

*Conformations, dynamics, and phase separation of  
disordered proteins.*



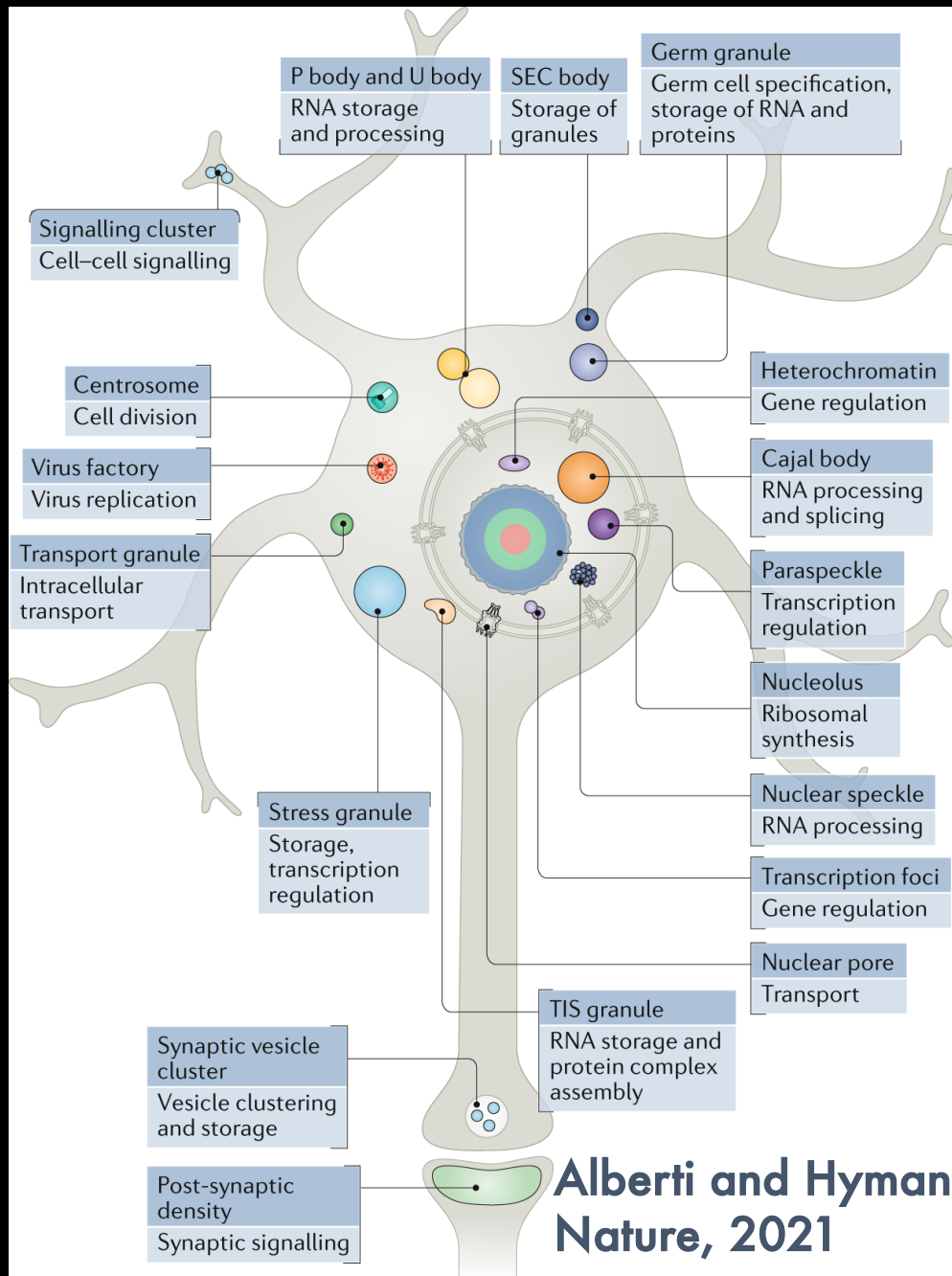
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Finding cures. Saving children.

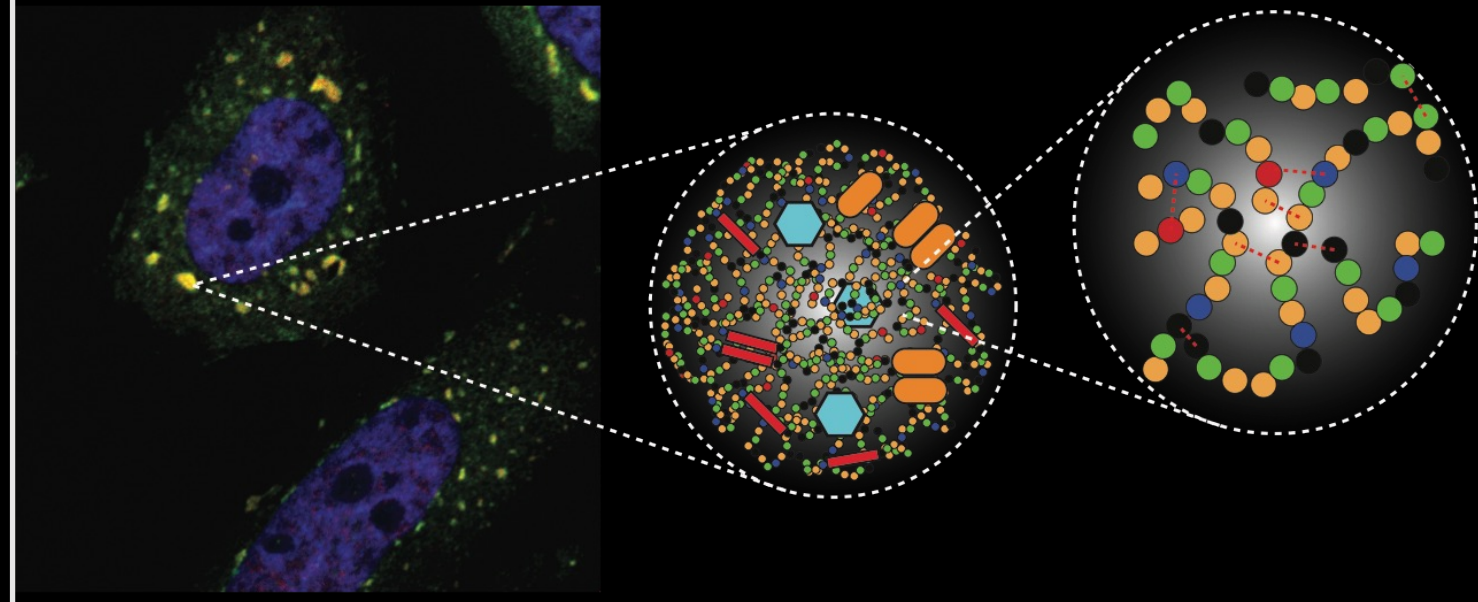
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**Everything BioSAXS 8  
06/23/2022**

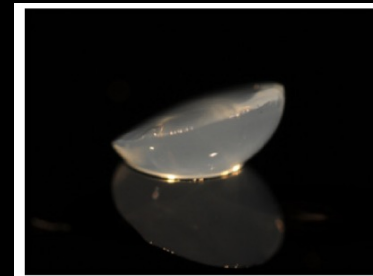
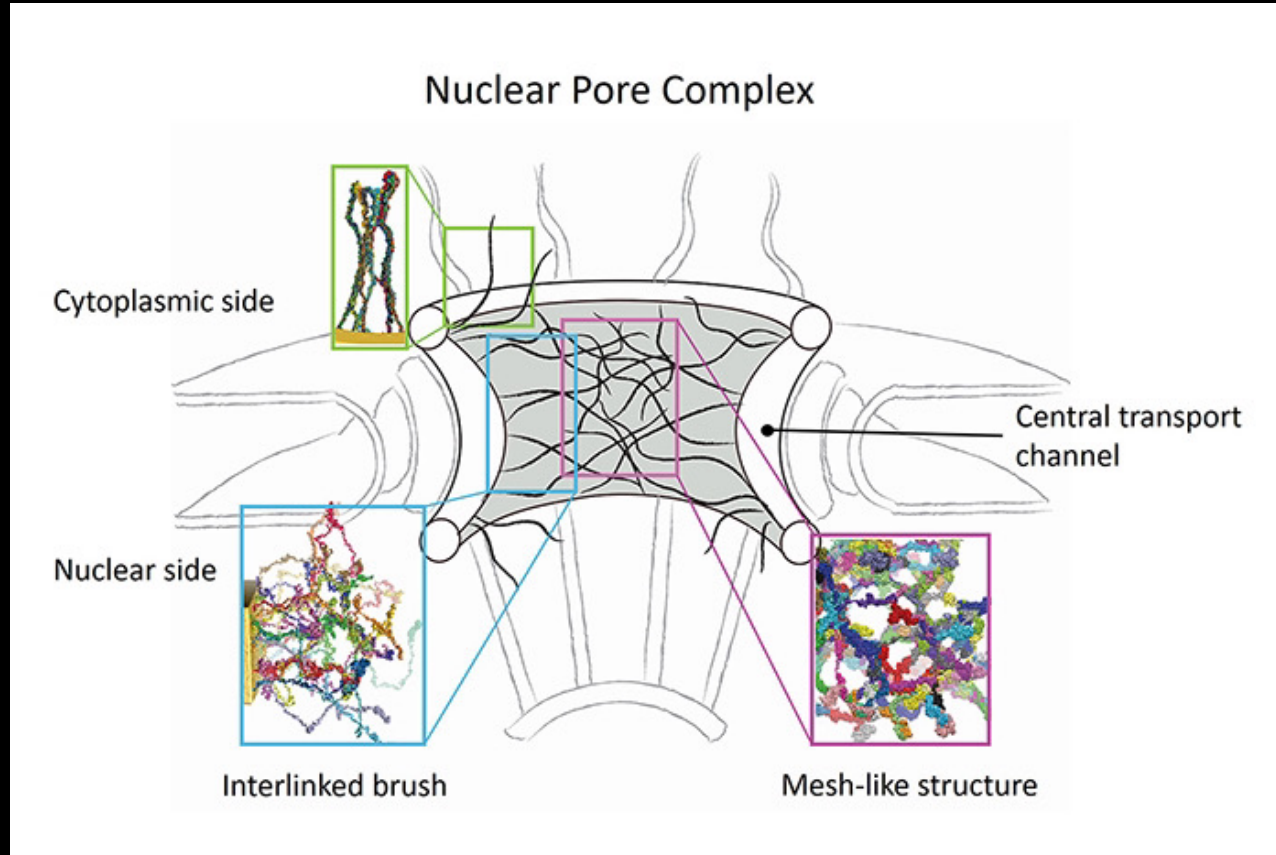
# Membraneless compartmentalization is central to cellular organization



Infer mesoscale properties from model systems.

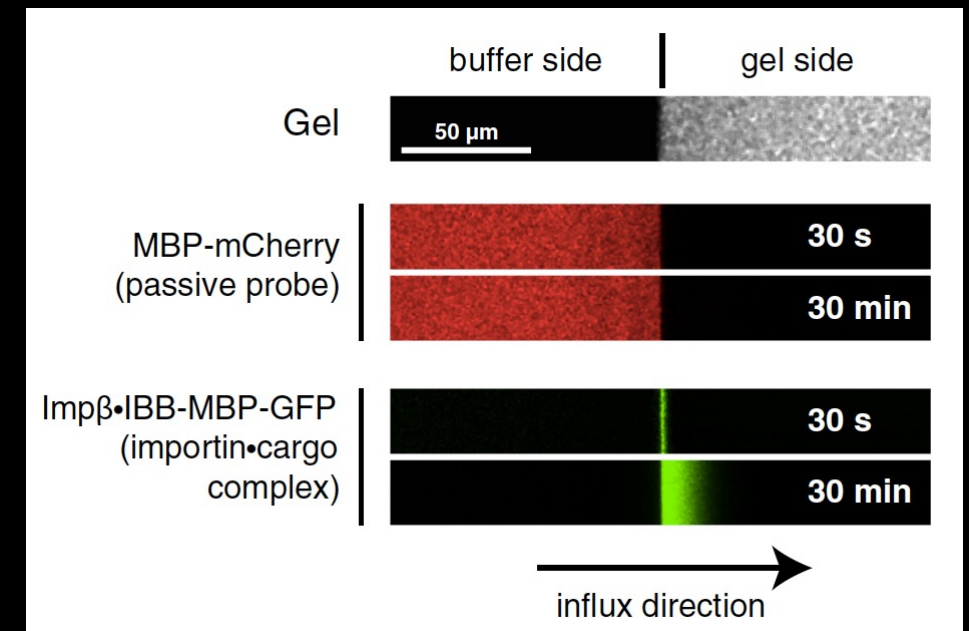


# Nuclear transport relies on cooperation between structure and disorder



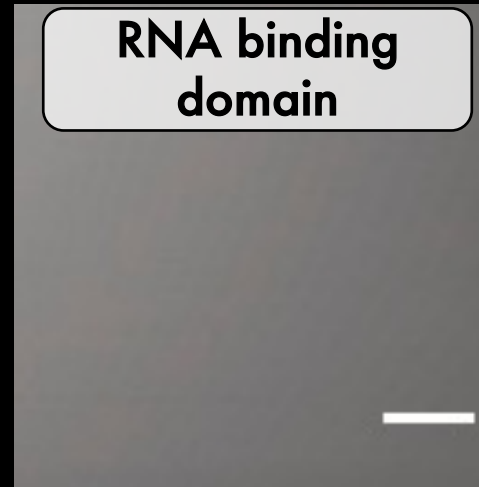
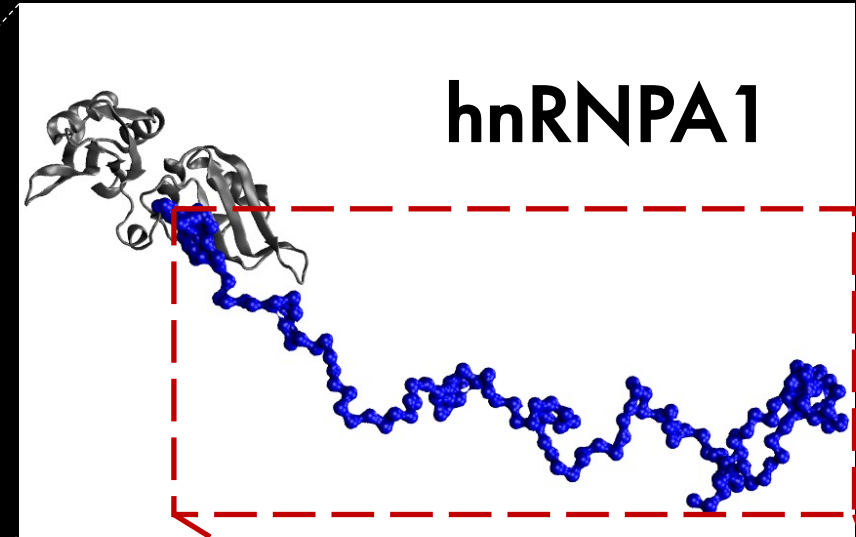
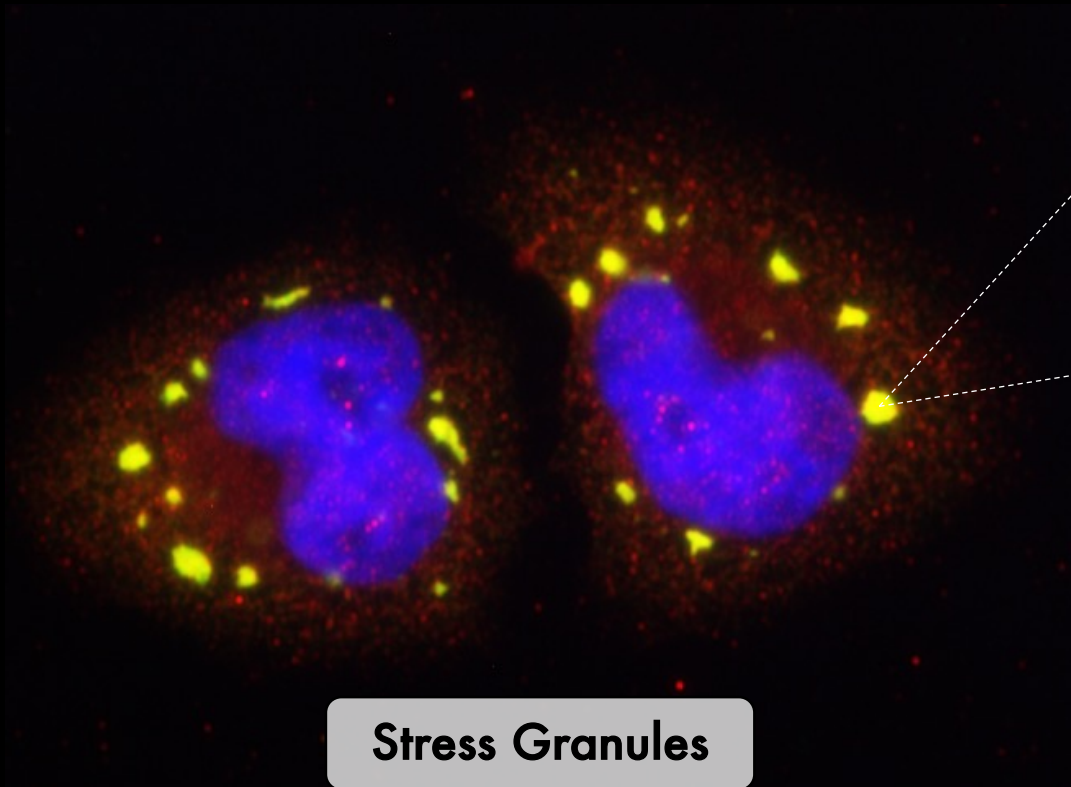
Macroscopic hydrogel made up of cohesive Nup98 FG domain

Hülsmann et al.  
Cell, 2012

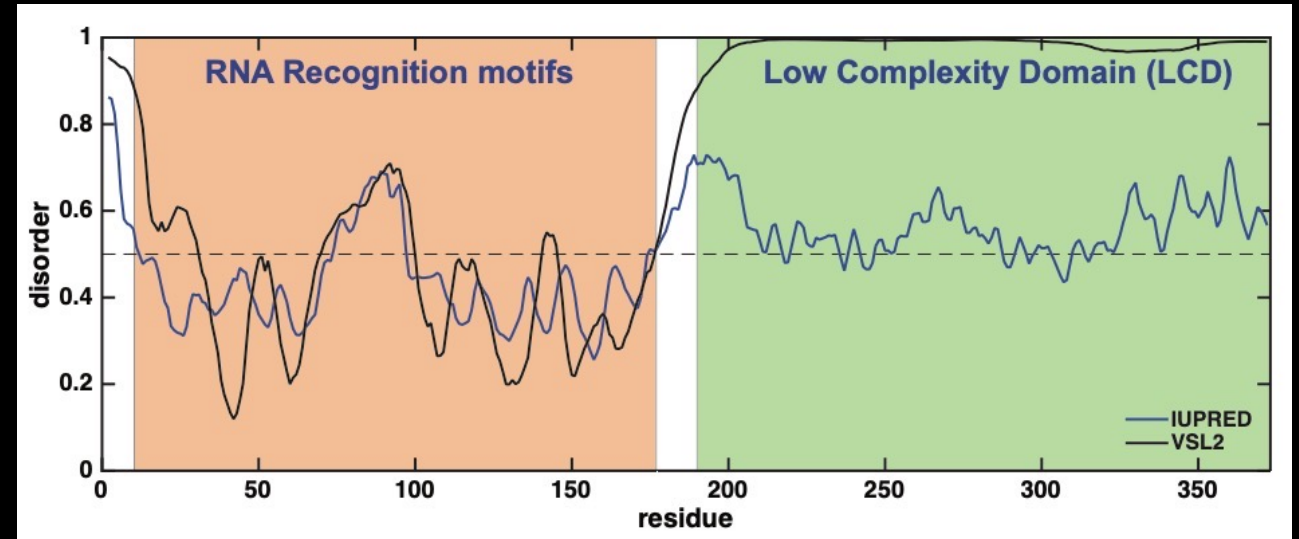
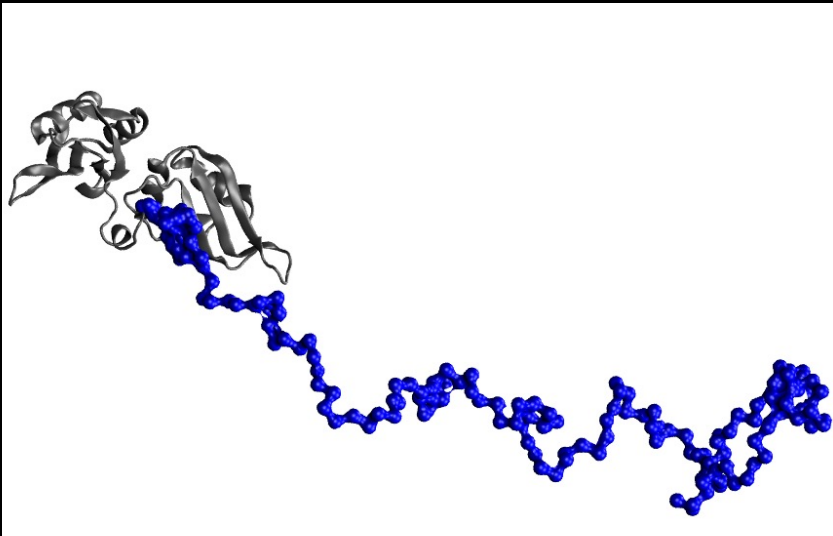


- 1. Use the properties of single proteins to infer the thermodynamics of phase separation**
- 2. Link the thermodynamics of phase separation to kinetics**

# Disordered protein regions are critical regulators of cellular organization

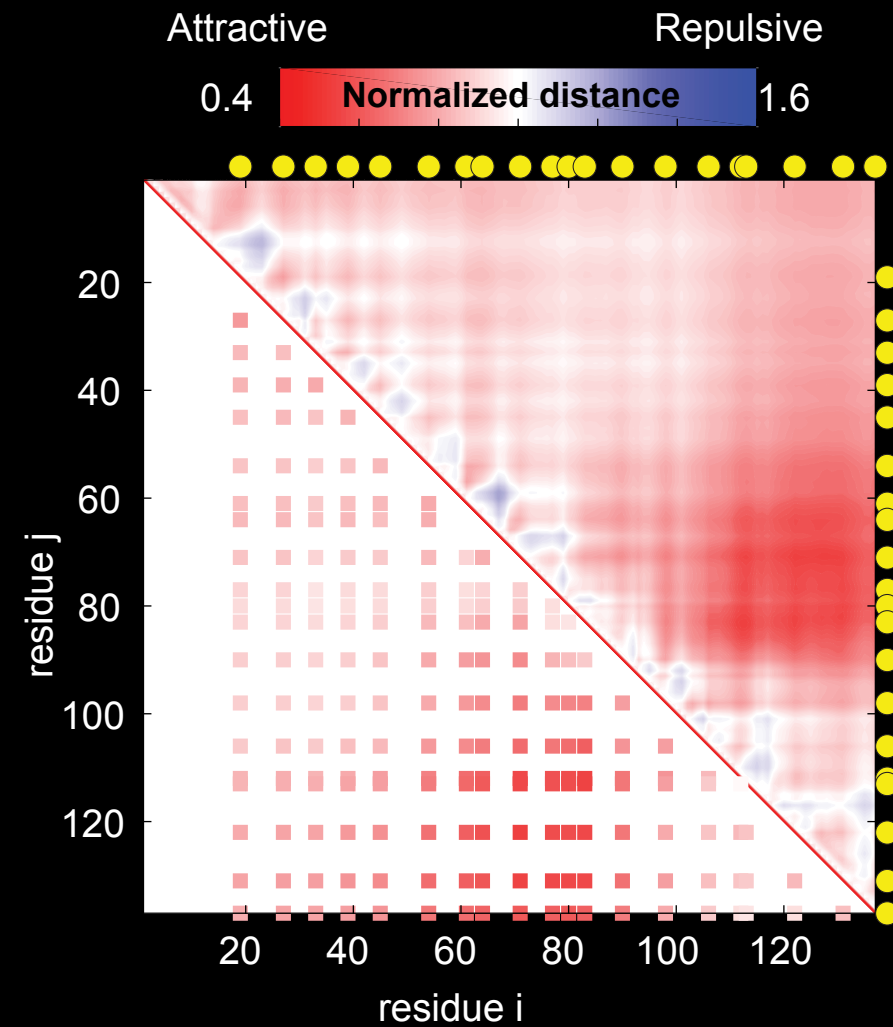
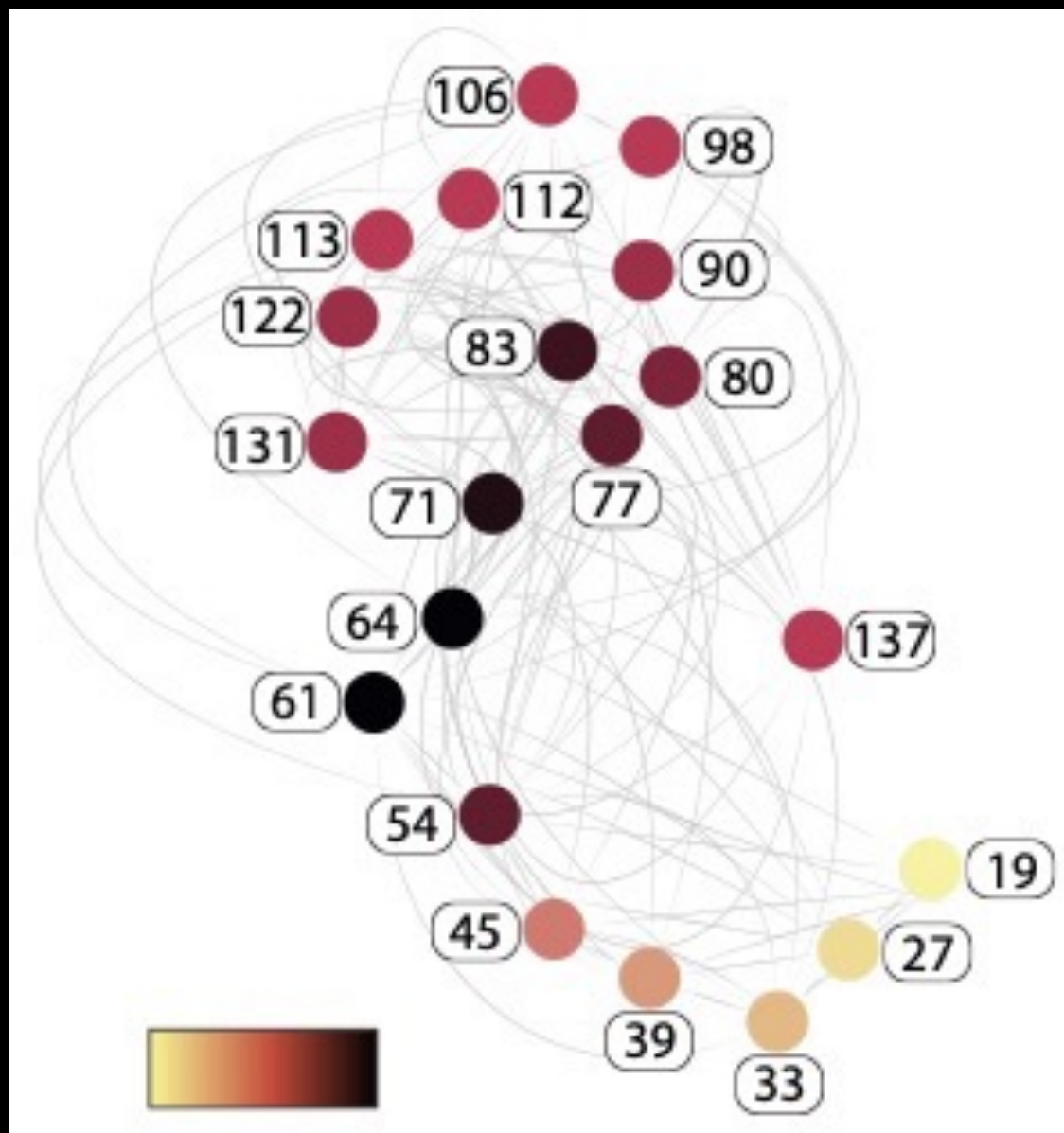


# Adhesive elements in disordered proteins



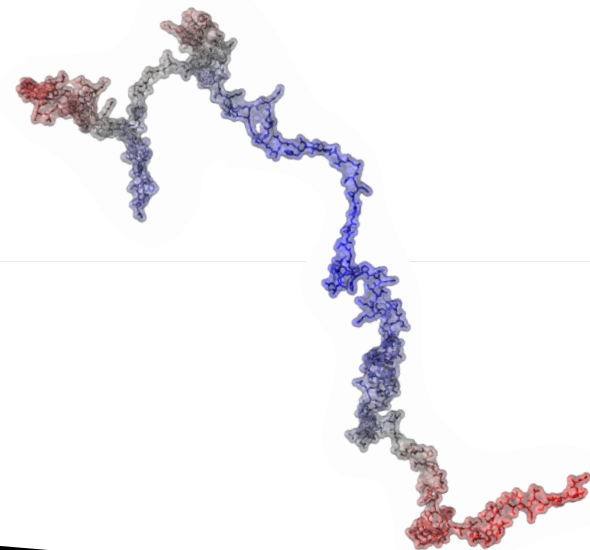
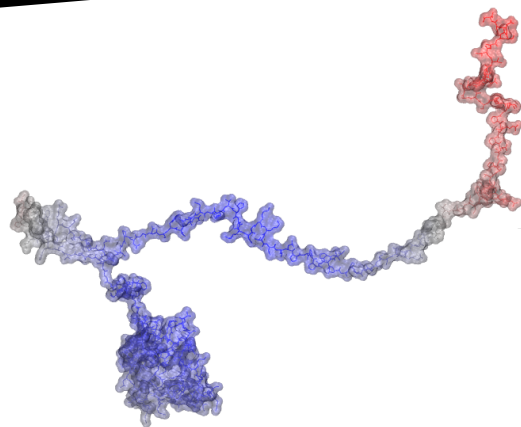
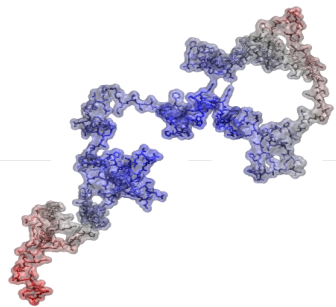
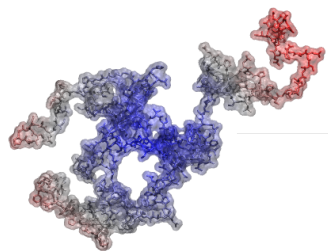
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GGGGGGGGGGS    SSSSSSSSSSS    SSSSSSSSSSS    NNNNNNNNNNN  
NNNQQQQFFF    FFFFFFFFY    YYYYYRRRRR    RRRRRKKDDD  
PPPAAMM

# Distributed low affinity network of aromatic interactions



# Single proteins to emergent properties

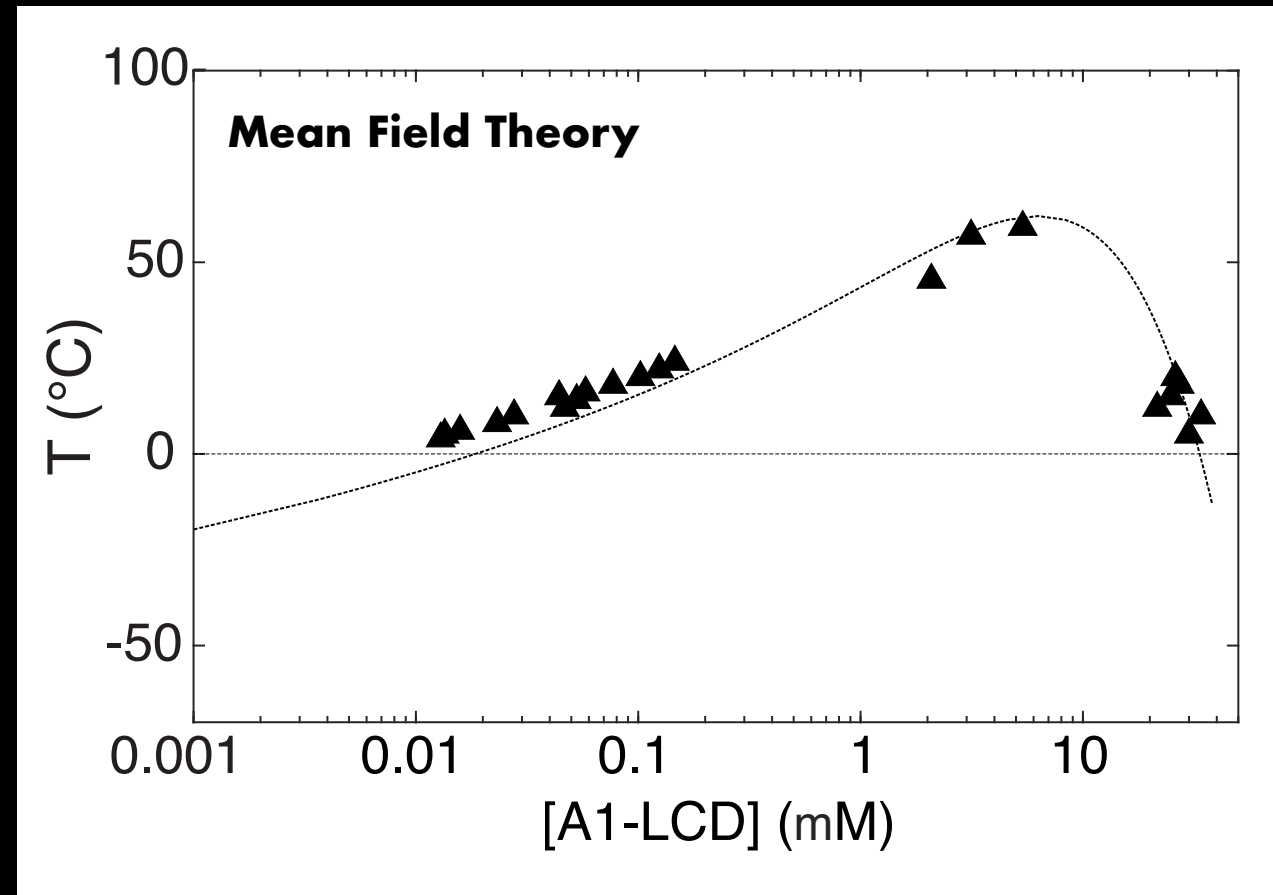
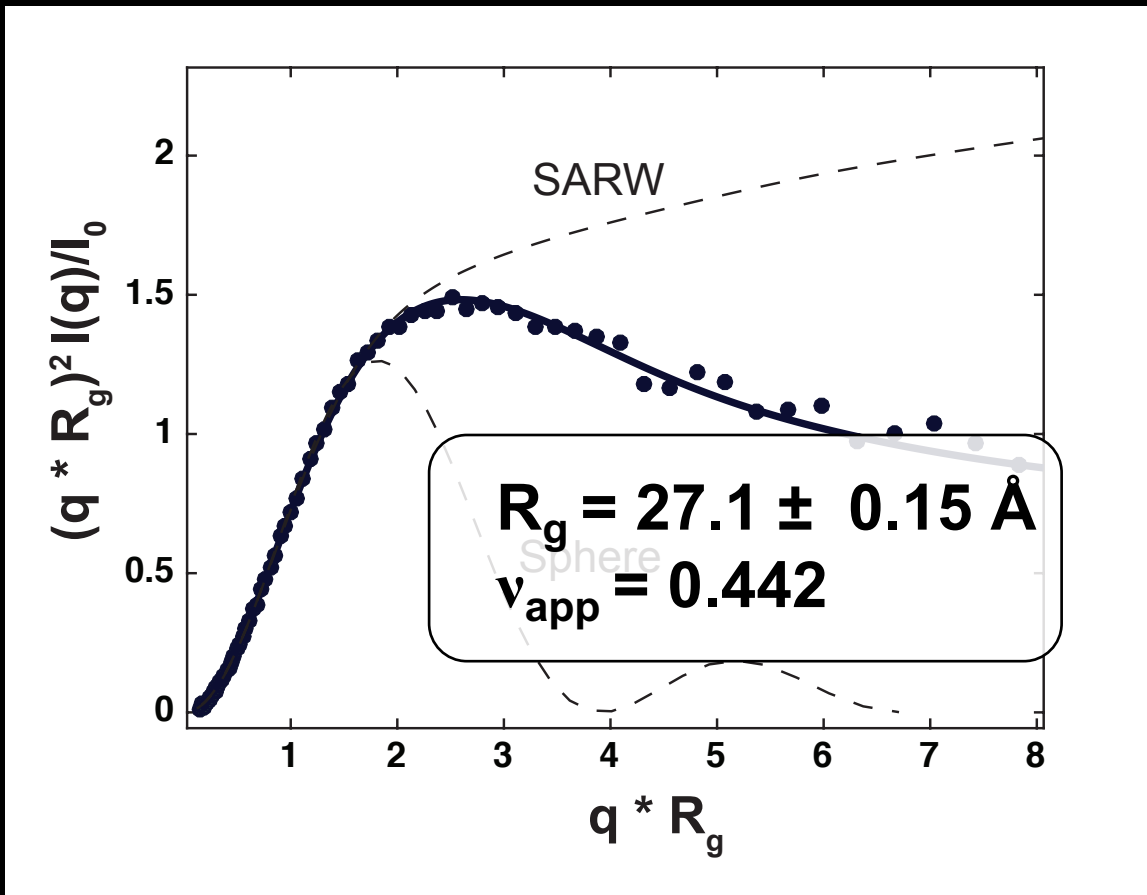
INCREASING  $R_G$



INCREASING  $v_{app}$



# Single proteins to emergent properties



Martin, Hopkins, Mittag, MiE, 2021

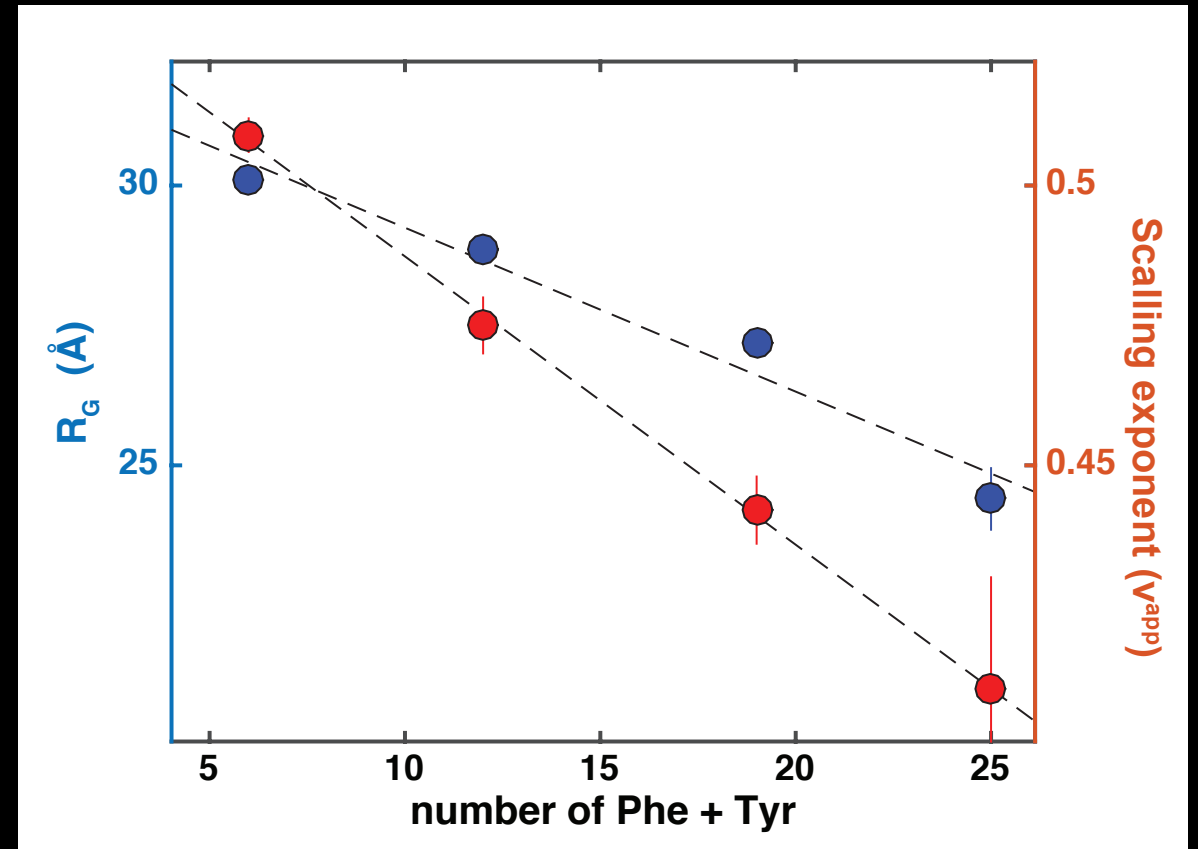
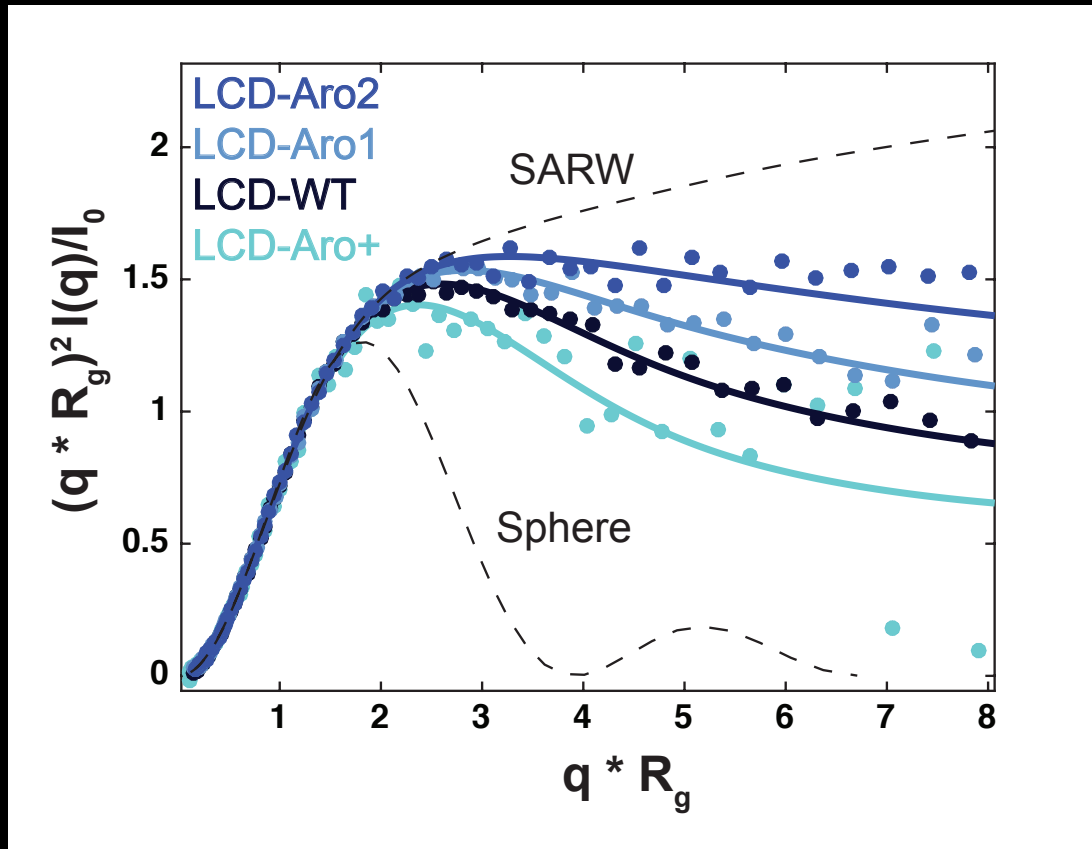
Martin, Holehouse, Peran ... Pappu, Mittag, Science, 2020

# Single proteins to emergent properties

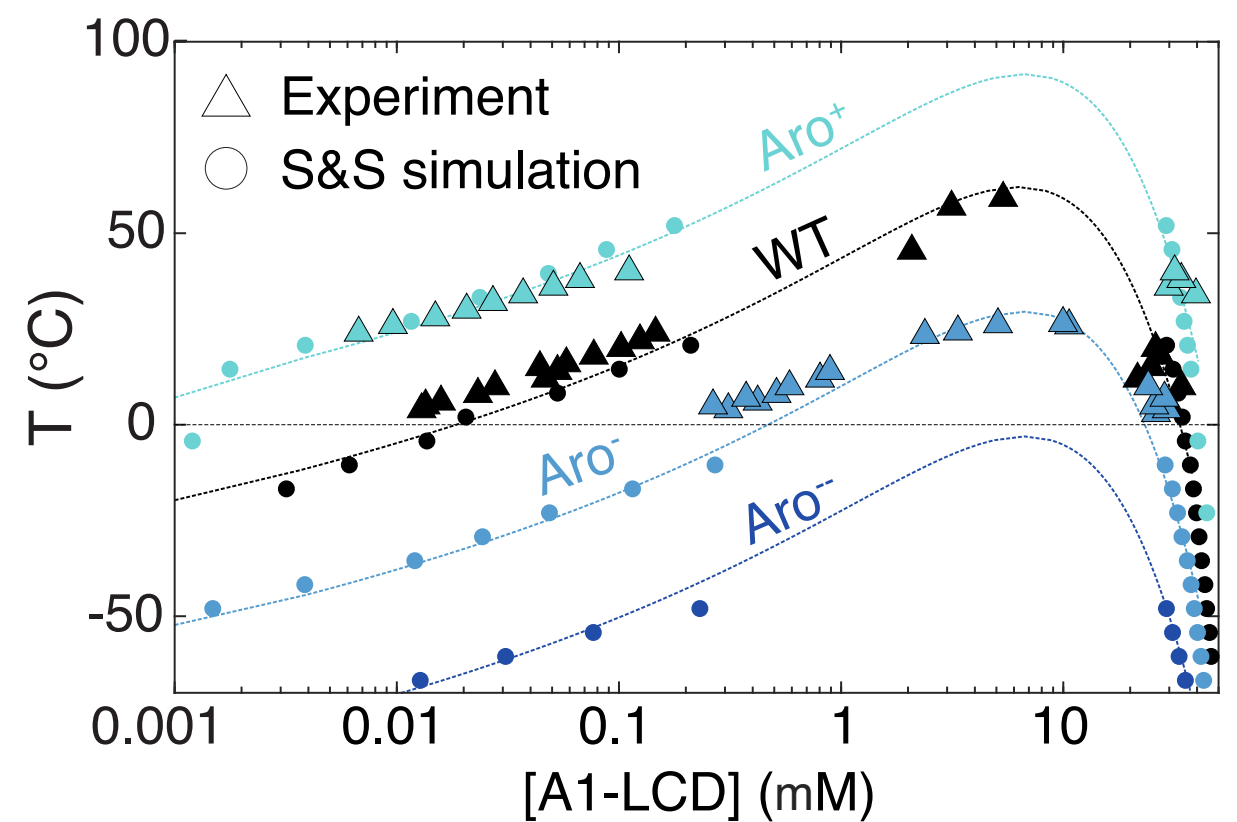
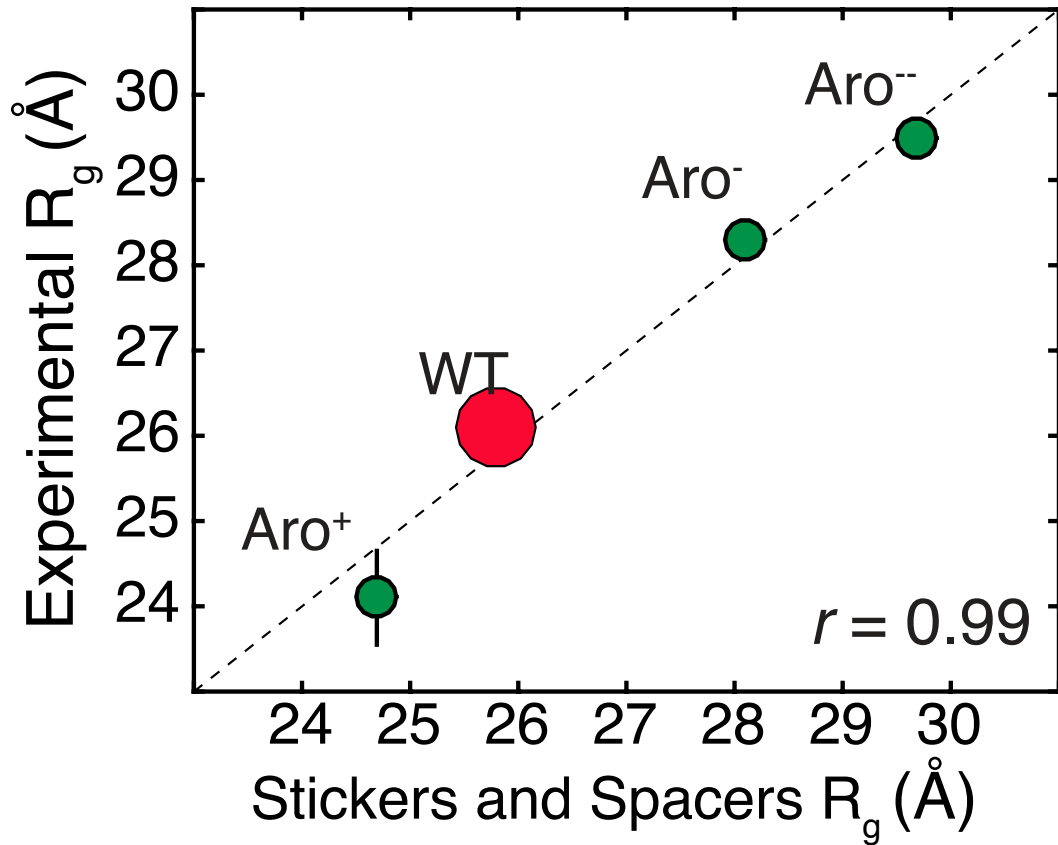
**WT LCD**



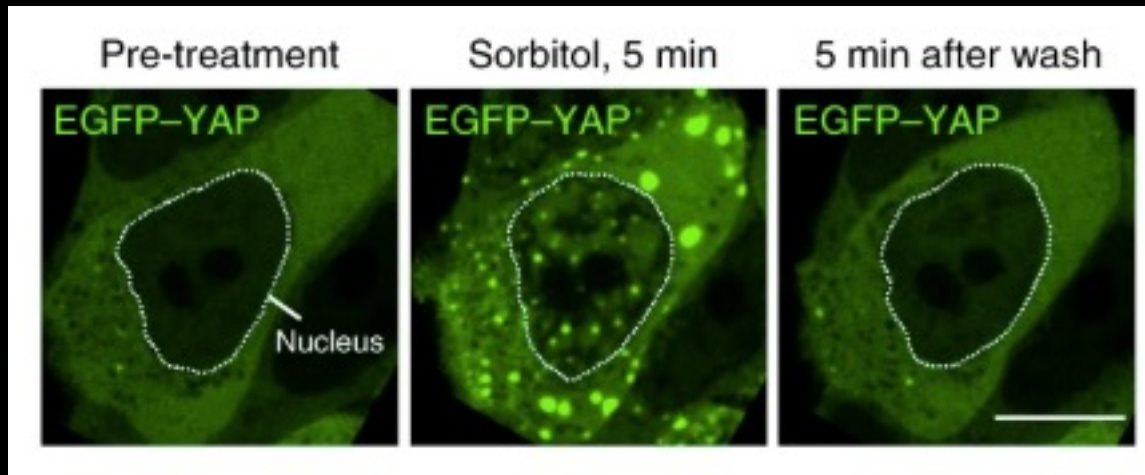
# Single proteins to emergent properties



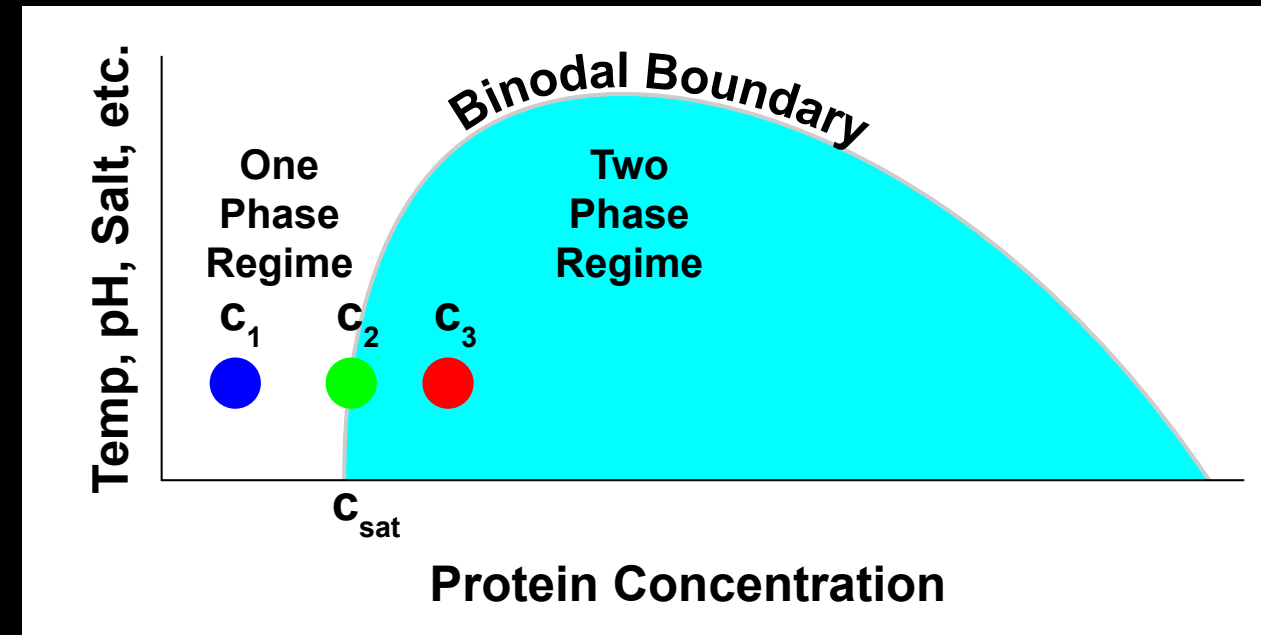
# Single proteins to emergent properties



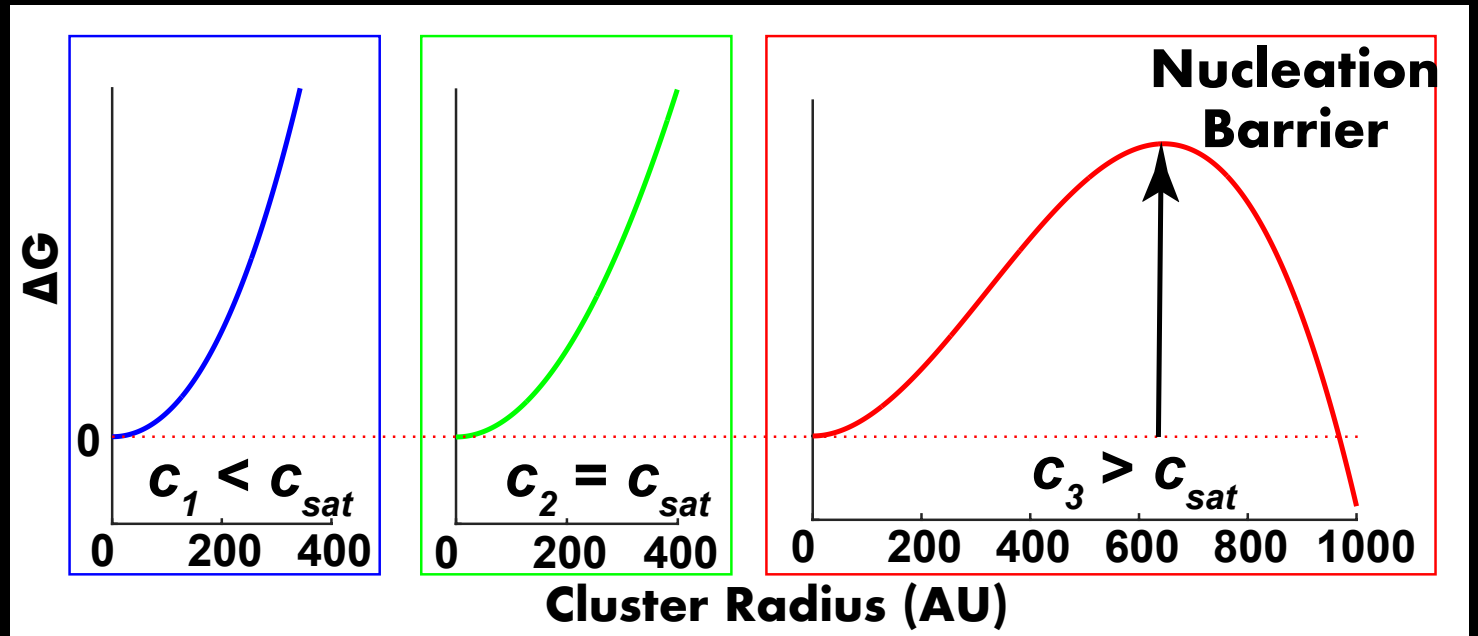
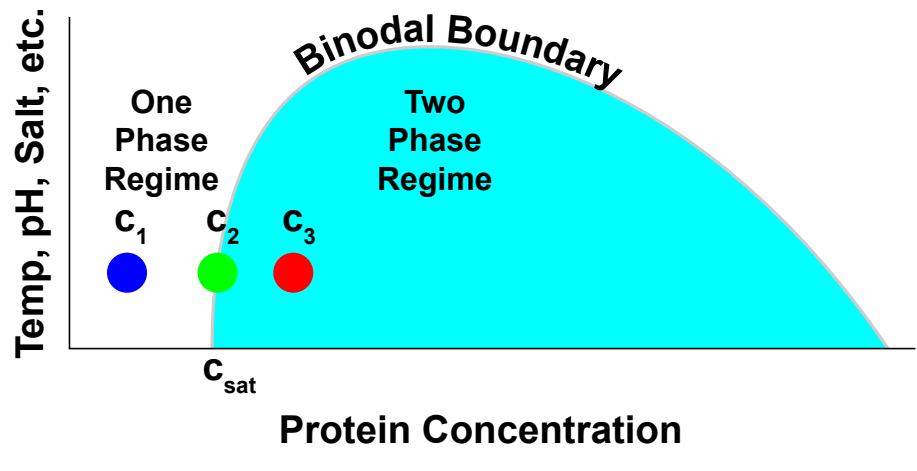
# How do proteins condense in response to changes in cellular conditions?



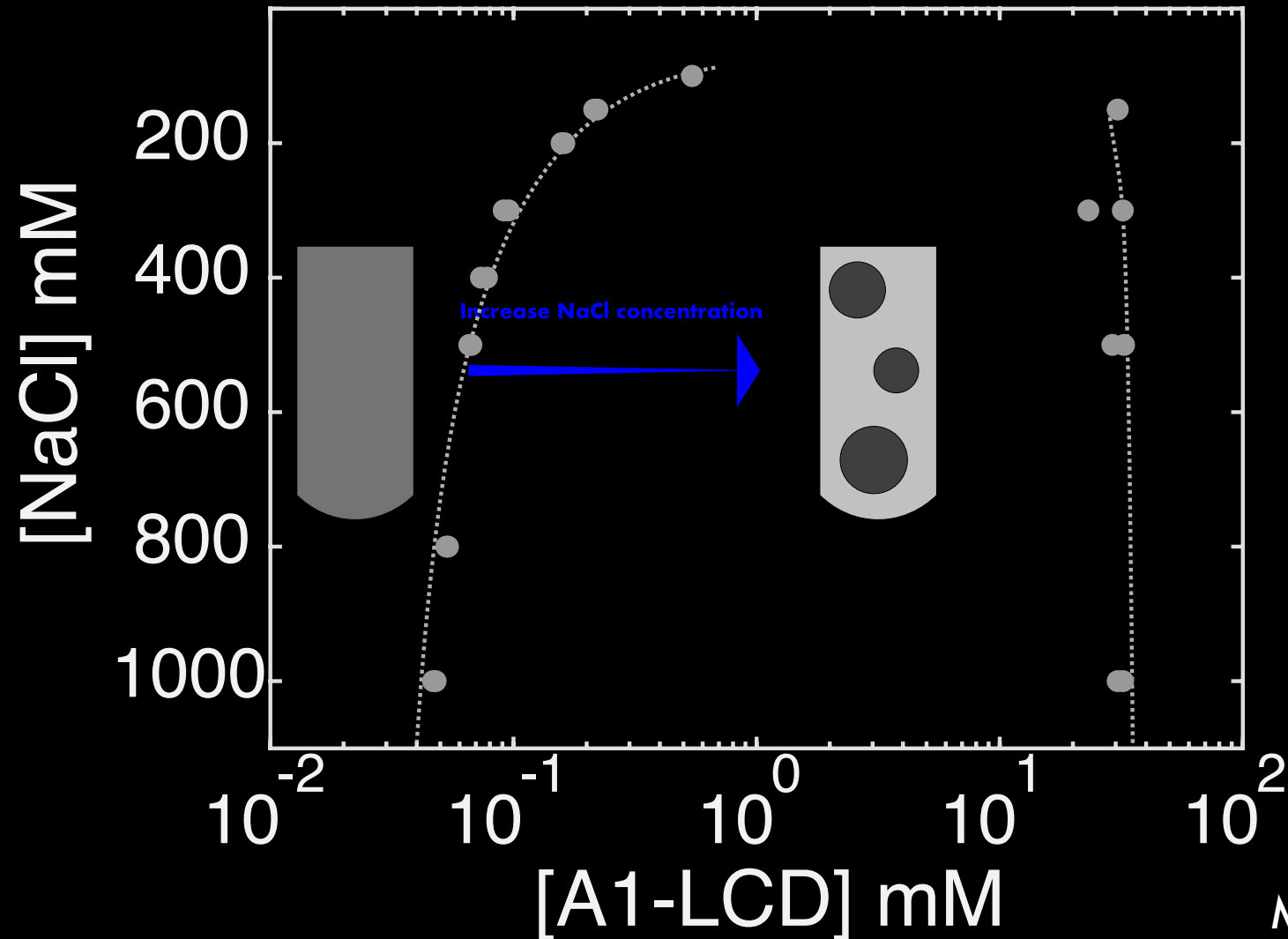
Cai et al. Nature Cell Biology 2019



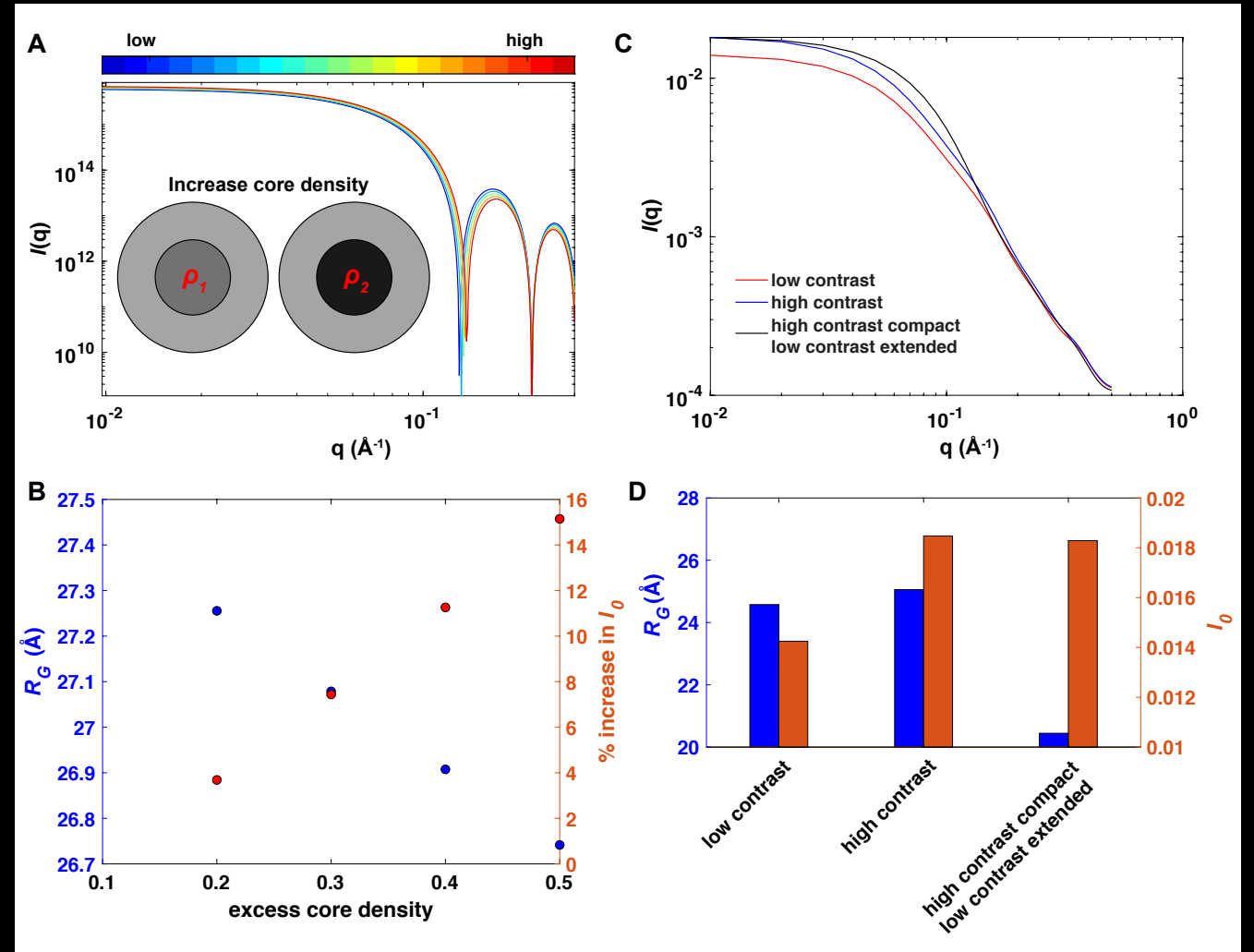
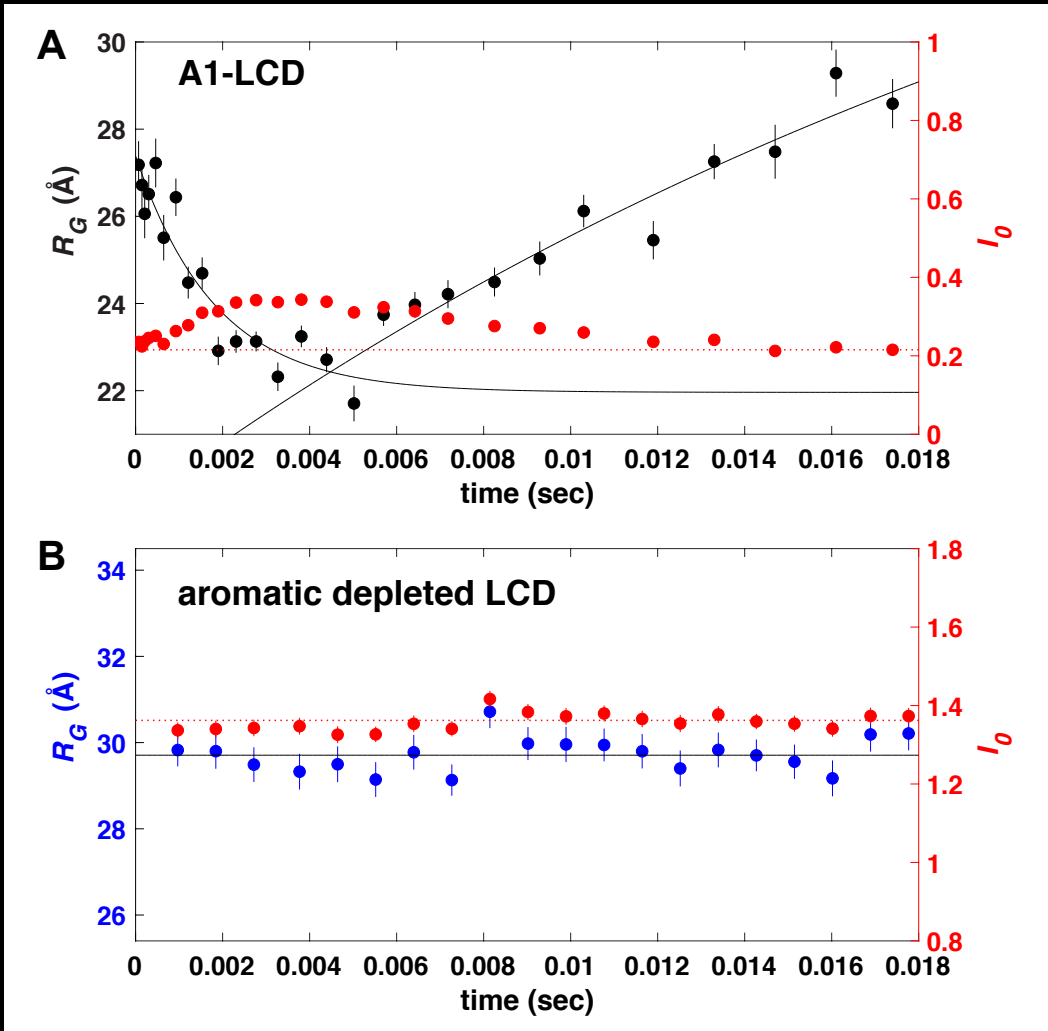
# Nucleation of phase separation



# NaCl concentration modulates A1-LCD phase separation

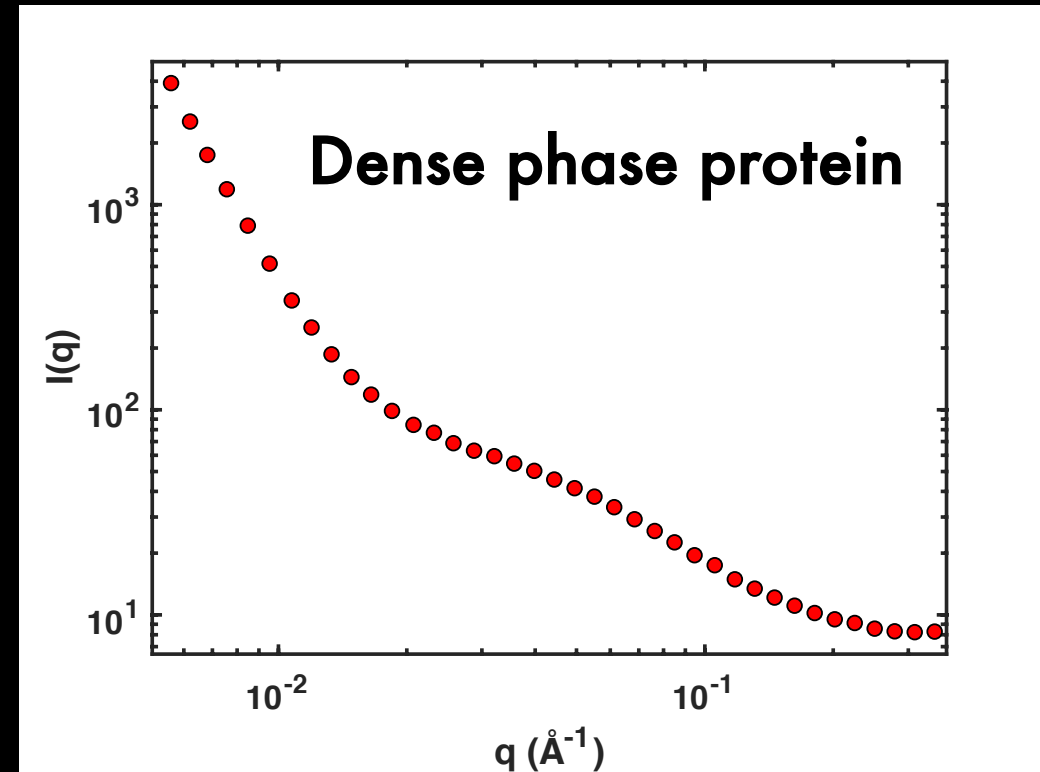
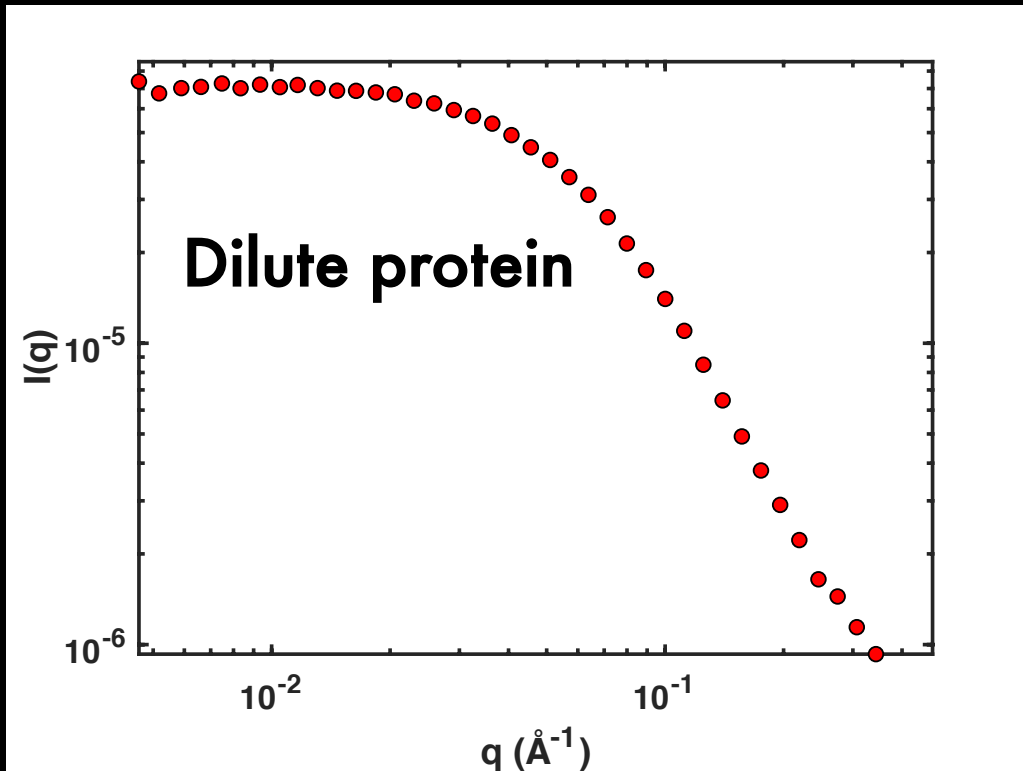


# Nucleation of phase separation

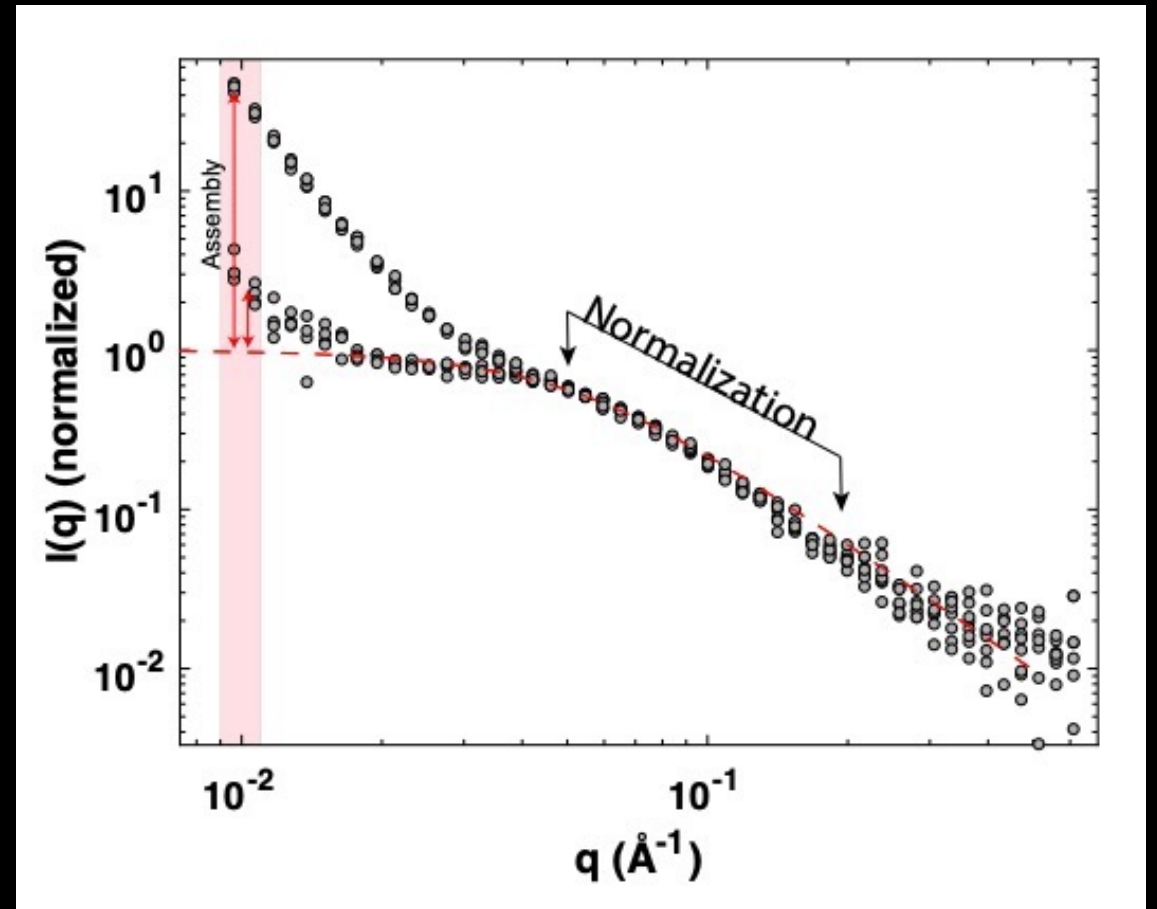
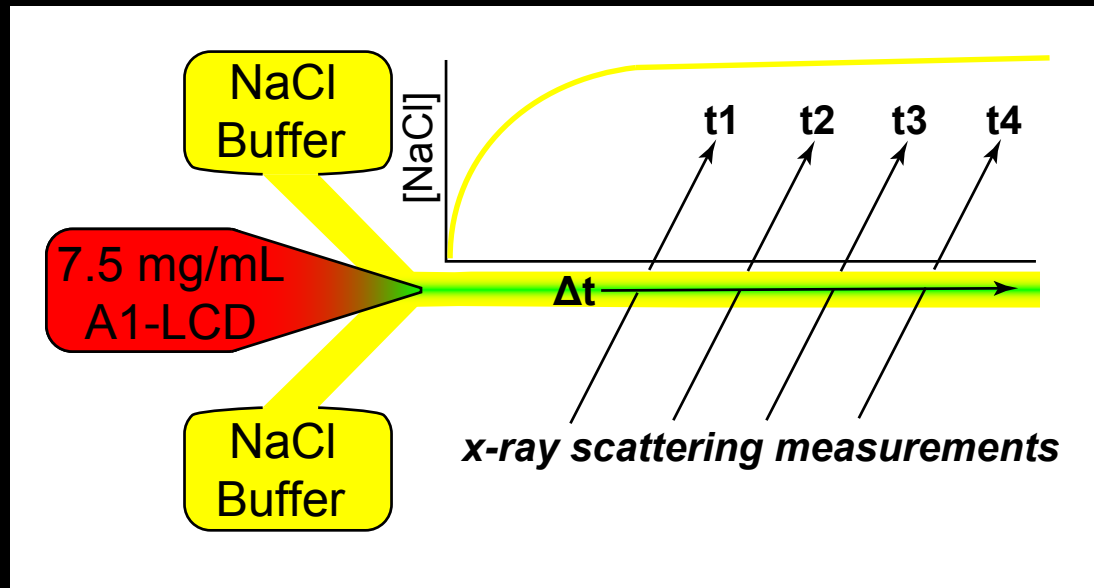




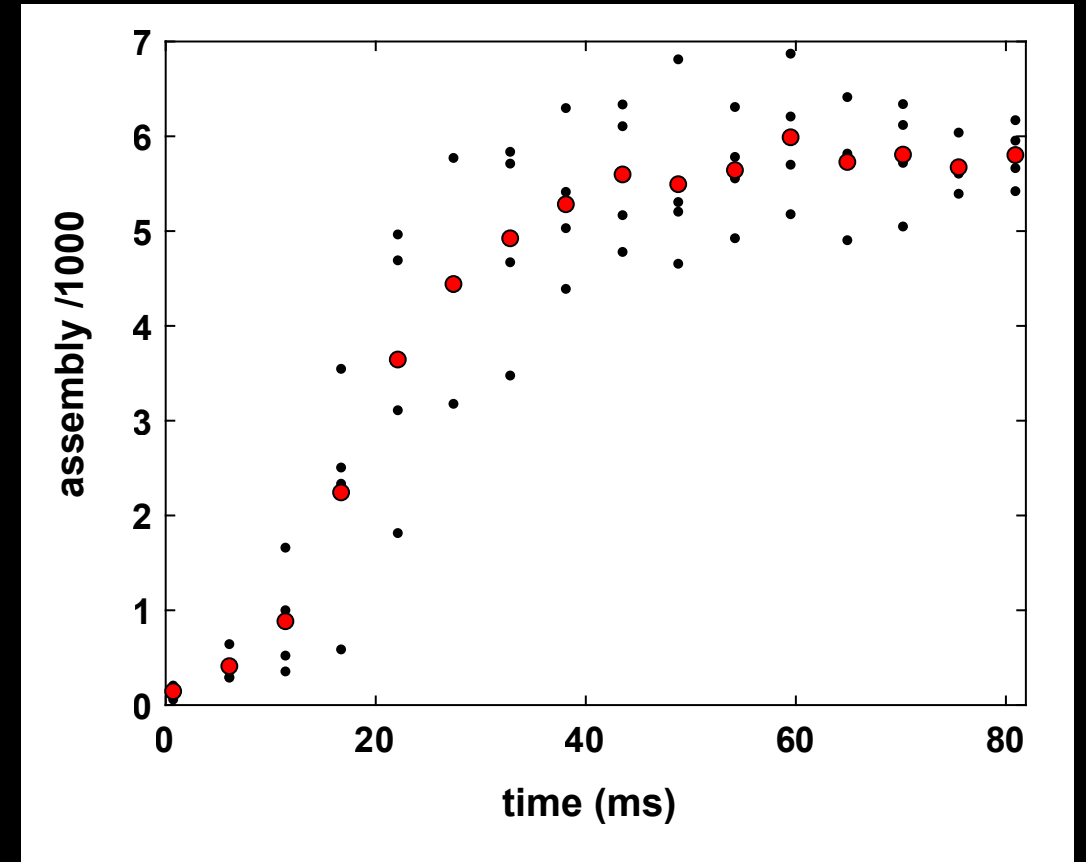
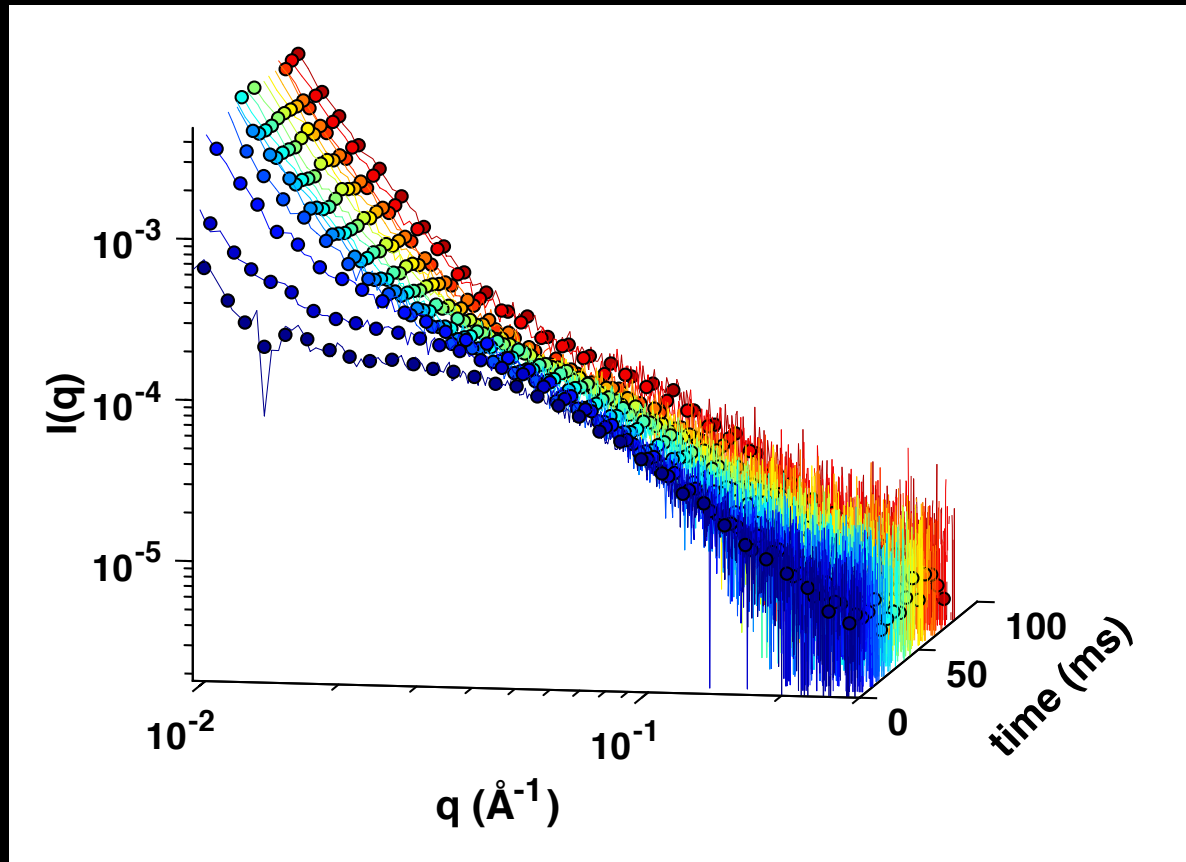
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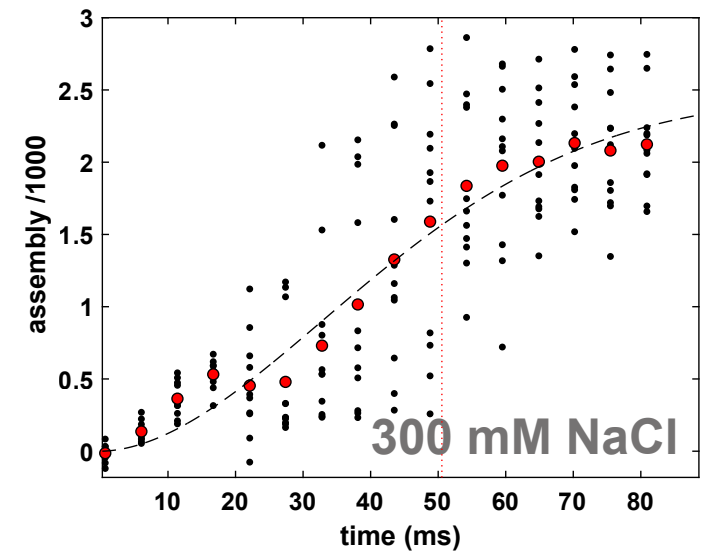
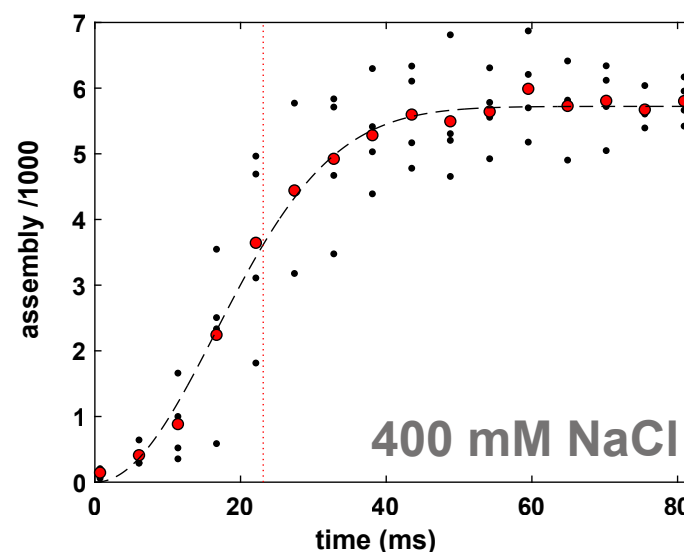
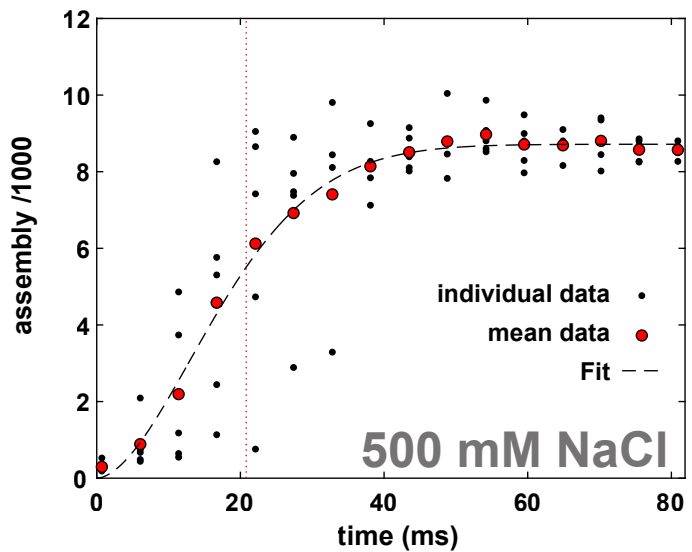
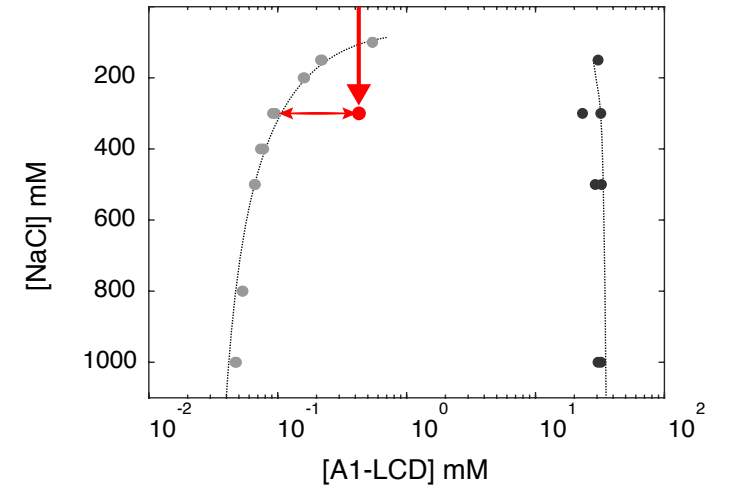
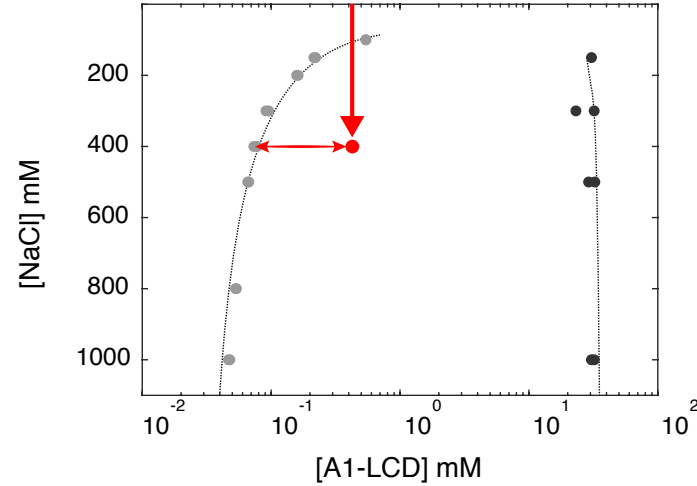
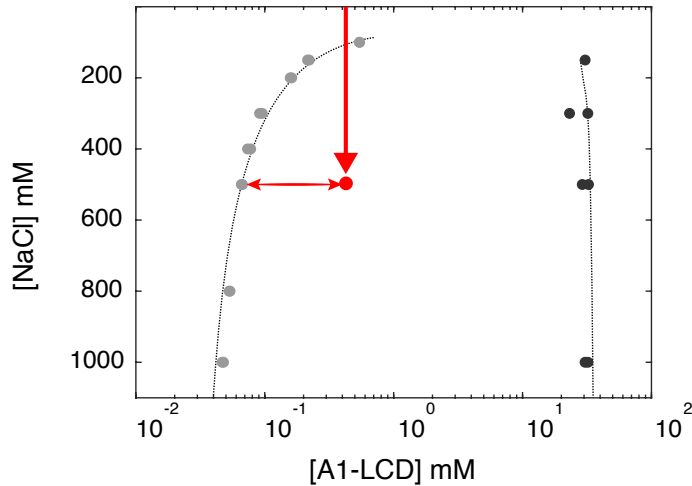
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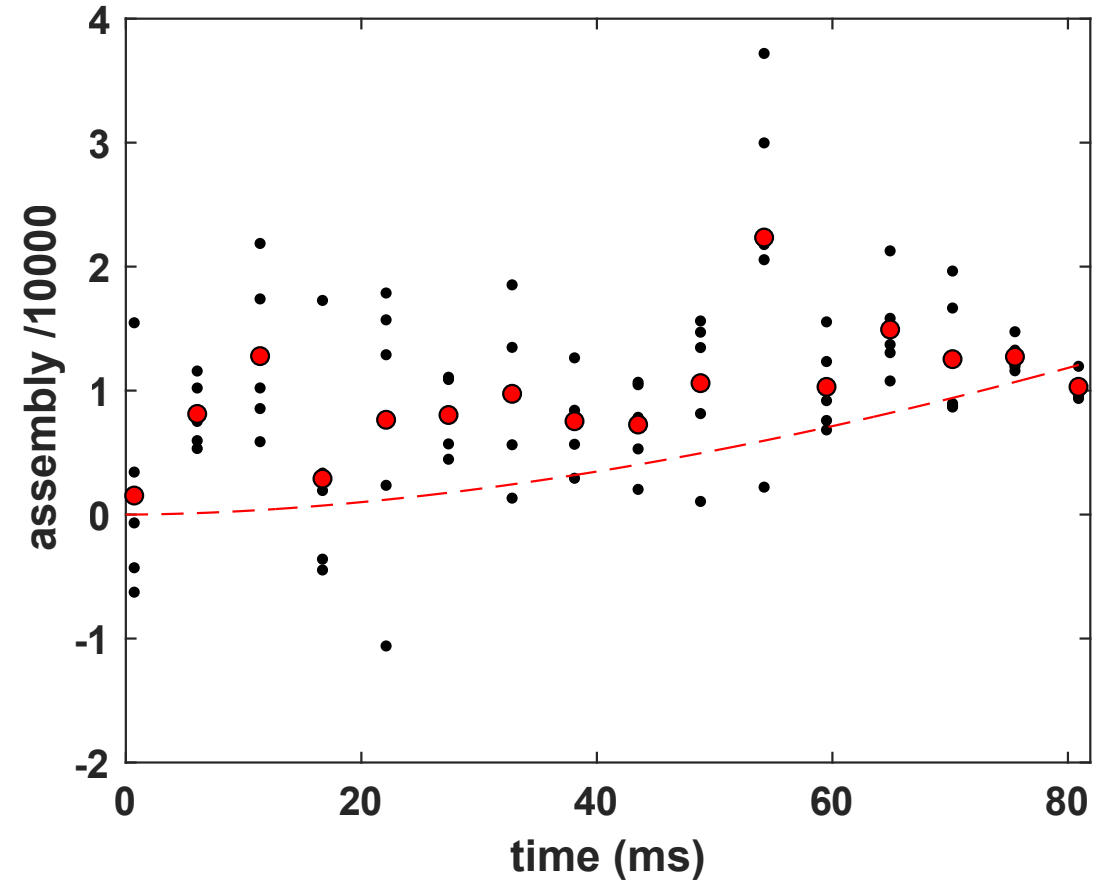
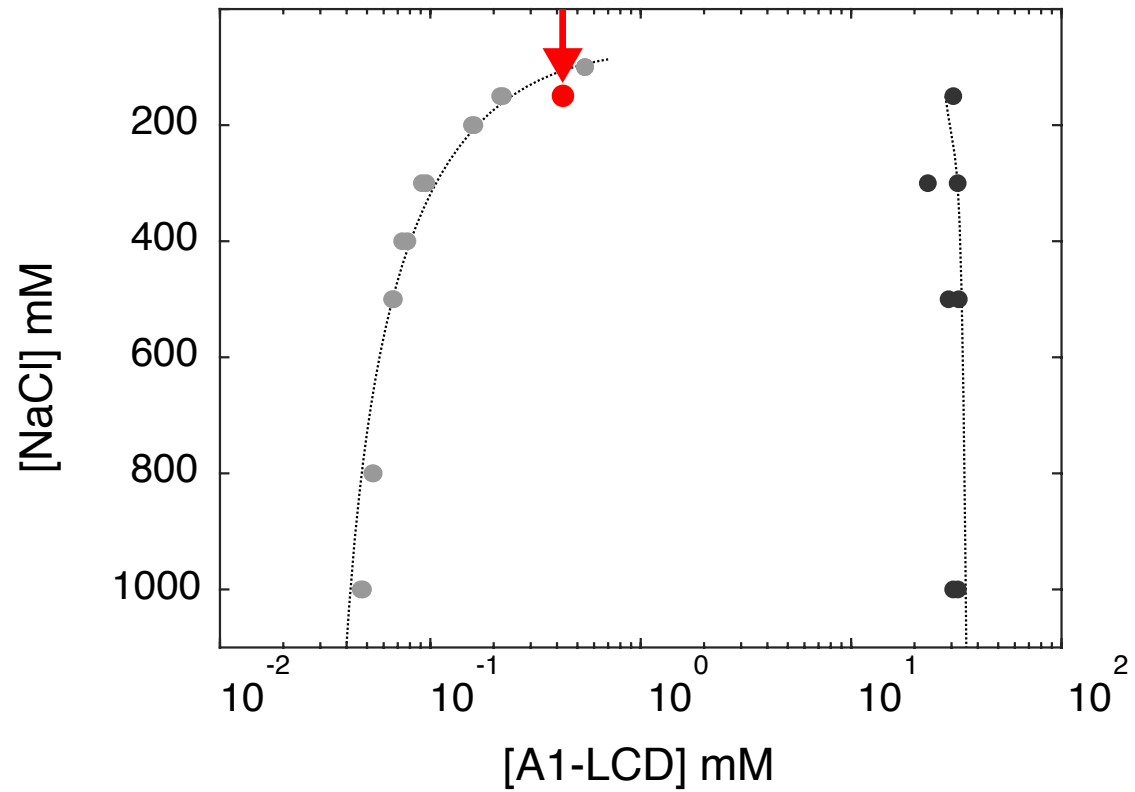
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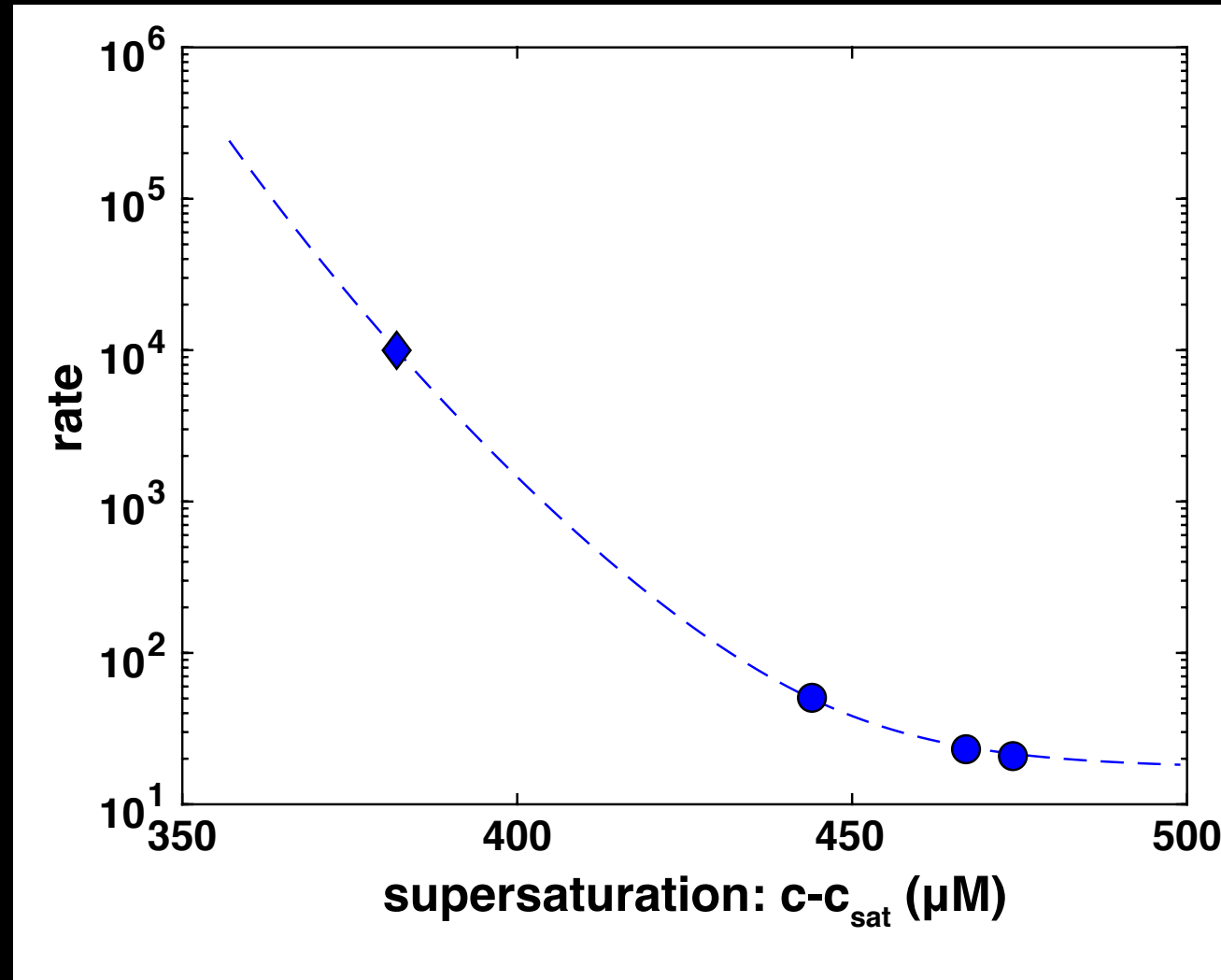
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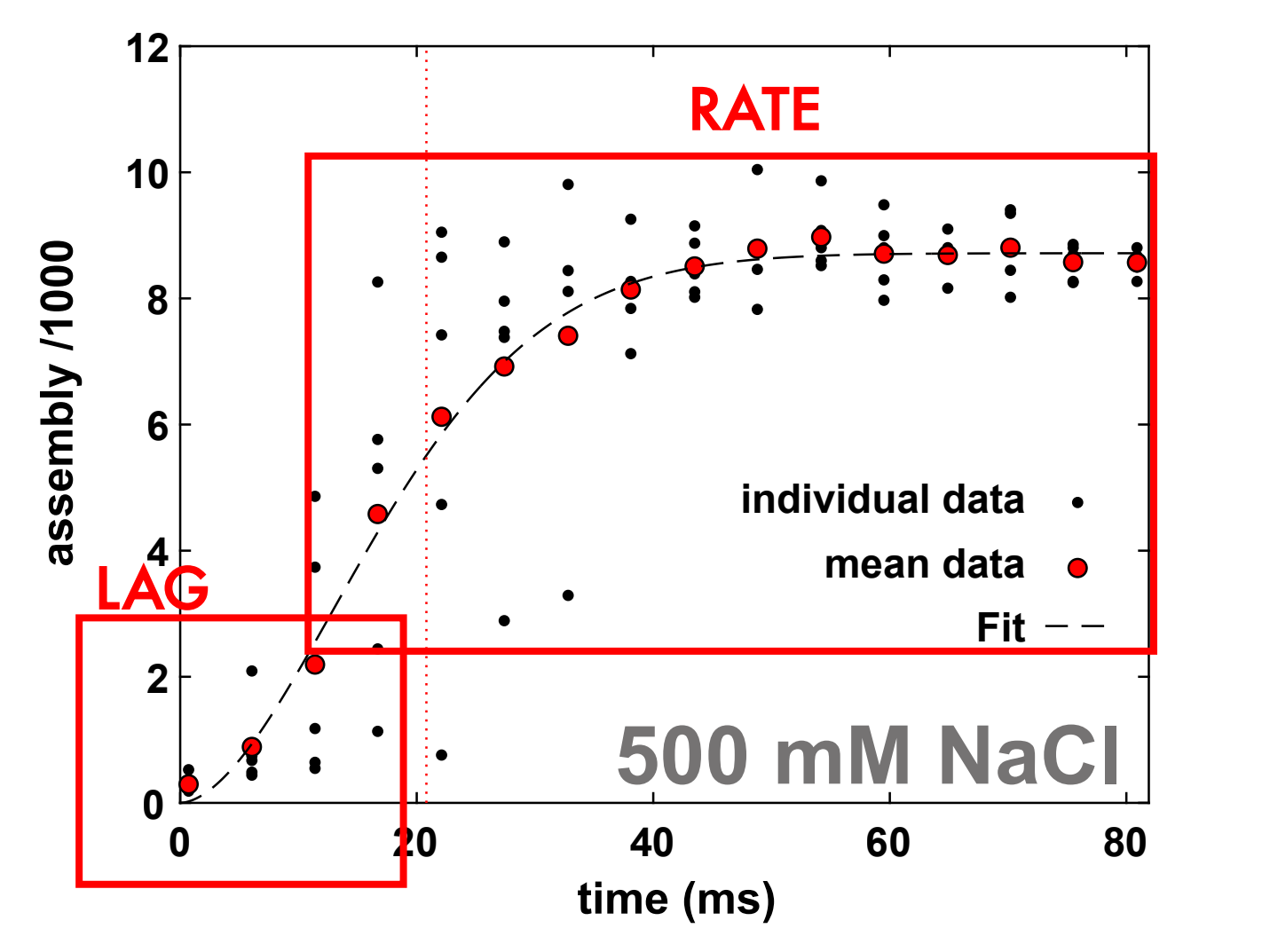
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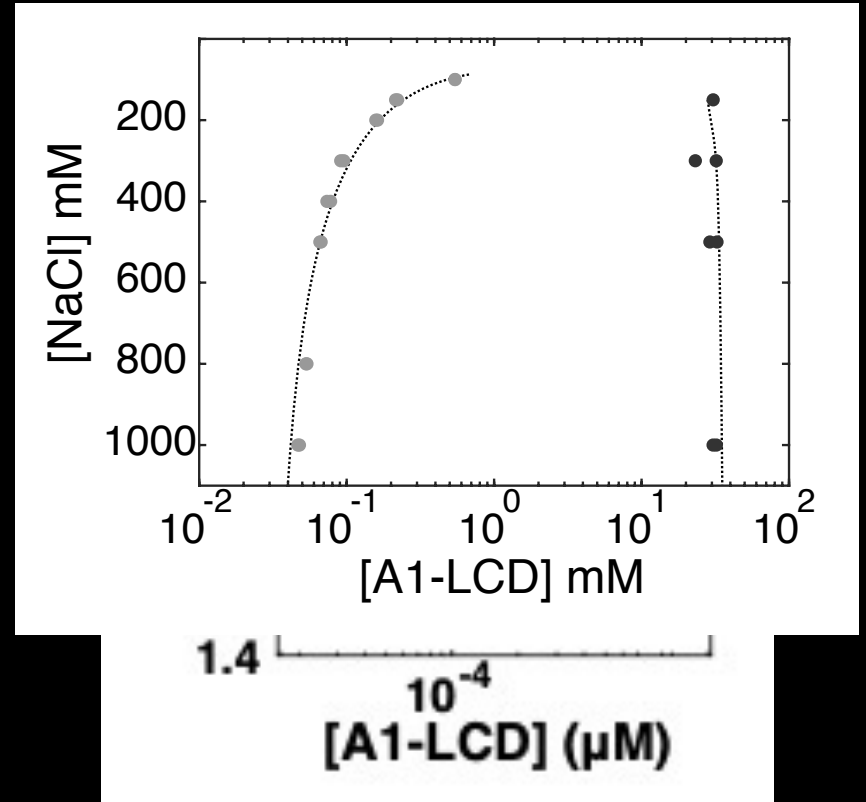
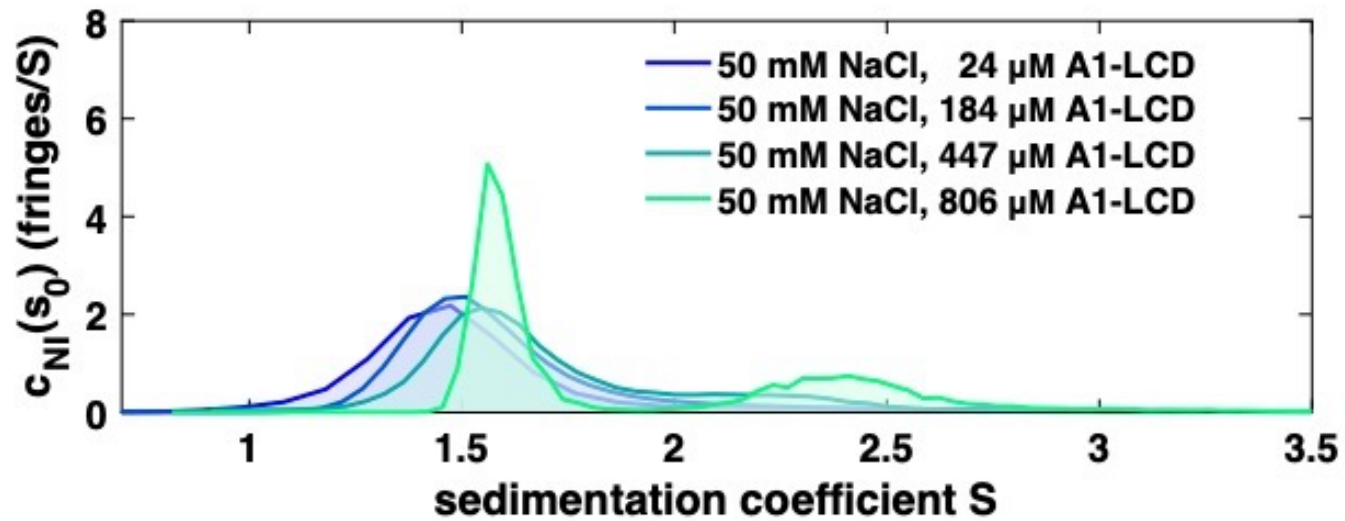
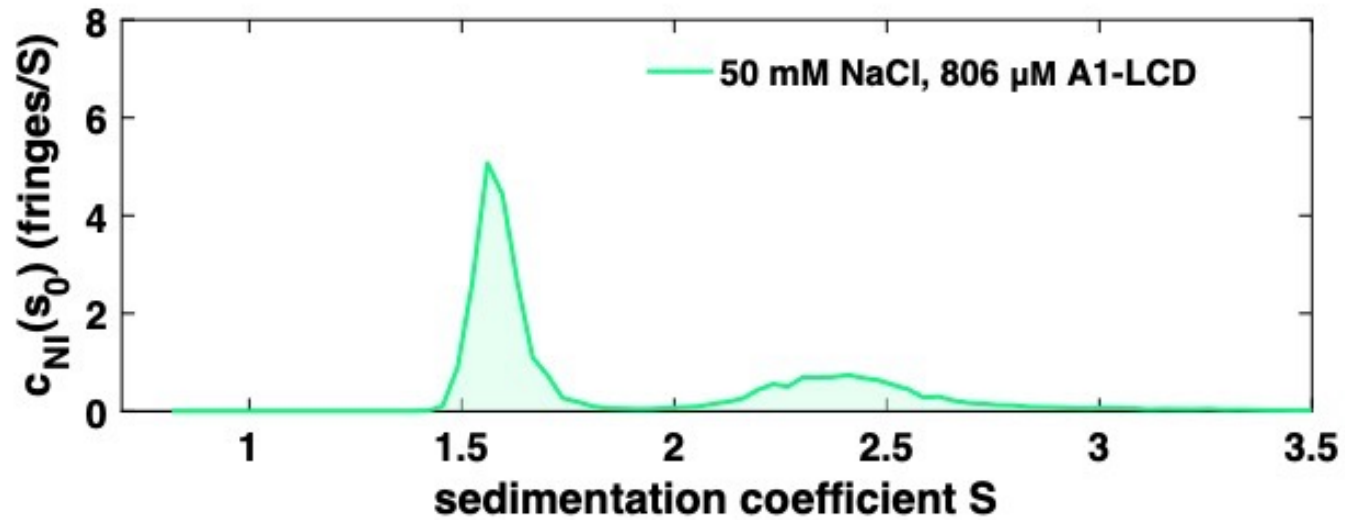
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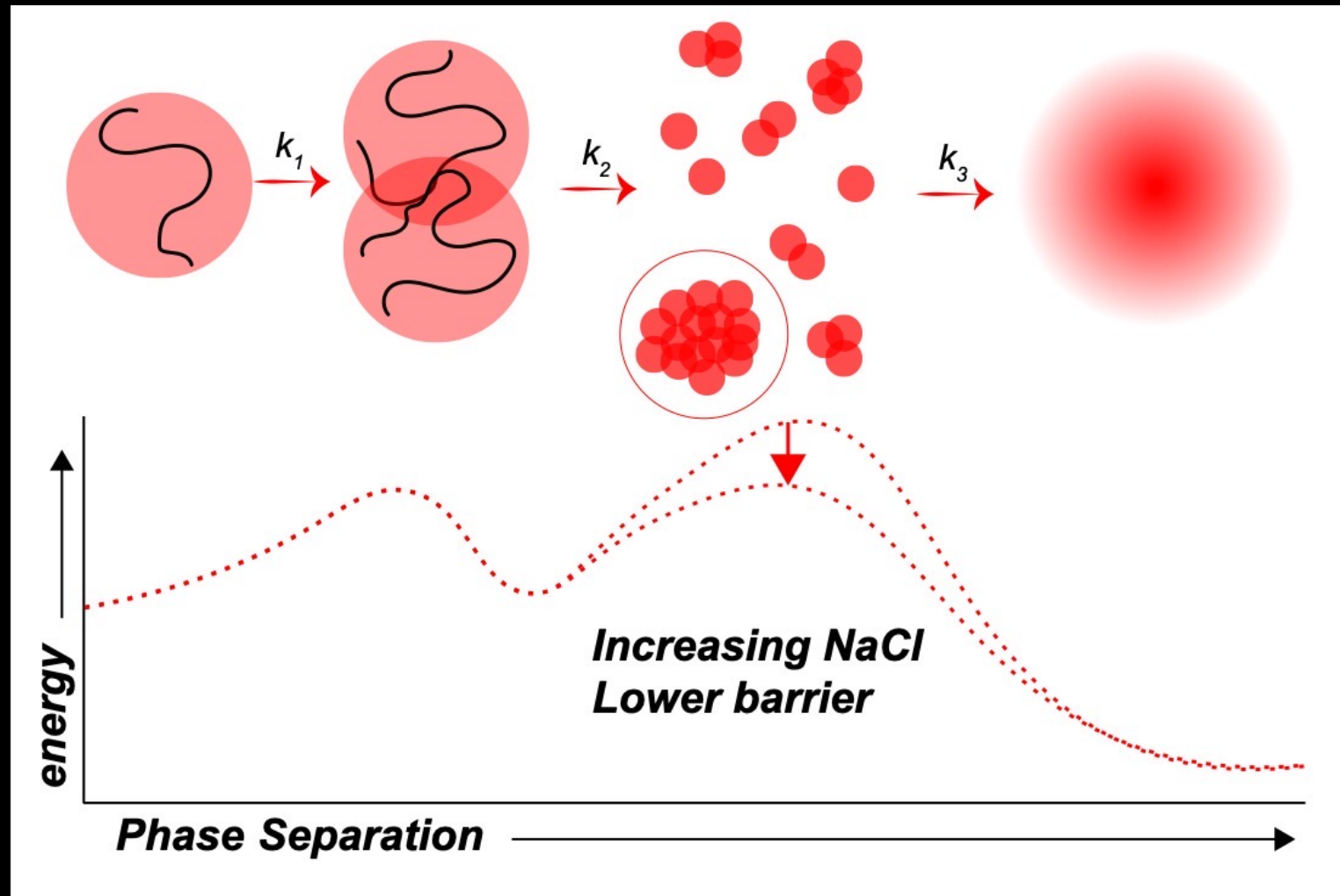


# Nucleation of phase separation





# Nucleation of phase separation





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# Acknowledgements

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