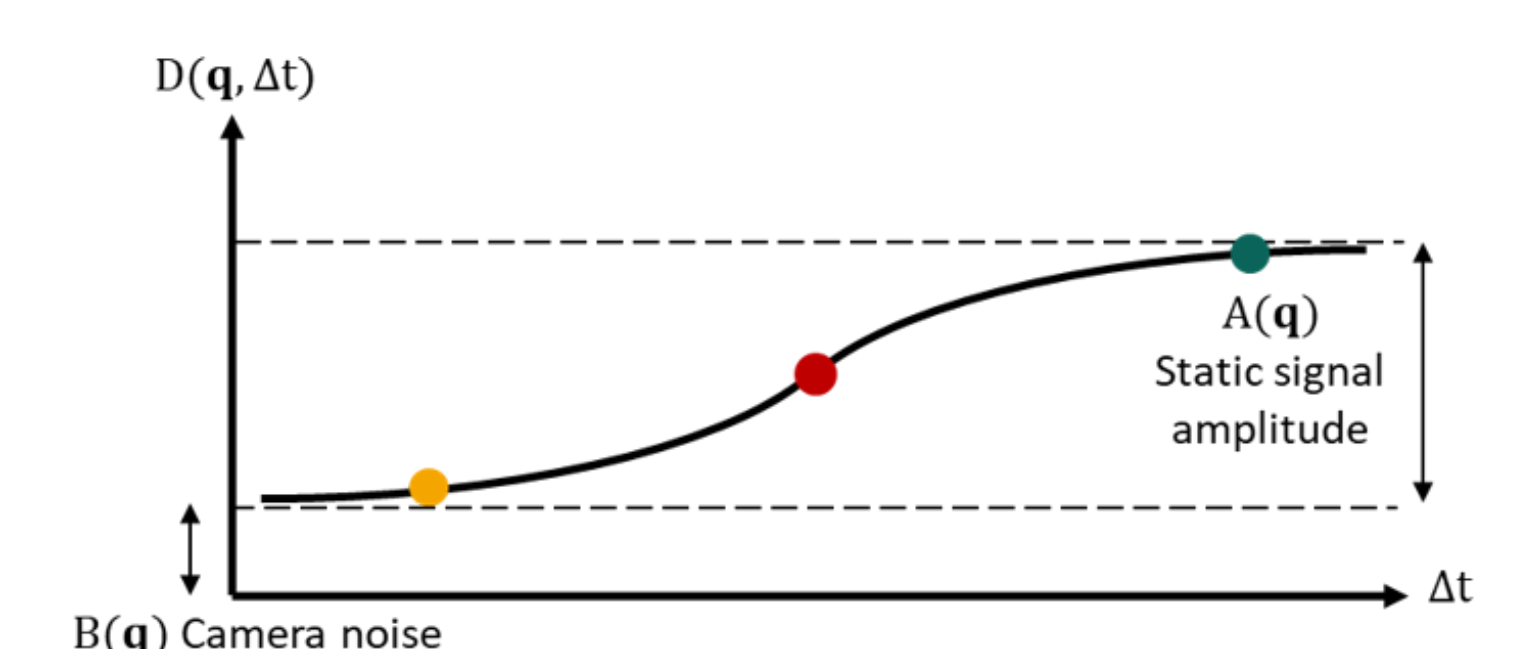
**Cellular Jamming is not governed by a universal set of physical rules.**

## DDM in pictures



### Image Structure Function

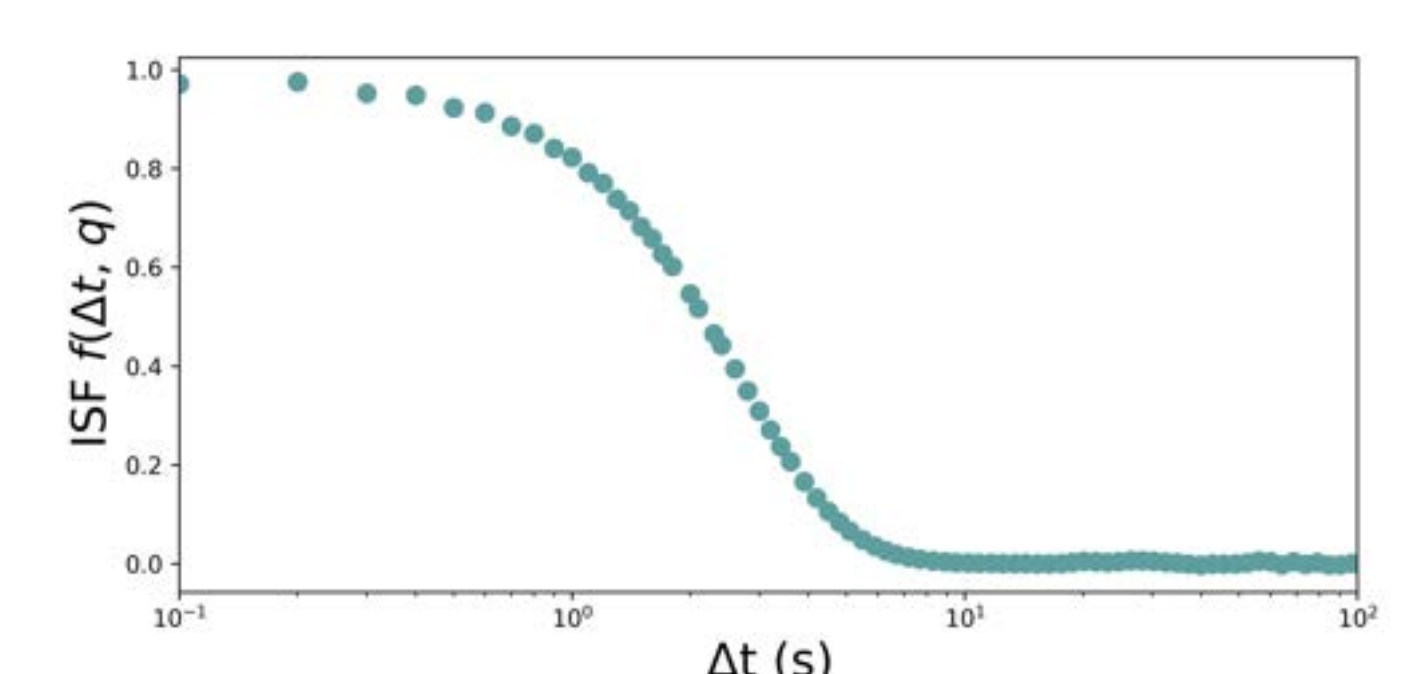
$$D(q, \Delta t) = \langle |\Delta I(q, t, \Delta t)|^2 \rangle_t$$



$$ISF(q, \Delta t) = 1 - \frac{D(q, \Delta t) - B(q)}{A(q)}$$

The **Intermediate Scattering Function** (ISF) measures correlation of particles positions for lagtimes  $\Delta t$ , at a spatial frequency given by  $q$

$$ISF(q, \Delta t) = (1 - \alpha)e^{-(\Gamma(q)\Delta t)^\beta}$$



### Relaxation rate

$$\Gamma(q) = vq^k$$

v monolayer activity  
k dynamical exponent

## References

<sup>a</sup>Cerbino & Trappe, *Phys. Rev. Lett.*, 2008  
<sup>b</sup>Lattuada et al., *arXiv*, 2025

## Acknowledgements

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