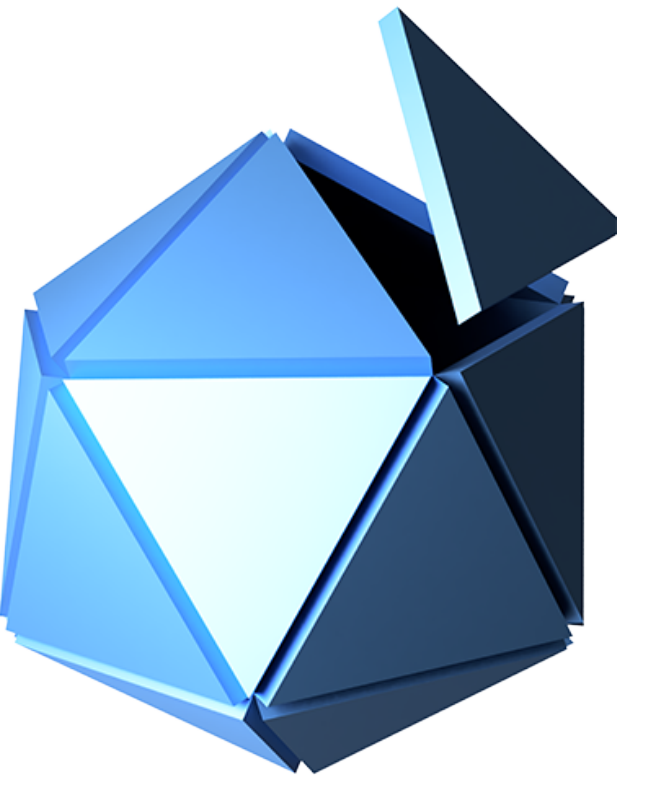




Shape fluctuations of deformable vesicles driven by dilute active nematics

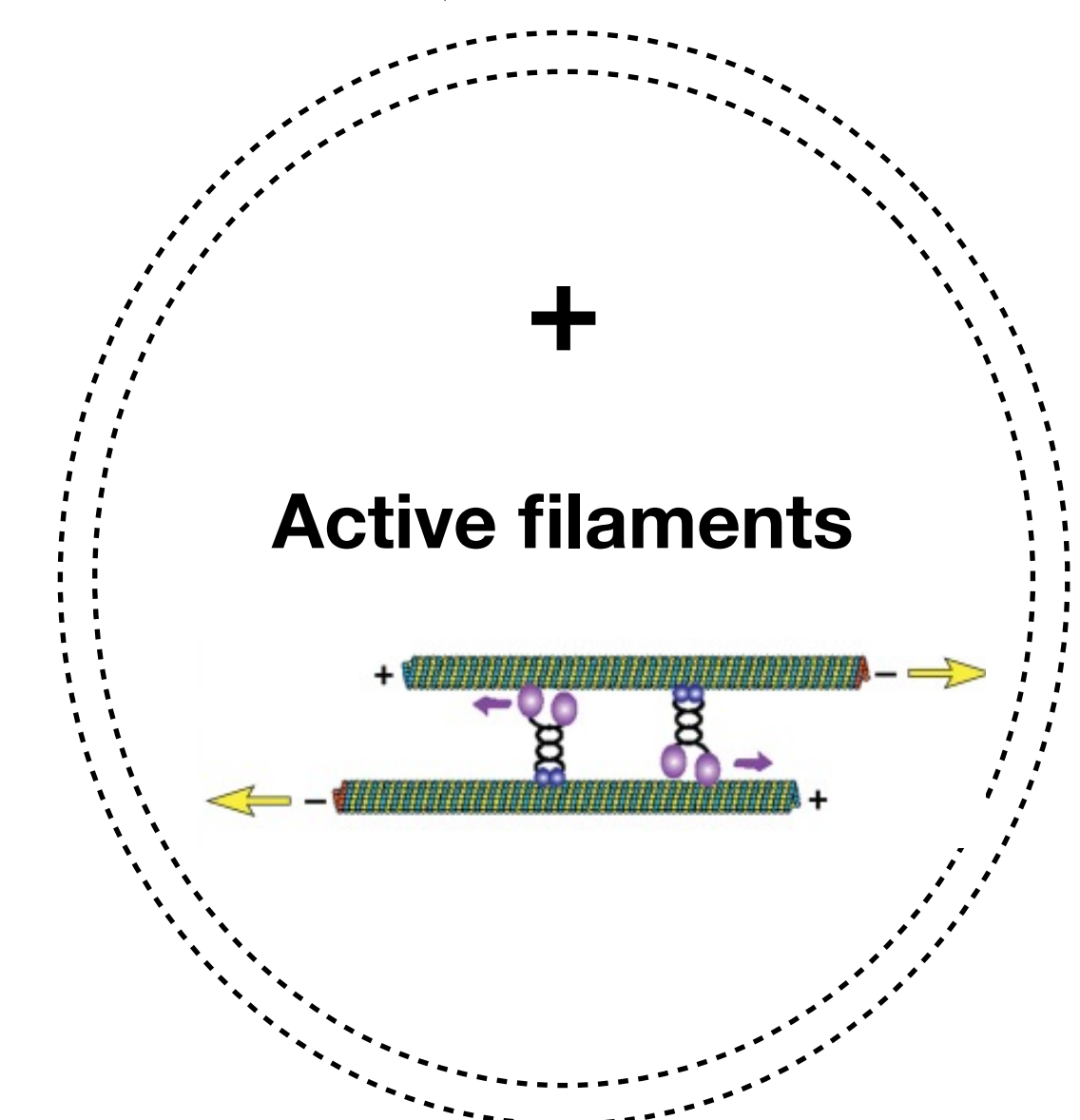
Sarvesh Uplap, M. Peterson, A. Baskaran, M. Hagan, Z. Dogic
A. Sciortino, A. Bausch, H. Faizi, P. Vlahovska



Methods and Model

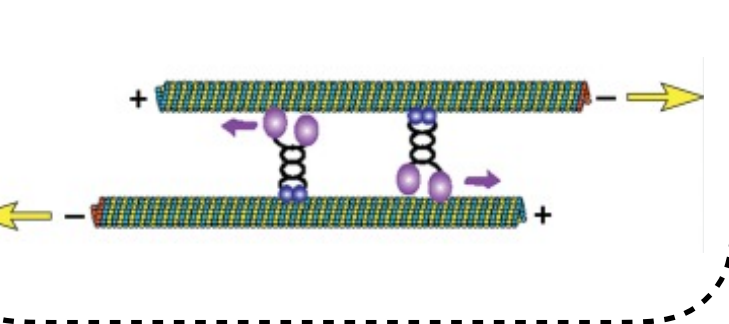
Simplified model

Deformable Vesicle

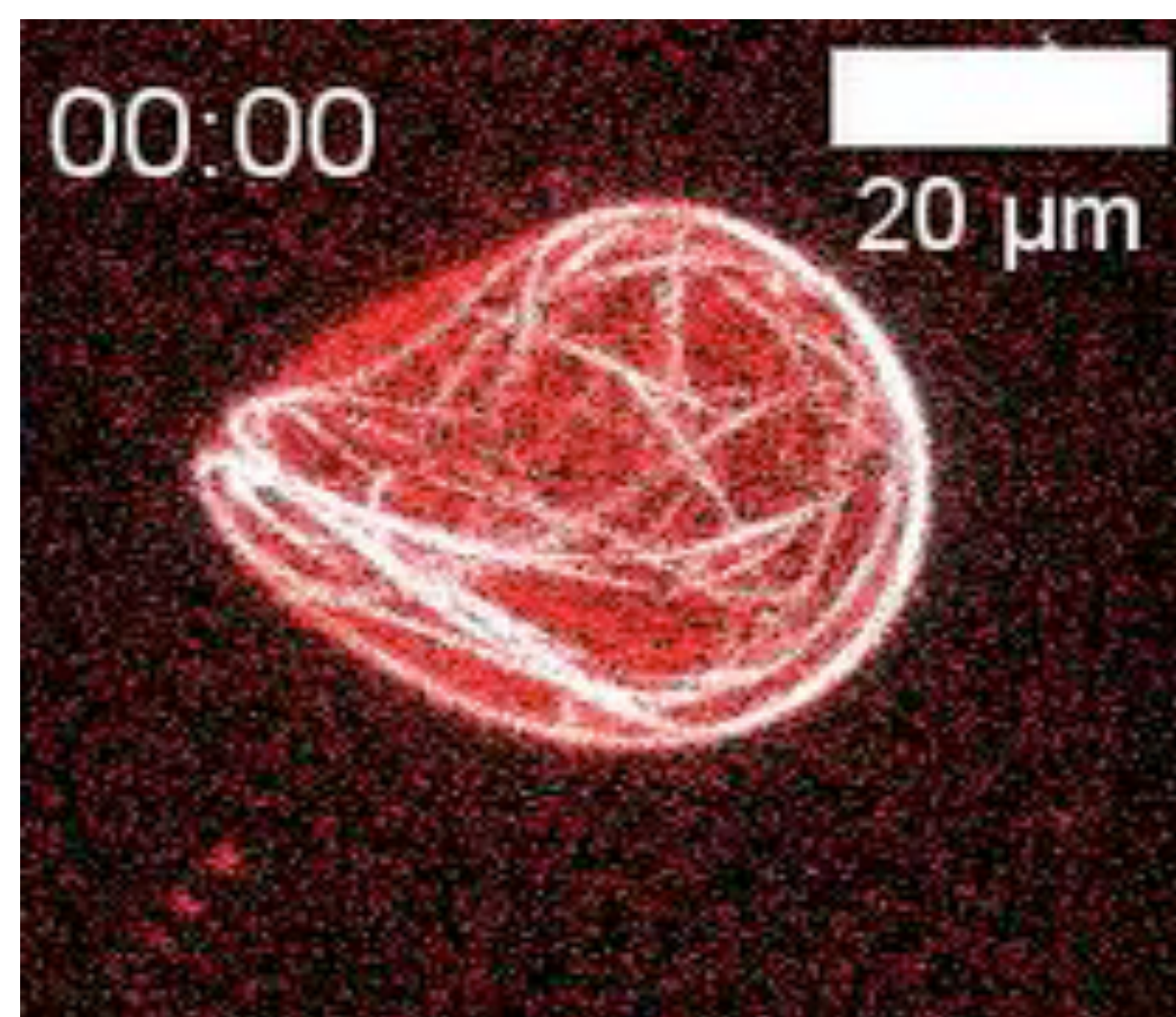
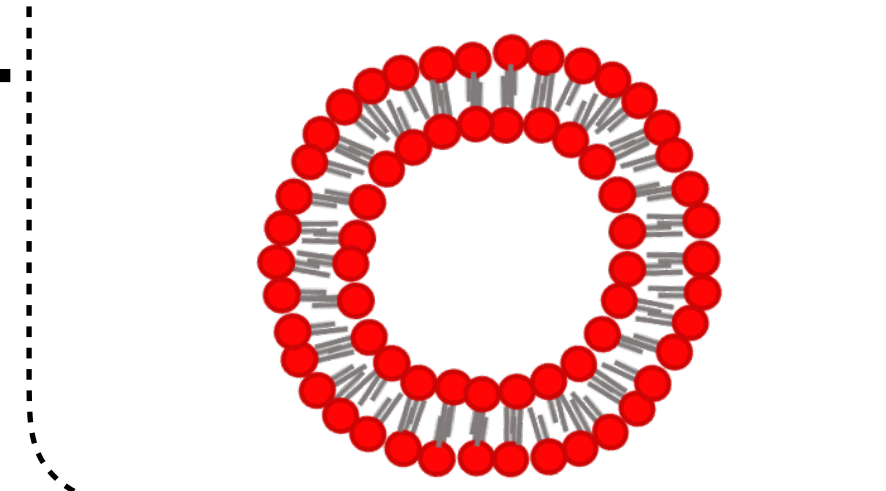


Experimental system

Active Filaments:
Microtubule bundles
+ Kinesin Motors
+ ATP



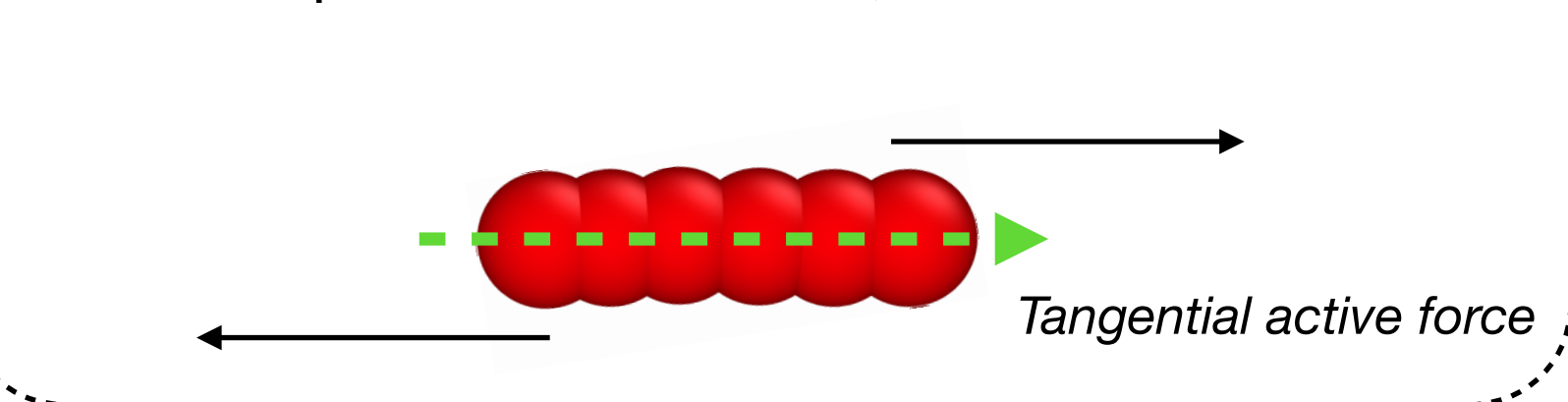
Vesicle:
- Giant uni-lamellar vesicle
- Single lipid bi-layer



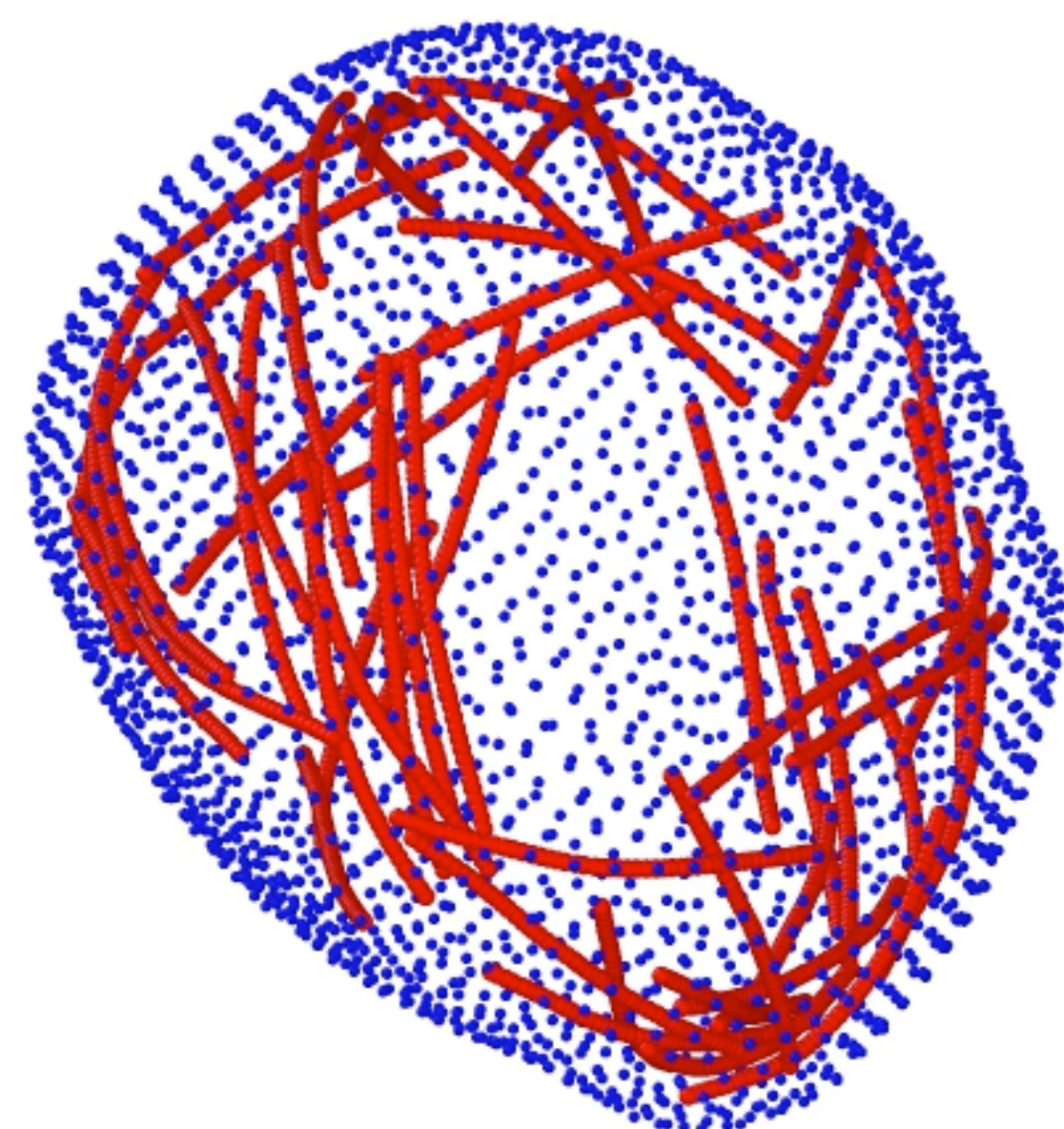
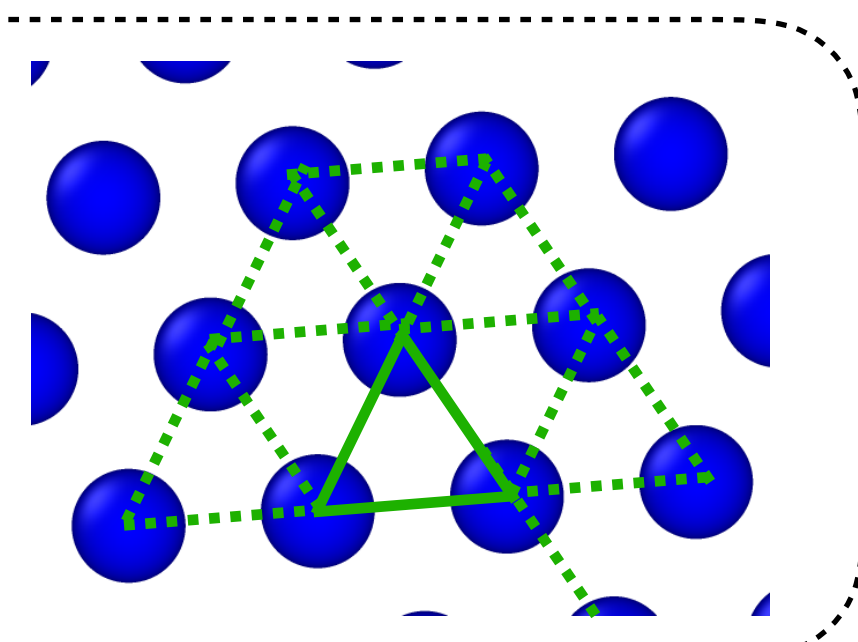
Simulations

Molecular dynamics in 3D

Filaments:
Bead and spring polymers
with non-polar active force



Vesicle:
- Passive
- Triangular mesh
- Deformable



Results

Equilibrium Membrane Fluctuation

Bending dominated vesicles

$$\text{Mode Strength: } \langle |u_q|^2 \rangle \sim \frac{1}{q^3}$$

$$\text{Mode Relaxation time scale: } \tau_q \sim \frac{1}{q^3}$$

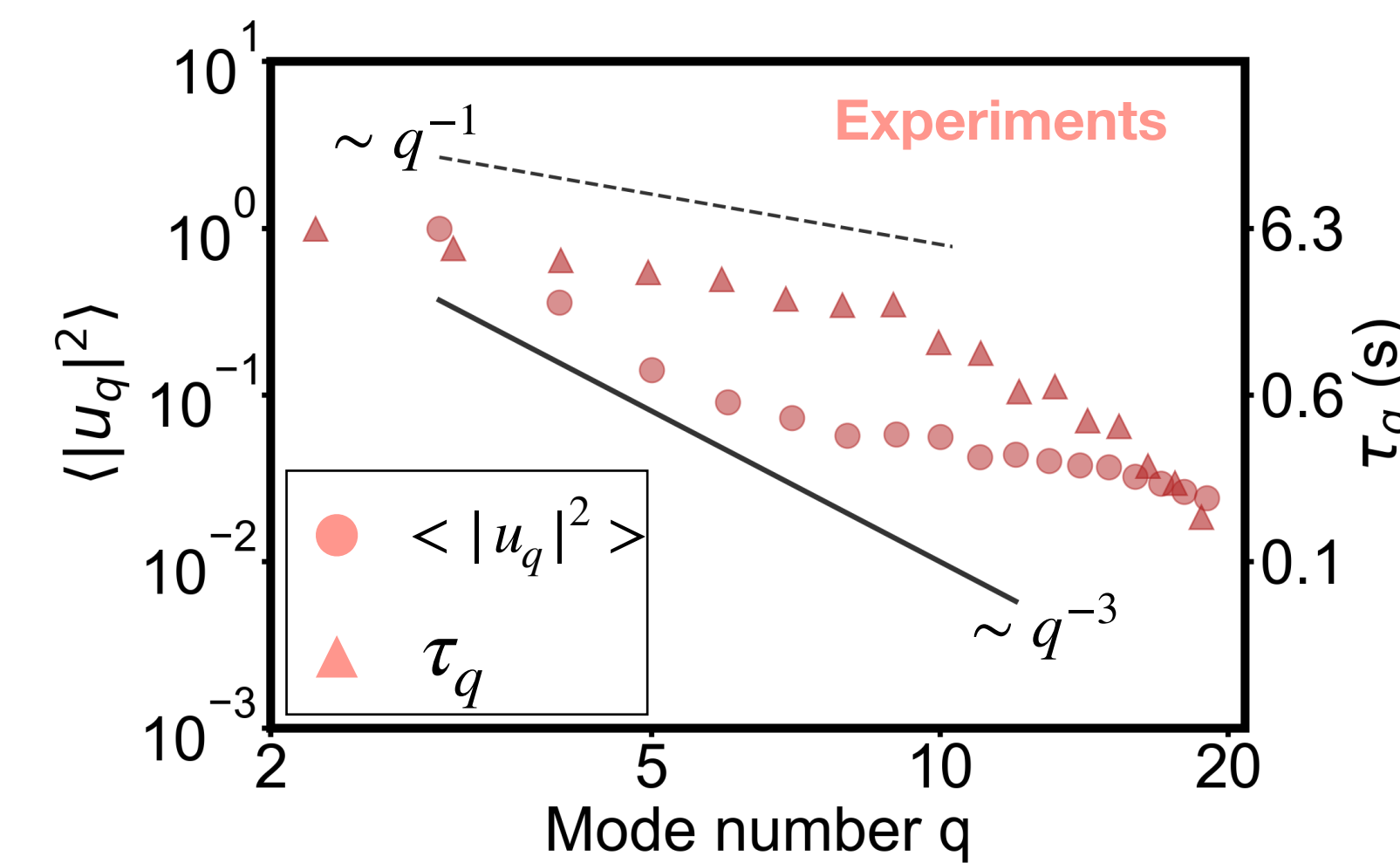
Tension dominated vesicles

$$\text{Mode Strength: } \langle |u_q|^2 \rangle \sim \frac{1}{q}$$

$$\text{Mode Relaxation time scale: } \tau_q \sim \frac{1}{q}$$

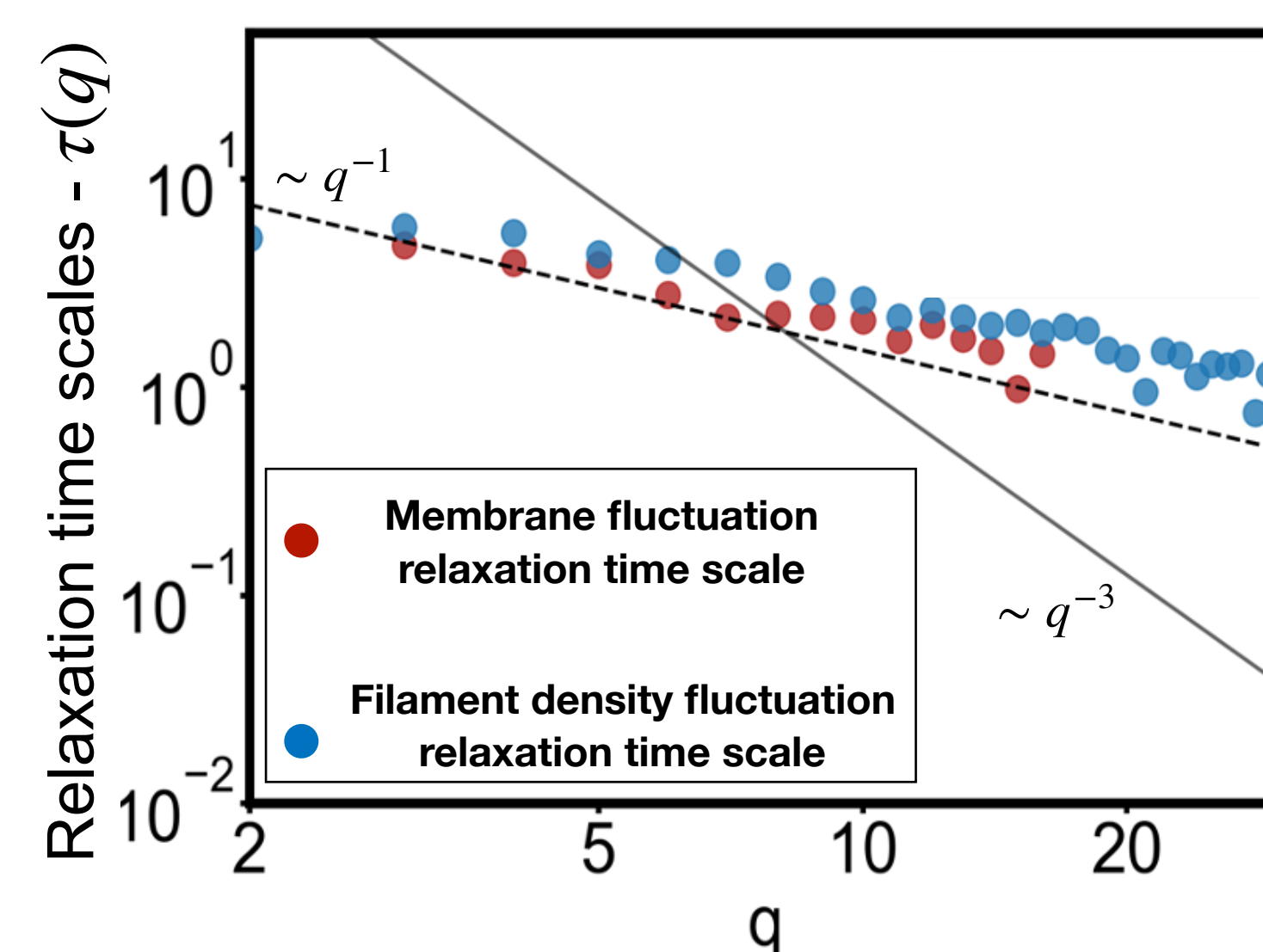
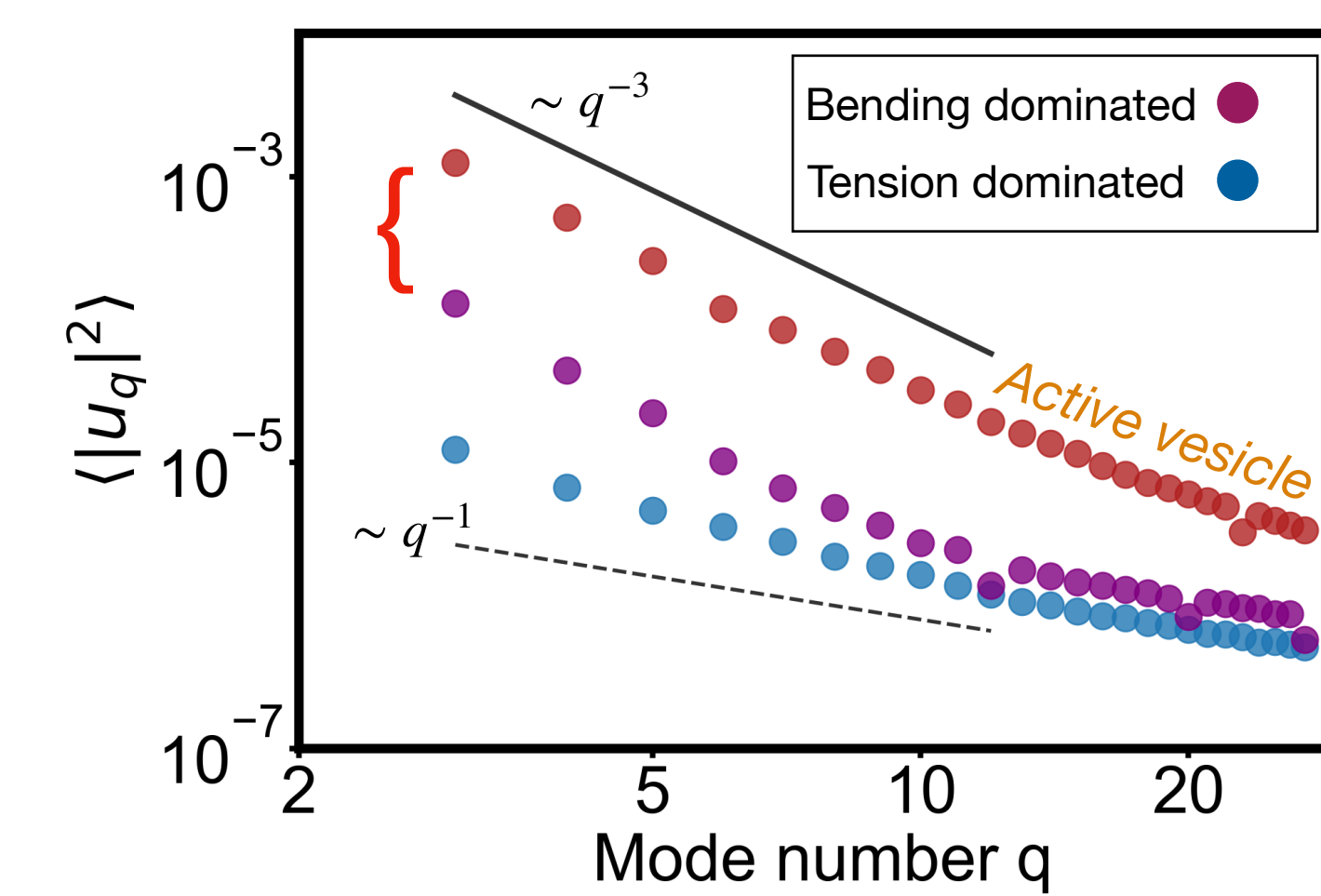
Non-equilibrium fluctuations

Relaxation time scales
decoupled from equilibrium
vesicle properties



Activity enhances fluctuation

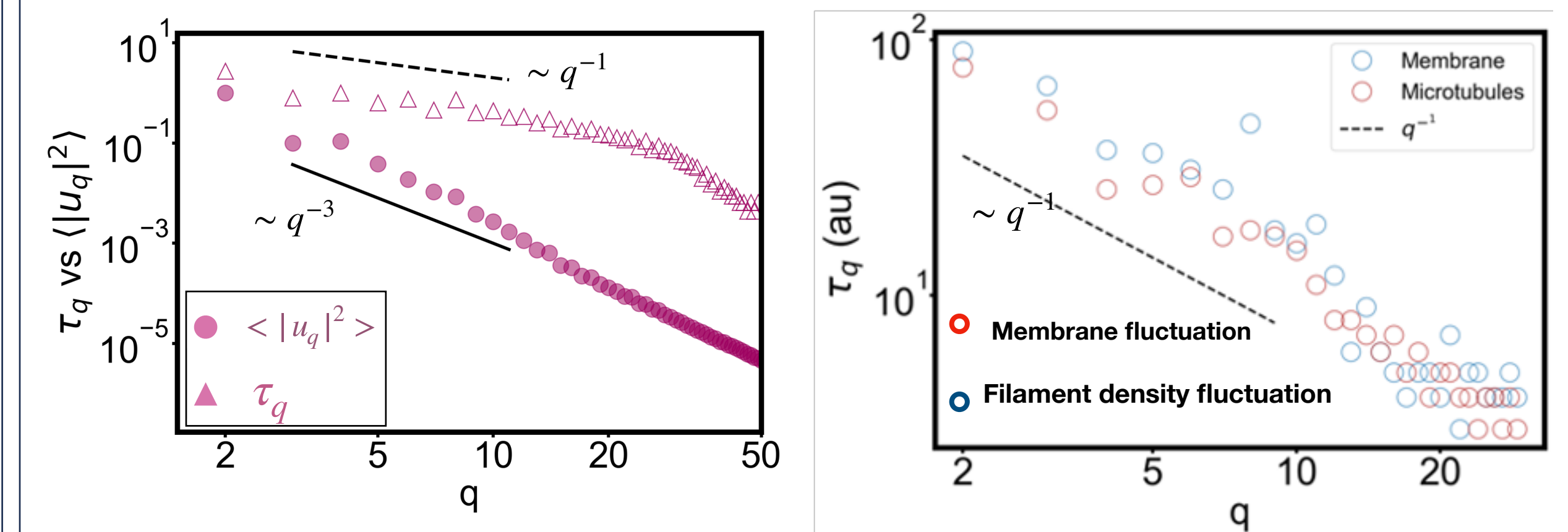
Scaling law as that of
equilibrium vesicle



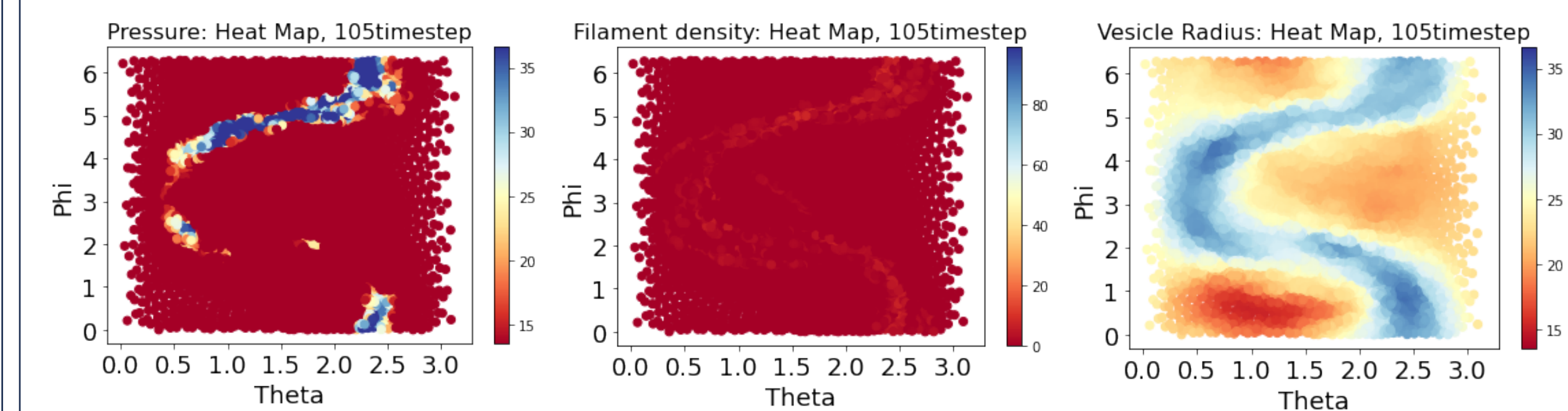
Filament density
fluctuations
↕
Membrane fluctuations
Strongly coupled

Comments

- Simulations verify all the results seen in experiments



- Simulations give access to information that is not available via experiments



- Simulations can give insights into complex feedback mechanism that drives the dynamics

References

1. A. Sciortino, H. Faizi et al
2. Zvonimir Dogic, John Berezney, Remi Boros
3. R. Rodriguez-Garcia, I. Lopez-Montero, M. Mell et al

Acknowledgments

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