

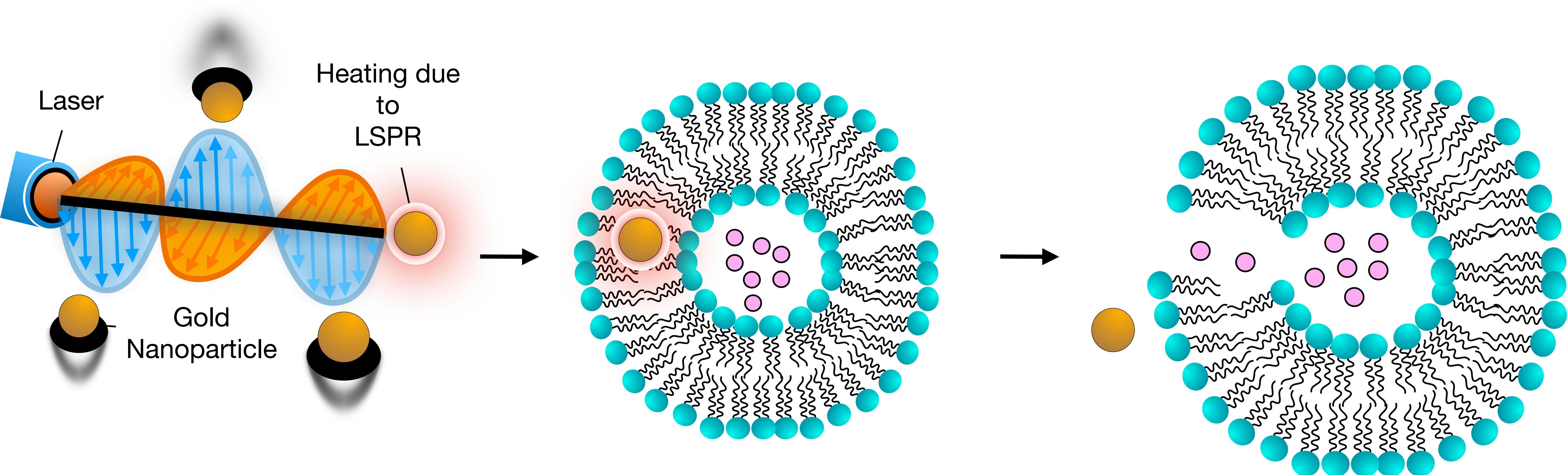
Restoring Order: Messing with Membrane Structure

Jahmal Ennis

Outline

- Background & Motivation
- Research Question
- Bare Hydrophobic Nanoparticle Aggregation
- Ligand Coated Hydrophobic Nanoparticle Aggregation
- Ligand Coated Charged Nanoparticle Aggregation
- Summary

Nanoparticle irradiation induces vesicle rupture



Motivation: A versatile tool that needs to be better understood

- Targeted Drug Delivery Systems
- Photodynamic Therapy
- Drug/Therapeutic Agent Delivery
- Diagnostic Tool

Targeted photodynamic therapy of breast cancer cells using antibody-phthalocyanine-gold nanoparticle conjugates

[Tanya Stuchinskaya](#), [Miguel Moreno](#), [Michael J. Cook](#), [Dylan R. Edwards](#) & [David A. Russell](#) 

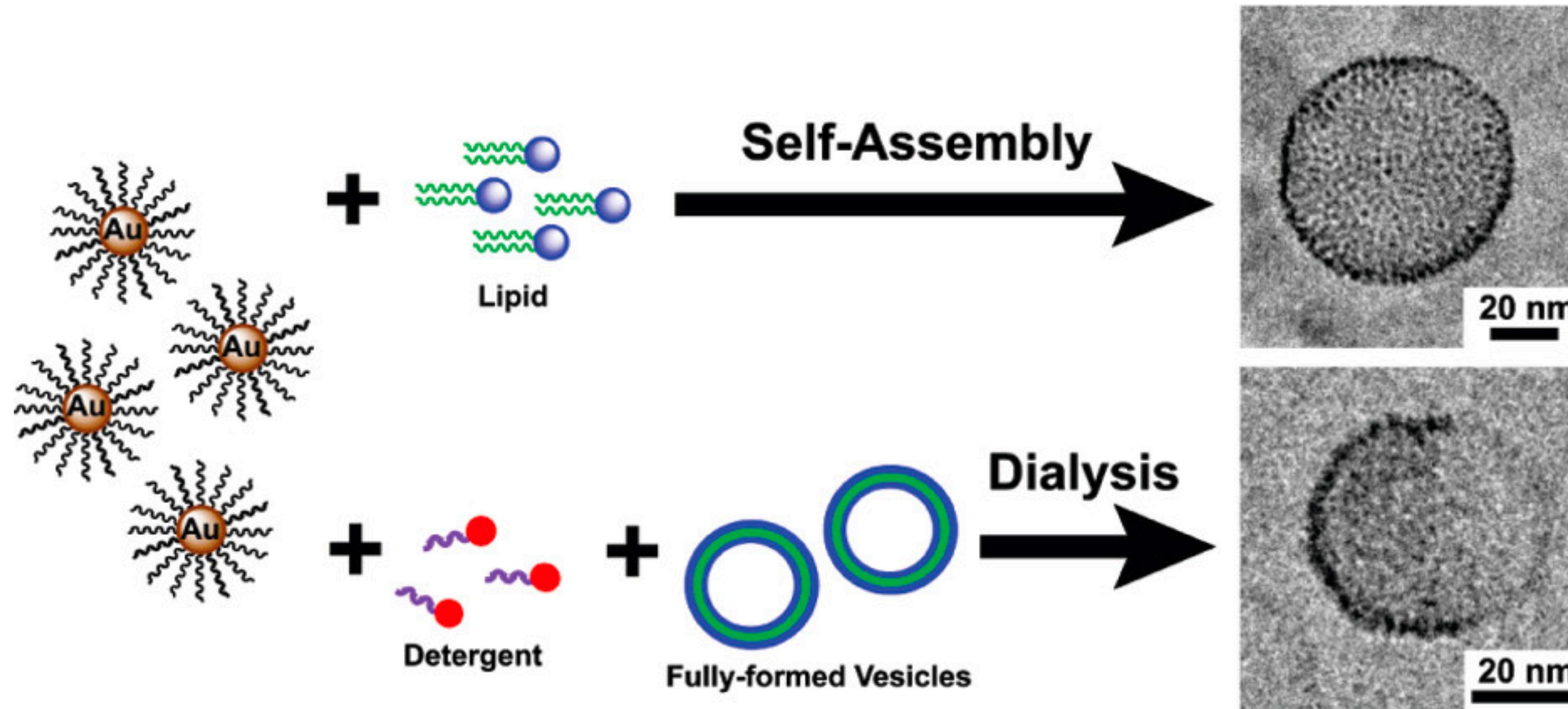
Diagnosing lung cancer in exhaled breath using gold nanoparticles

[Gang Peng](#), [Ulrike Tisch](#), [Orna Adams](#), [Meggie Hakim](#), [Nisrean Shehada](#), [Yoav Y. Broza](#), [Salem Billan](#),
[Roxolyana Abdah-Bortnyak](#), [Abraham Kuten](#) & [Hossam Haick](#) 

Gold Nanoparticles for the Improved Anticancer Drug Delivery of the Active Component of Oxaliplatin

Sarah D. Brown^{†‡}, Paola Nativo[†], Jo-Ann Smith[‡], David Stirling[§], Paul R. Edwards[¶], Balaji Venugopal[⊥], David J. Flint[‡], Jane A. Plumb[⊥], Duncan Graham^{*†}, and Nial J. Wheate^{*‡}

Motivation: nanoparticle aggregation is variable, why?

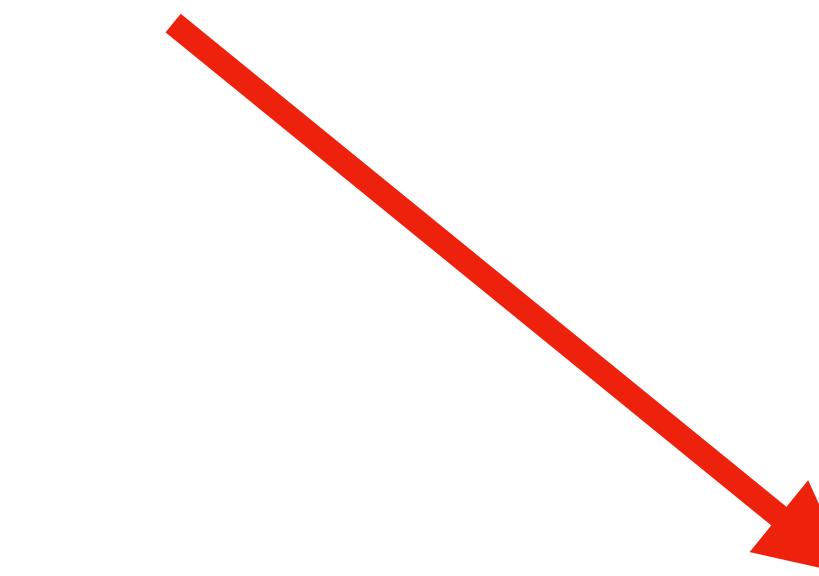


Research Question

- What is the mechanism of ligand coated gold nanoparticle aggregation in lipid membranes?



How does ligand length affect nanoparticle aggregation?

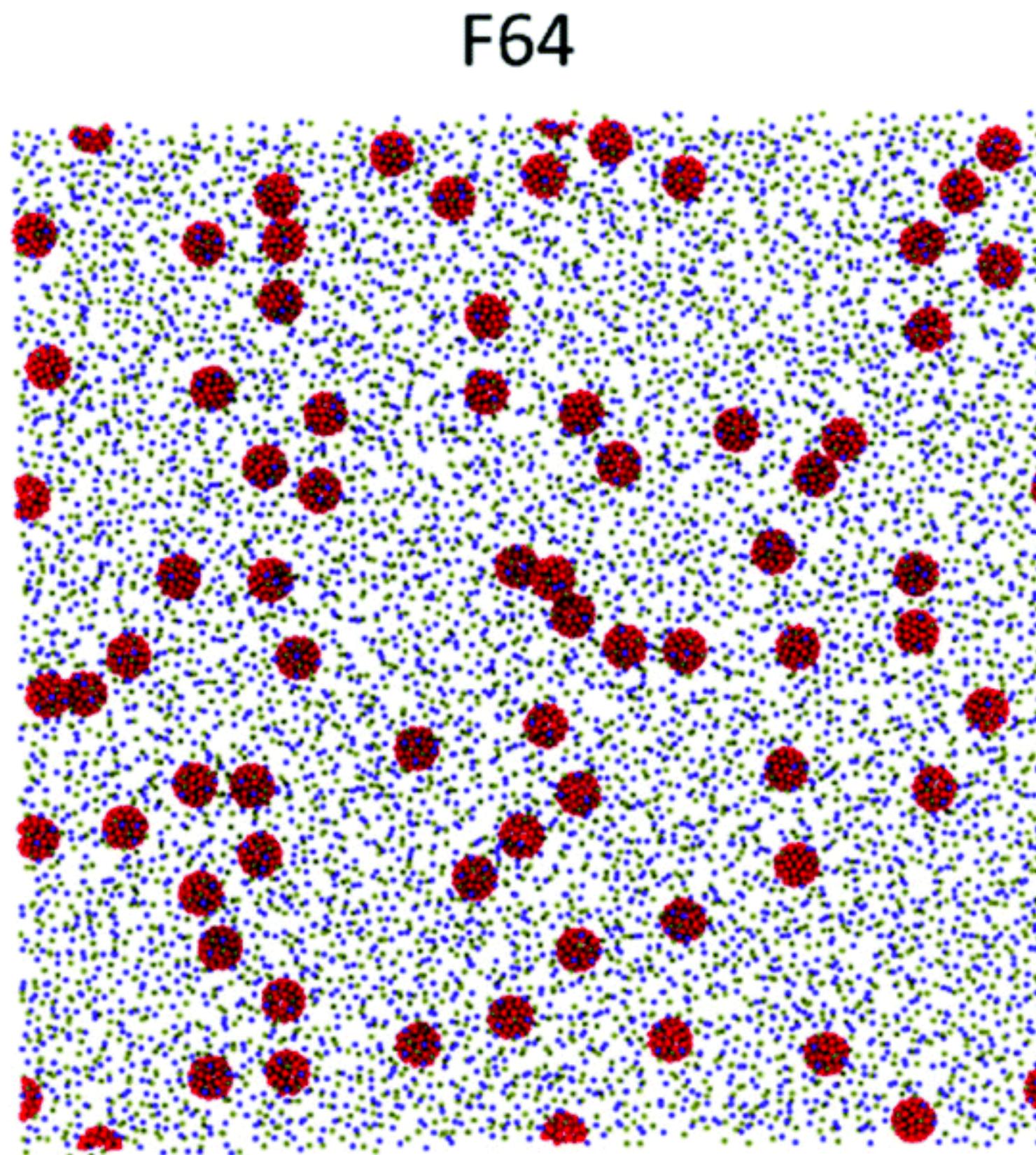


How does nanoparticle charge affect nanoparticle aggregation?

How does ligand length affect aggregation?

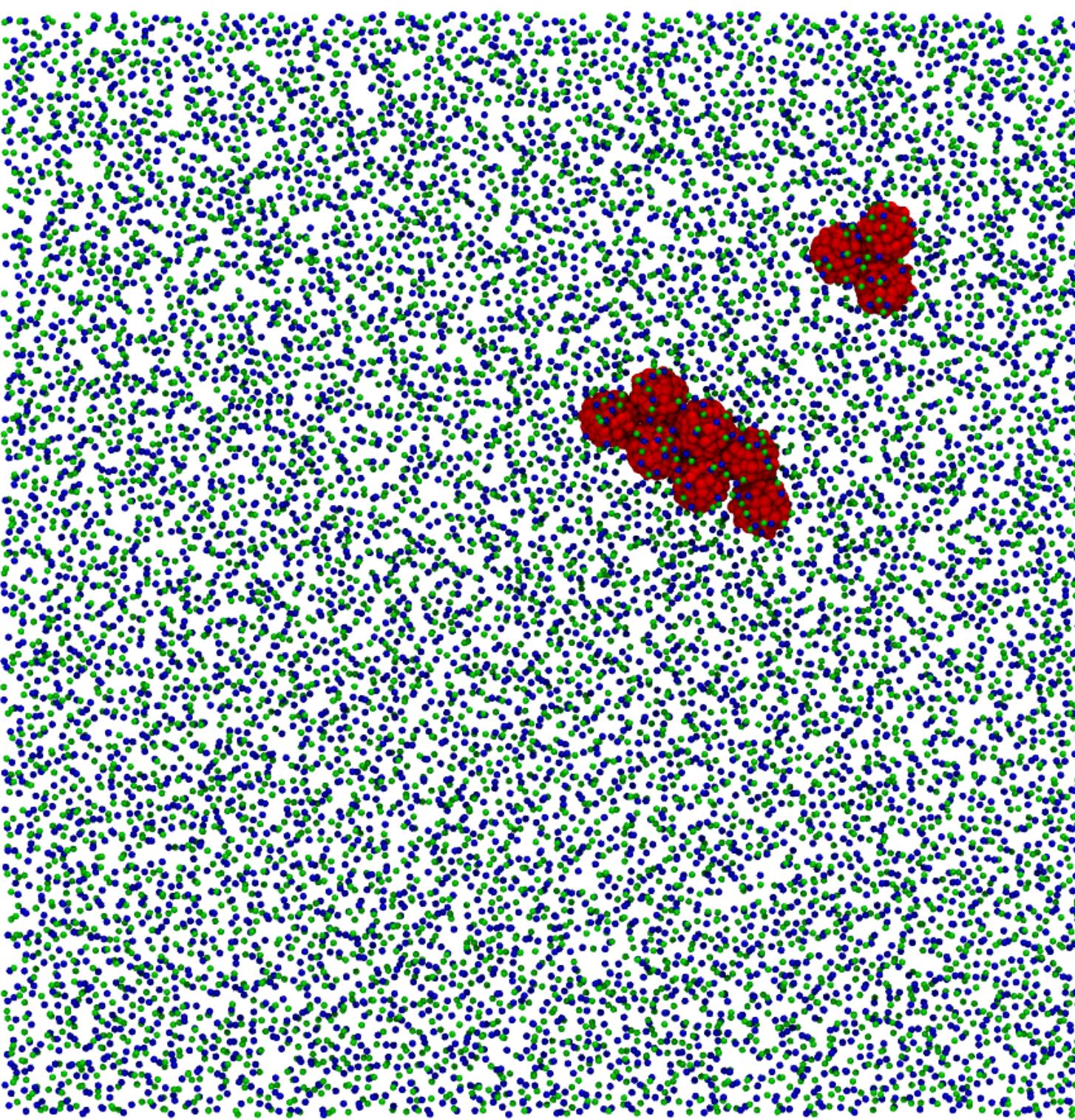
How do my 2nm hydrophobic nanoparticles compare to other hydrophobic nanoparticles?

1.44 nm



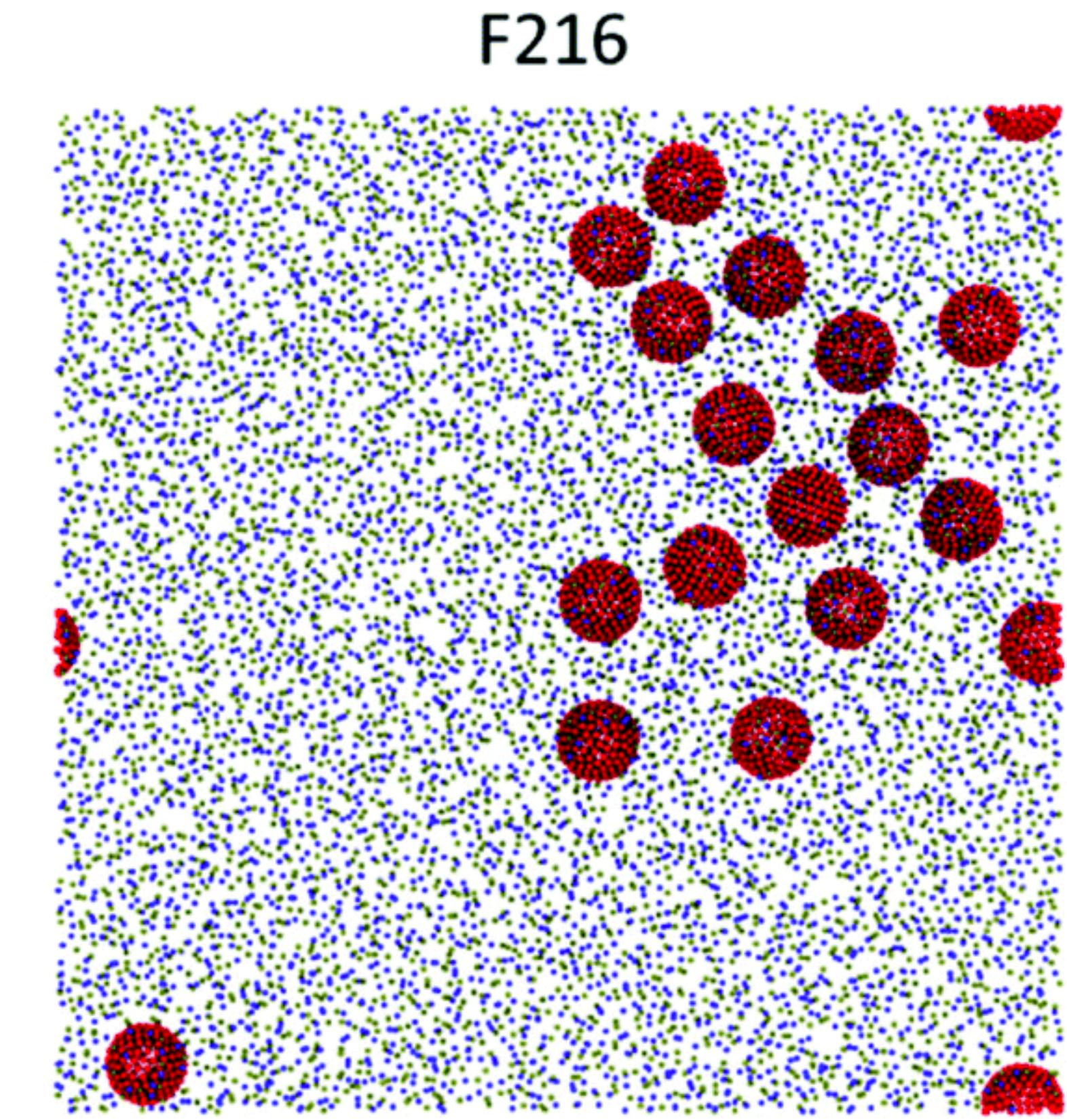
- Transient aggregates
- Aggregate with no lipid shells

2.00 nm



- Stable aggregates
- Aggregate with no lipid shells

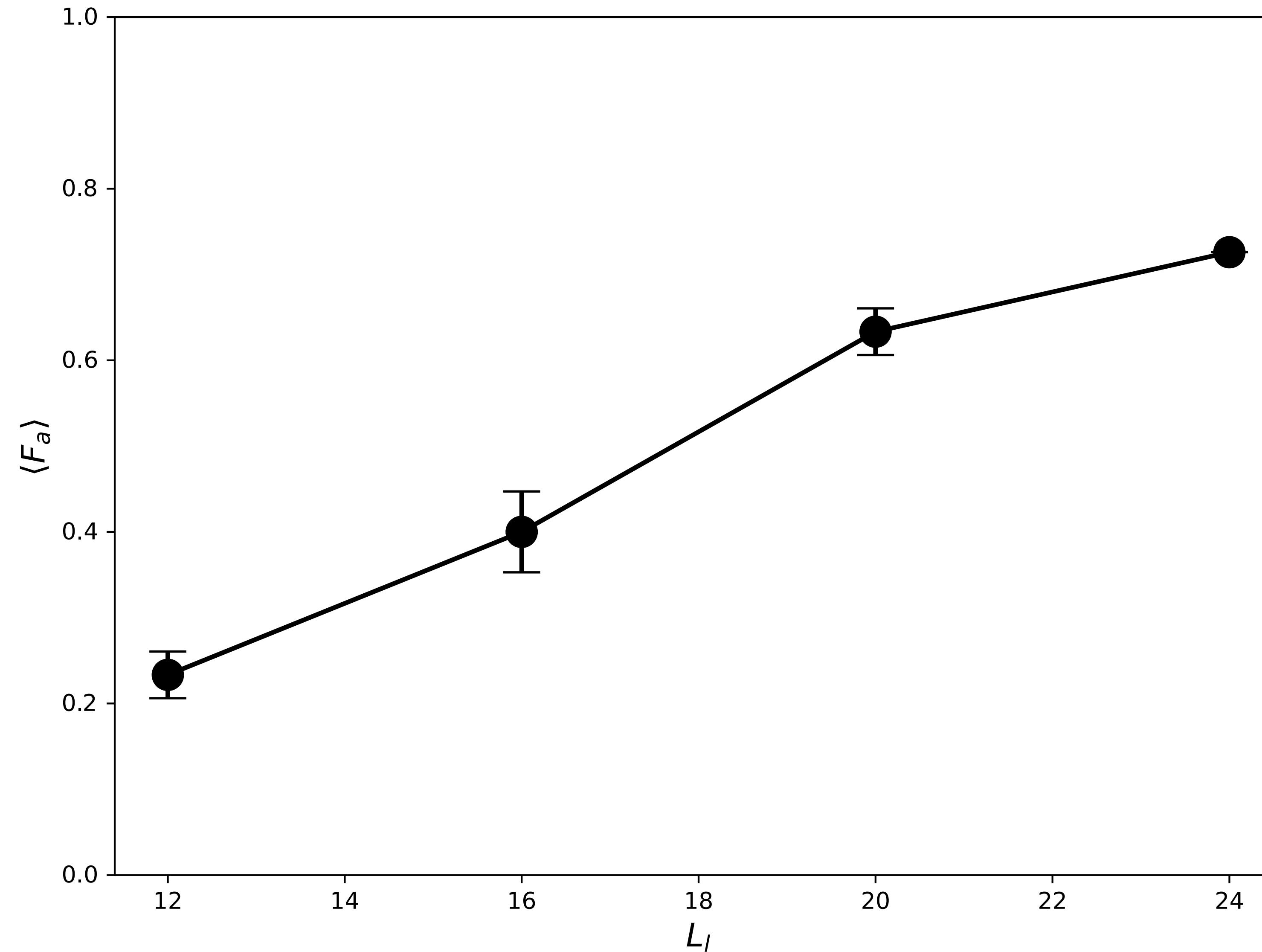
2.88 nm



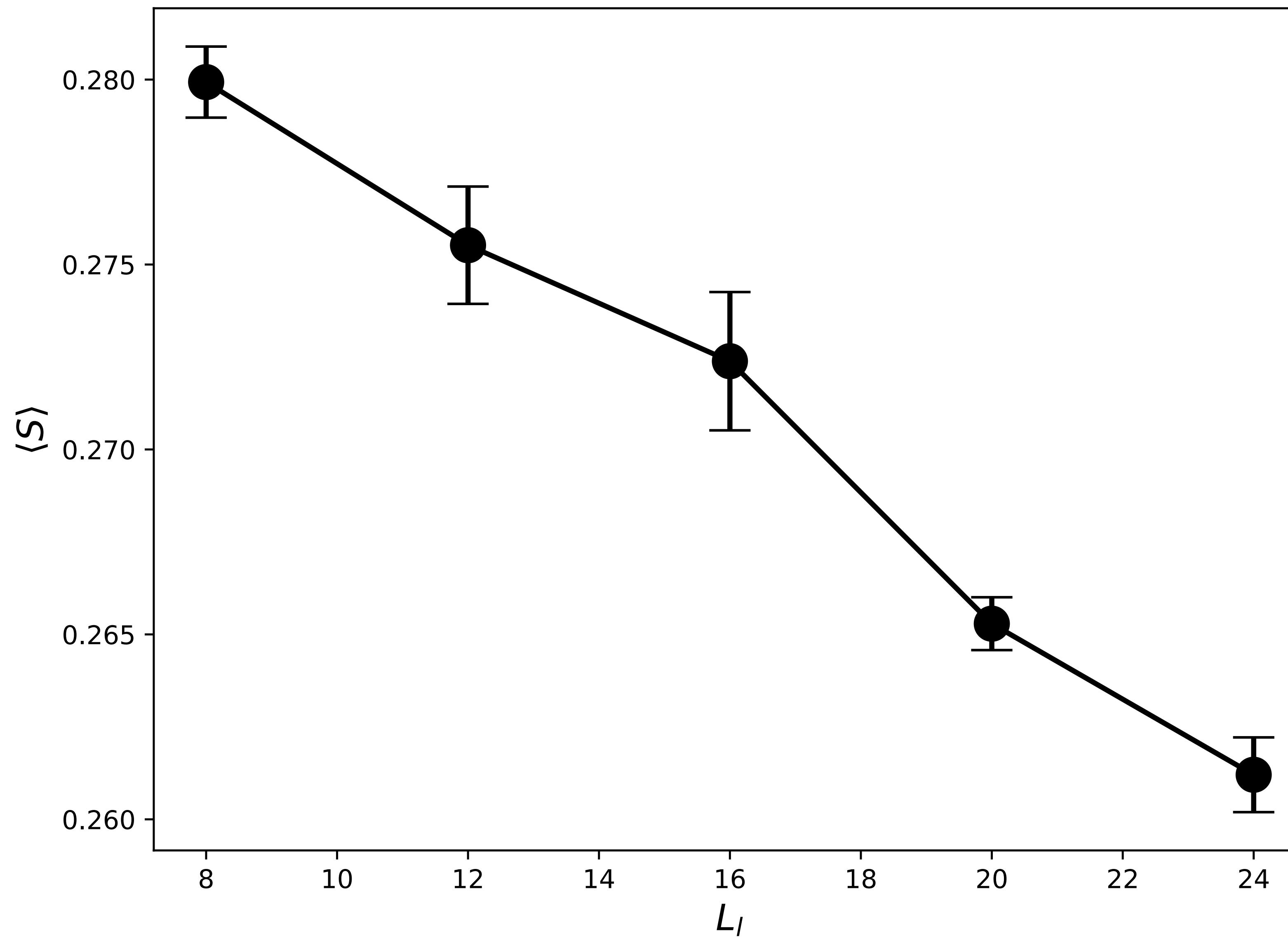
- Stable aggregates
- Aggregate with 1-2 lipid shells between

How is aggregation affected by changes in ligand length?

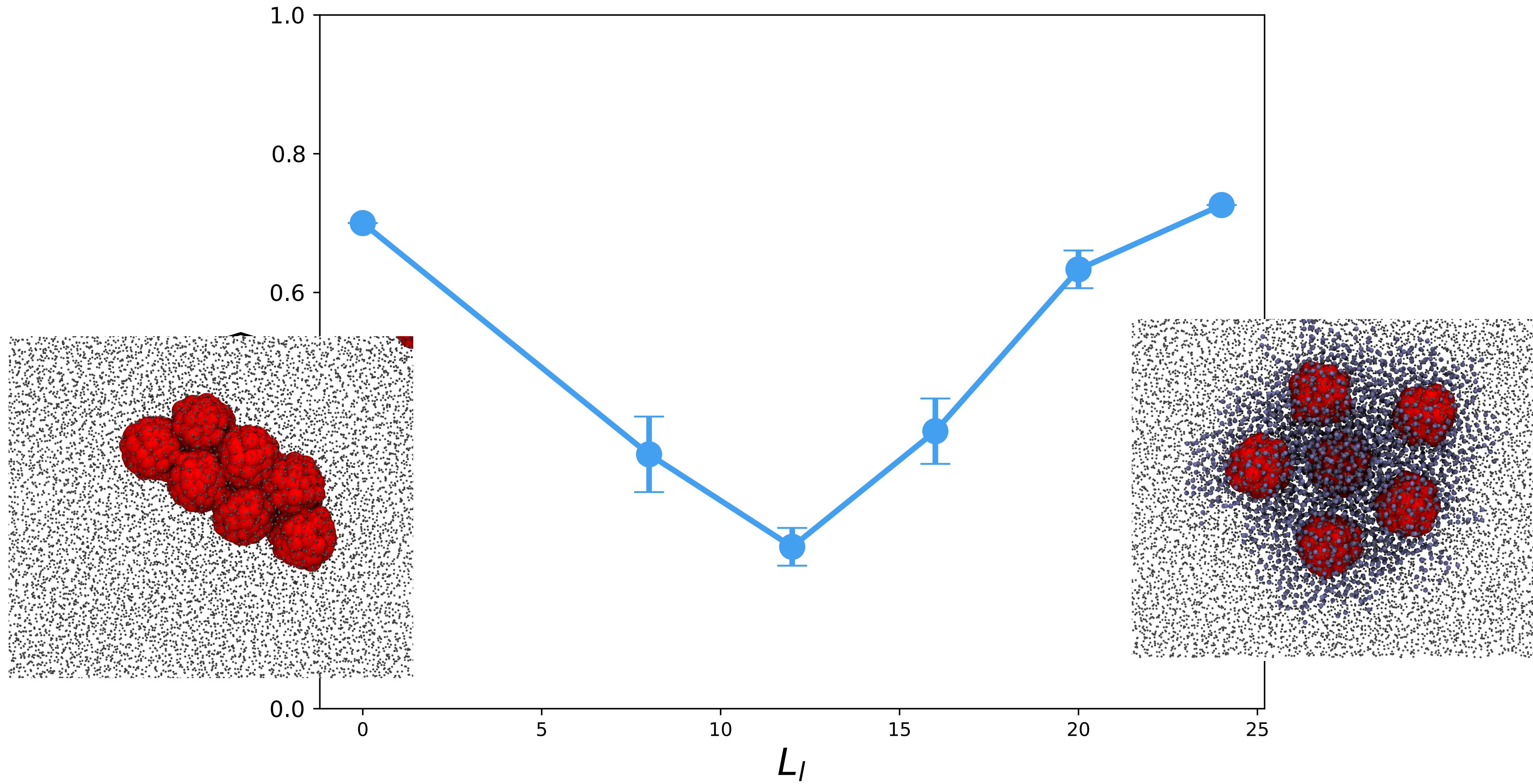
Fraction of
NP's in
Largest
Aggregate



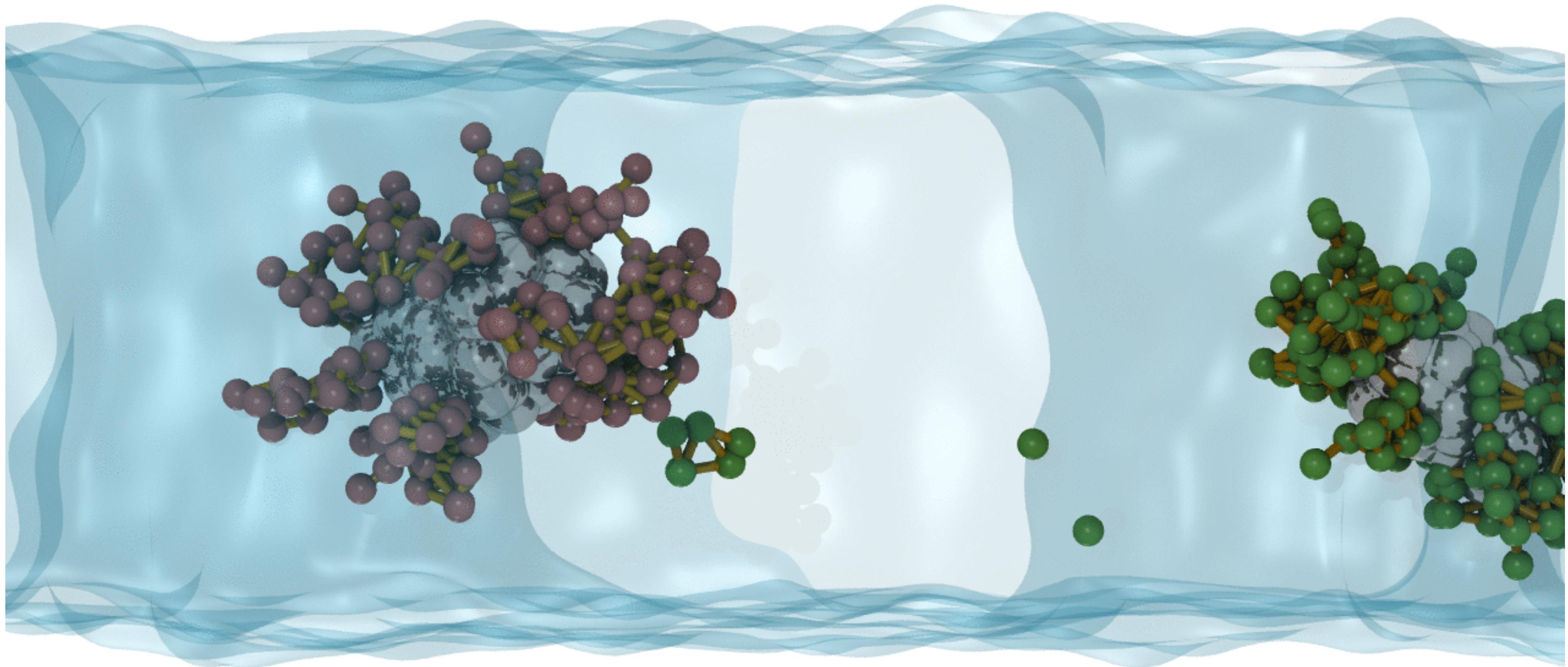
Longer ligands increase disorder of surrounding lipids



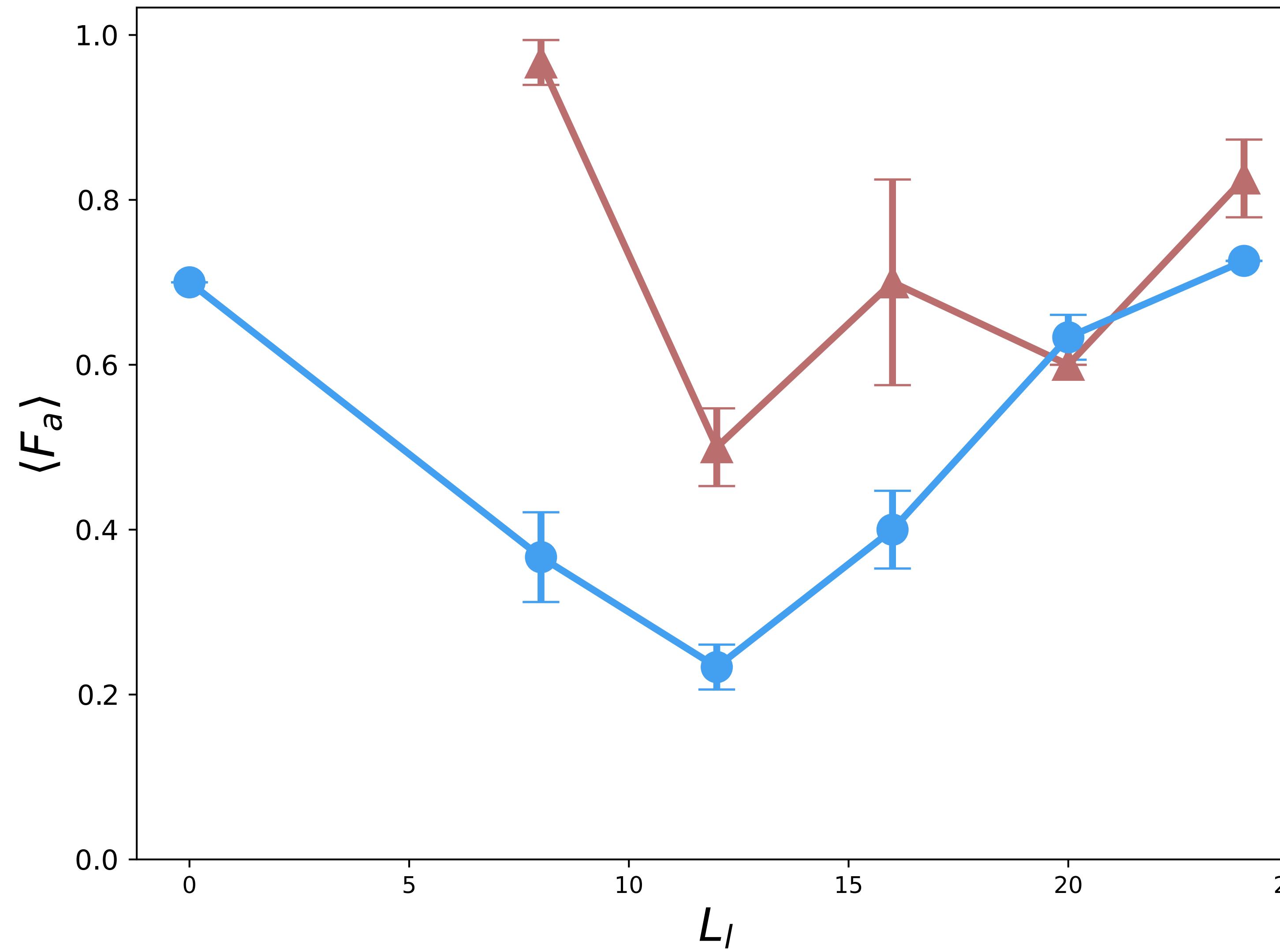
The full story is more complicated ...



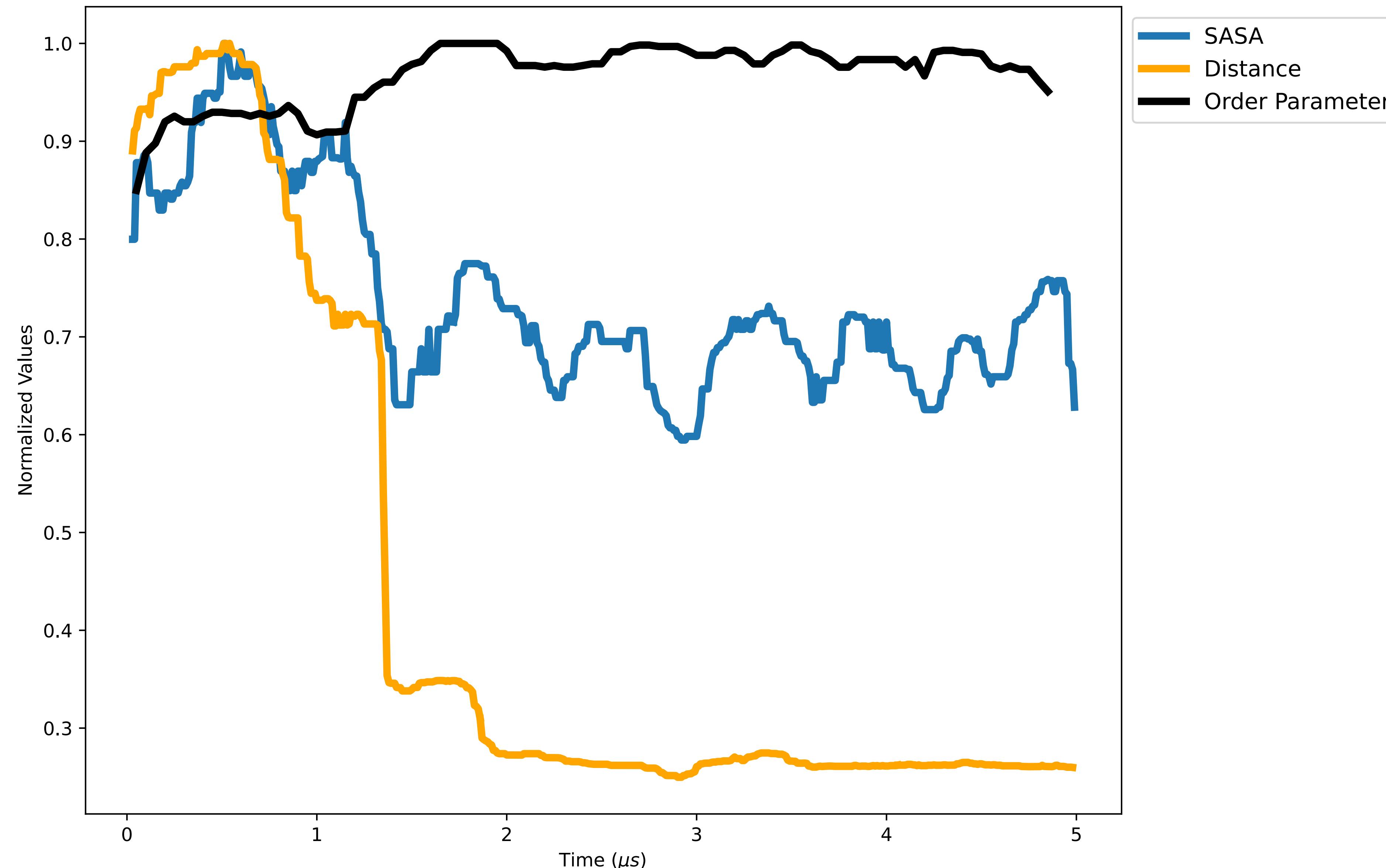
**How does charge affect
aggregation?**



Charged nanoparticles aggregate more than their hydrophobic counter parts at short ligand lengths



Do charged nanoparticles aggregate to reduce their exposed surface?



Summary

- 2 nm bare nanoparticles form stable and compact linear aggregates
- Nanoparticle aggregation may be due to the degree of acyl chain deformation caused by the ligands
- Charged nanoparticles may show increased aggregation due to their exposure to solvent

Questions?