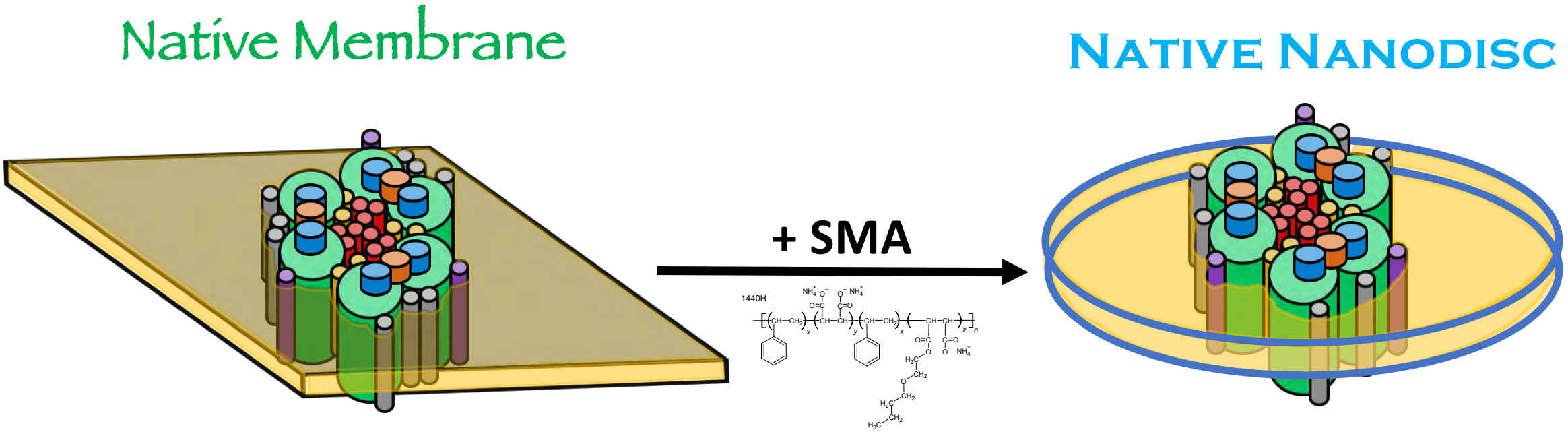
Insights into the Formation and Future Applications of PSI-SMALP



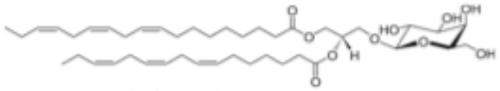
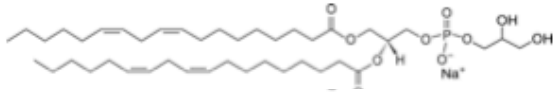
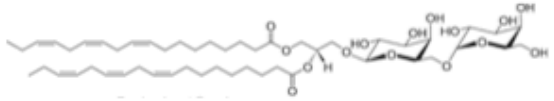
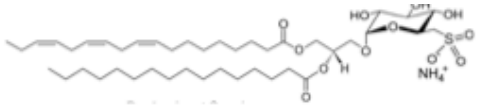
Nathan Brady

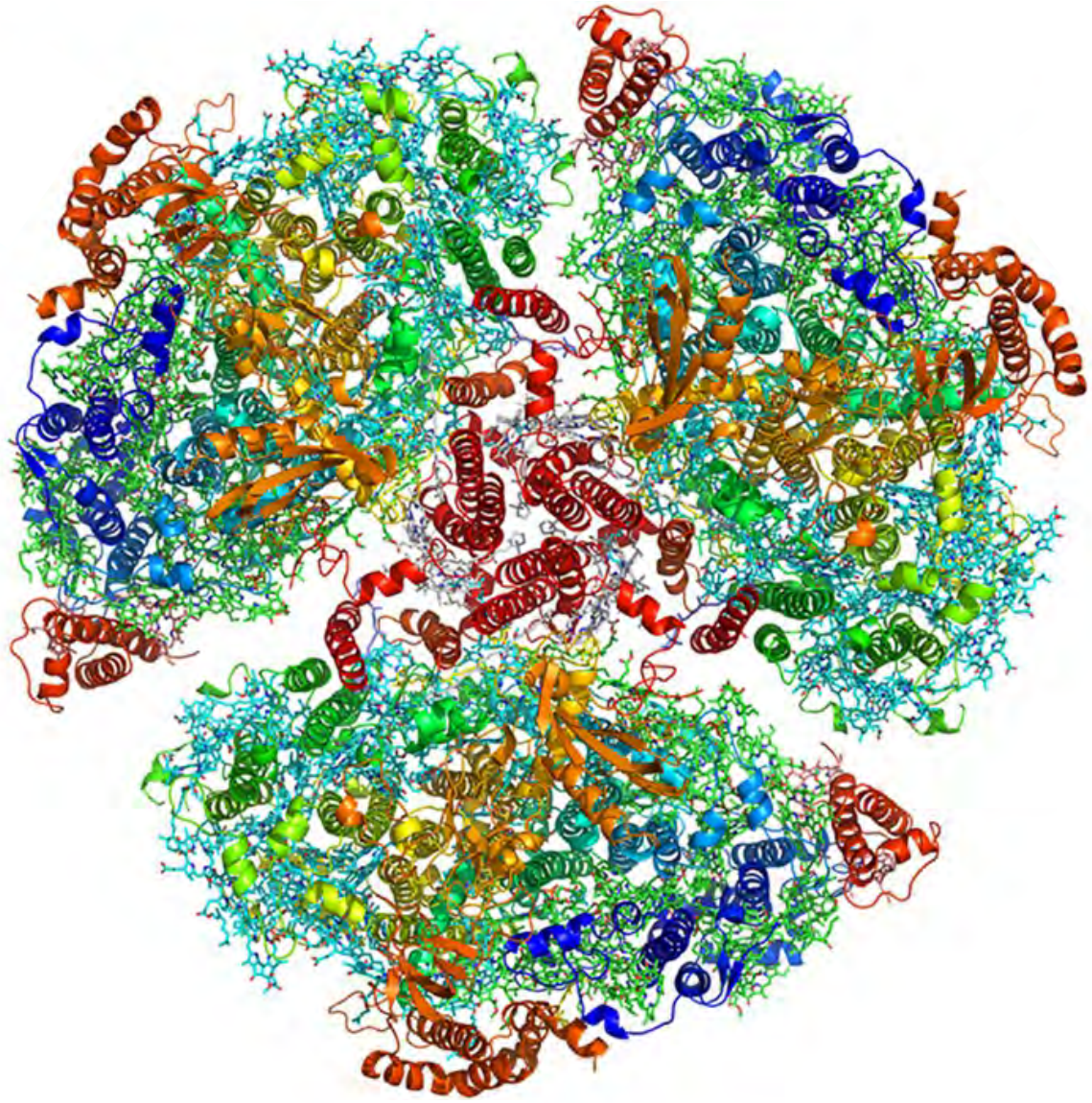
SMALP Conference 2020

March 20, 2020

PSI from *Thermosynechococcus elongatus*

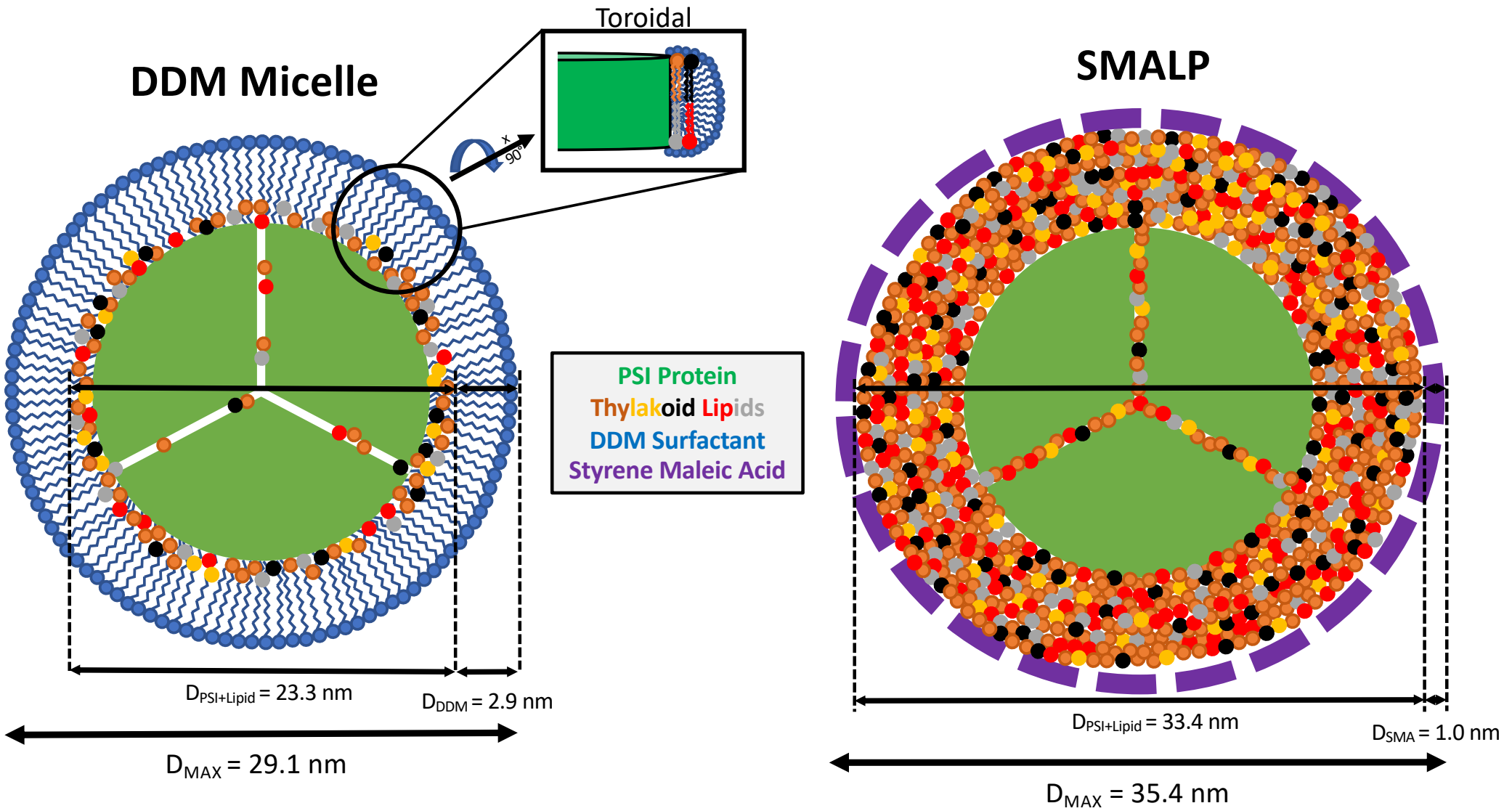
Thylakoid Membrane Lipids

	Lipid Name	Preferred Morphology	Net Charge	Structure
51%	Monogalactosyldiacylglycerol (MGDG)	H_{II} (cubic)	0	
21%	Phosphatidylglycerol (PG)	Lamellar	-1	
14%	Digalactosyldiacylglycerol (DGDG)	Lamellar	0	
14%	Sulfoquinovosyldiacylglycerol (SL)	H_{II} (cubic)	-1	



Yuval Mazor, et al. January 2014. *eLIFE*.

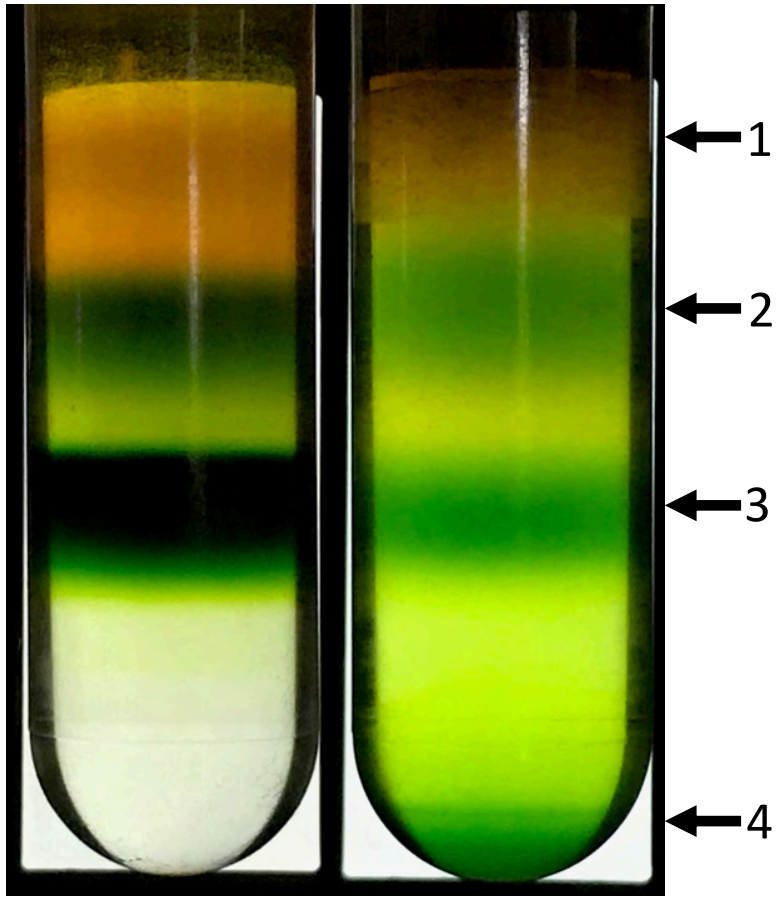
Lipo-protein complex is ~30% larger in SMALP compared to DDM

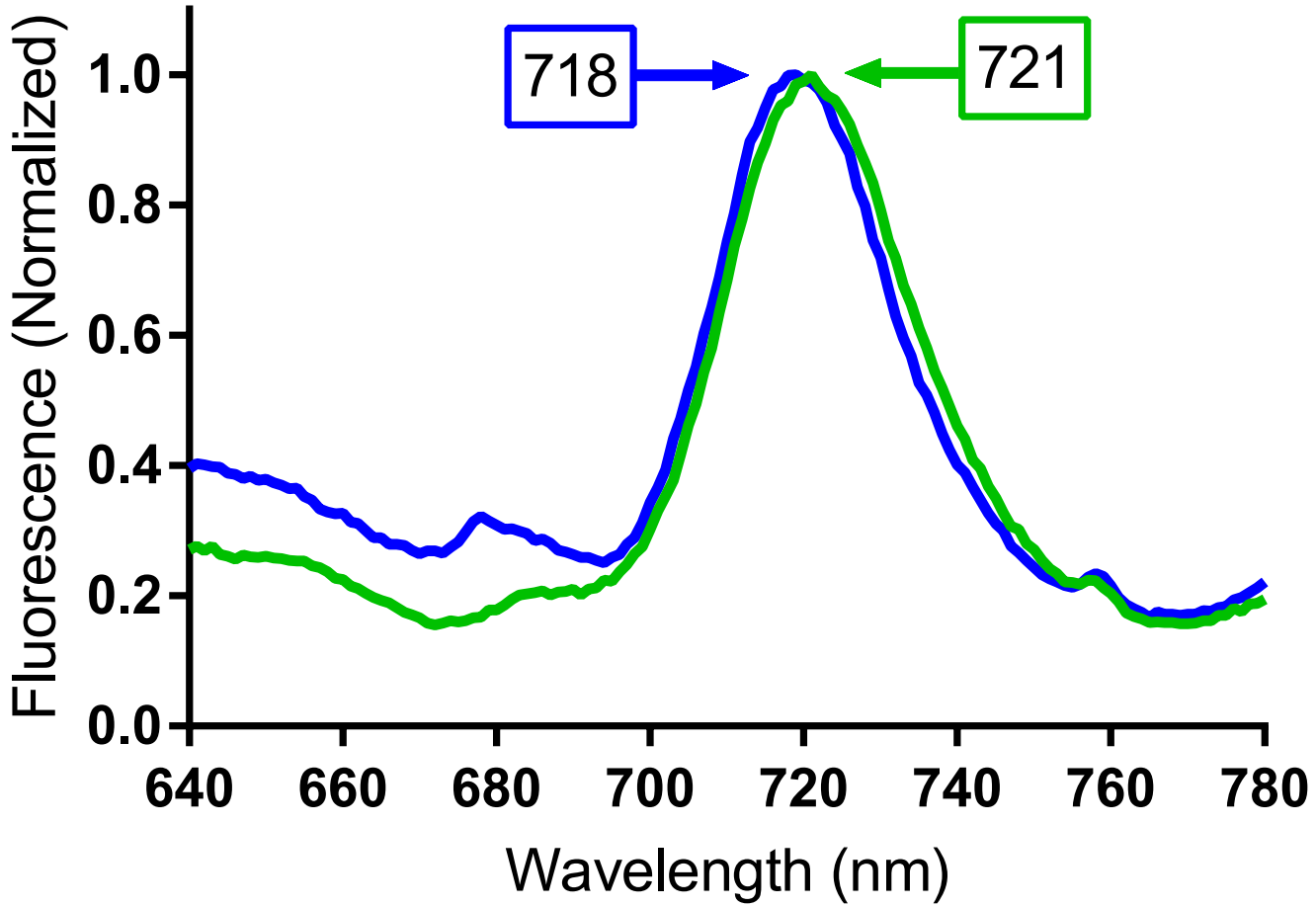


Nathan G. Brady, et al. *BBA Biomembranes.* (In Progress).

77K chlorophyll florescence red shifted in PSI-SMALP compared to PSI-DDM

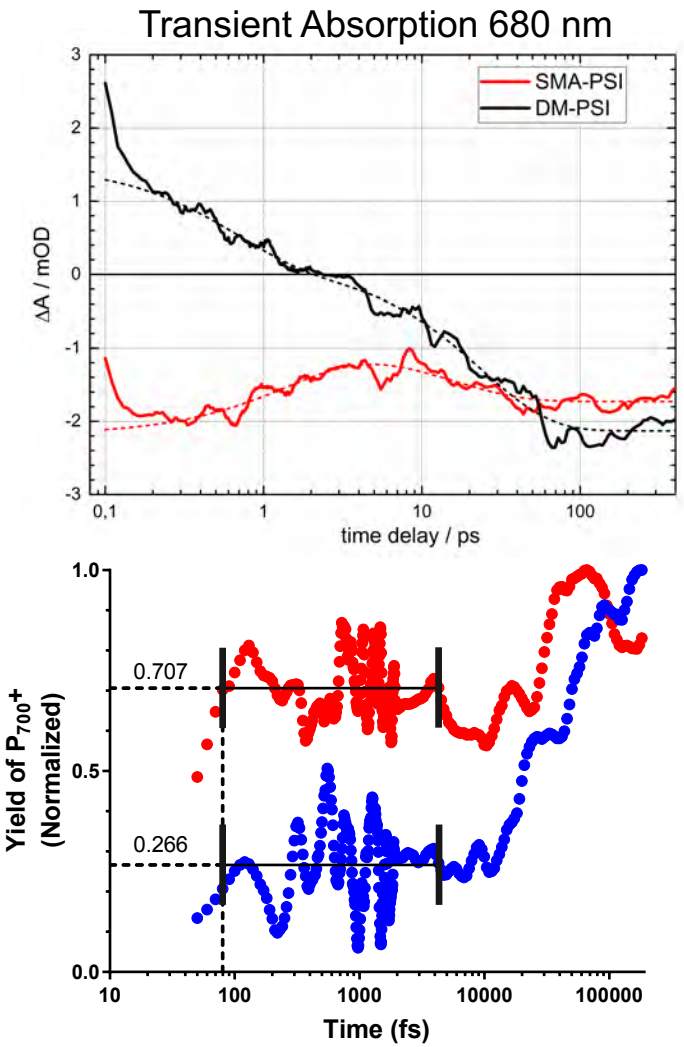
DDM **SMALP**

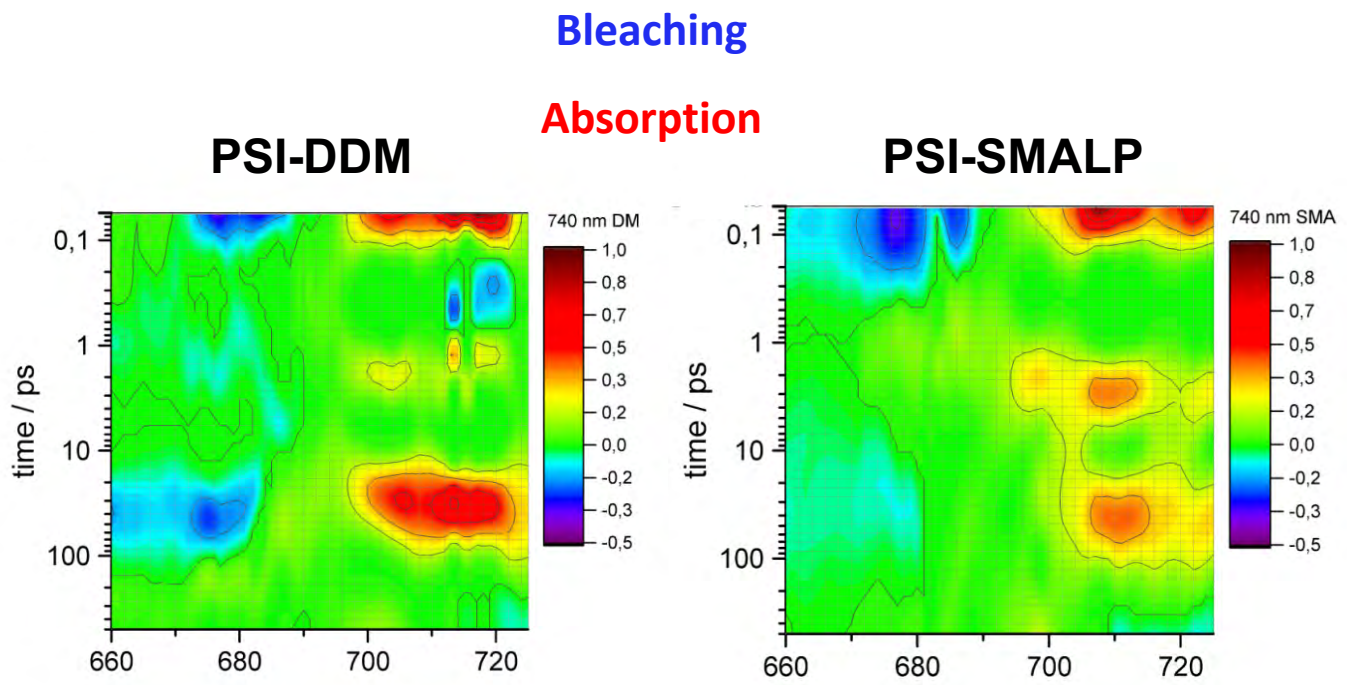




Nathan G. Brady et al. October 2019. *RSC Advances.*

Charge separation occurs 1,000 fold faster in ~45% of PSI-SMALPs compared to PSI-DDM



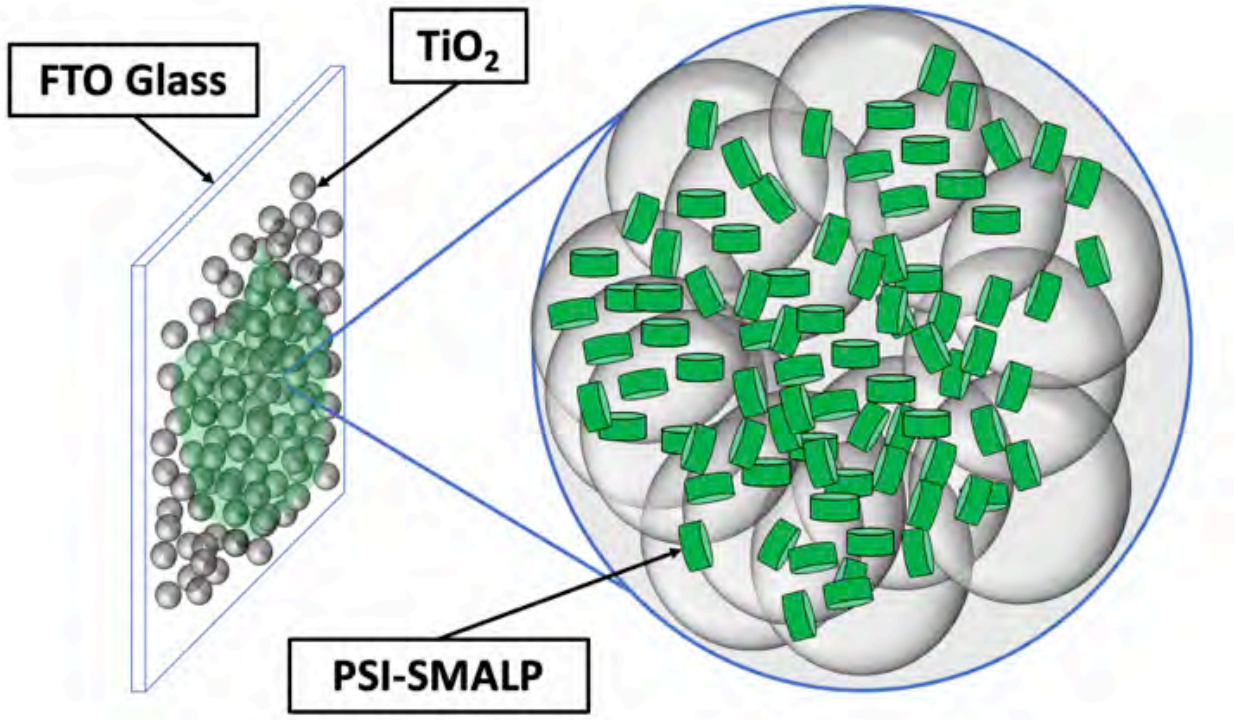


~45 % of PSI-SMALP particles show an ultrafast charge separation event that is disrupted during detergent isolation.

D. Cherepanov, N. Brady, et al. November 2019. *Biophysical Journal.*

Light to electricity via Applied Photosynthesis

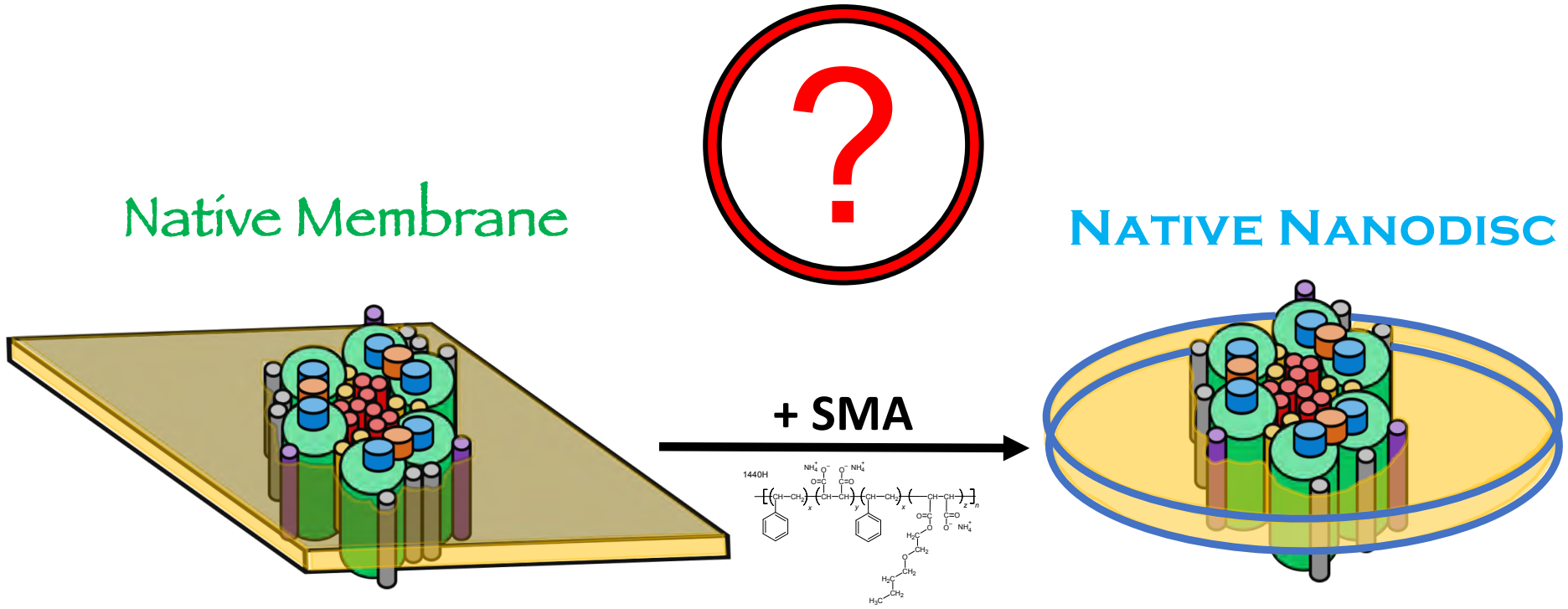
Light Energy Applied Photosynthetic (LEAPh) System



Potential Applications

- Solar energy conversion
- Optical sensors
- Laser guided systems
- Light intensity detectors
- Photon counting devices

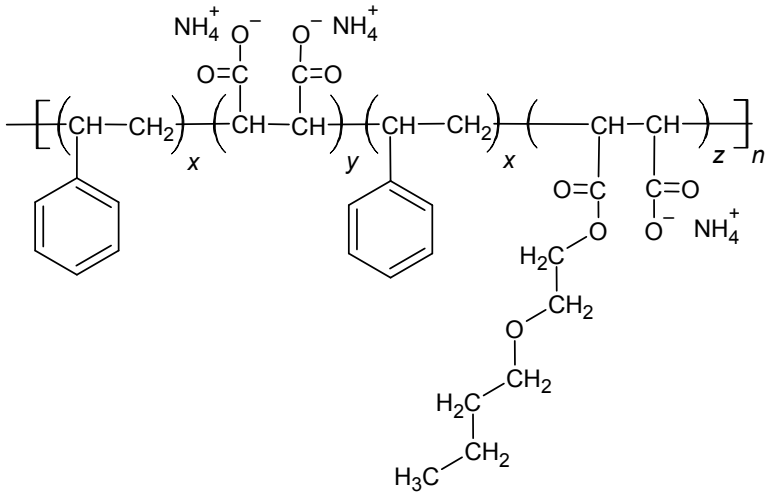
What is the mechanism driving SMALP formation?



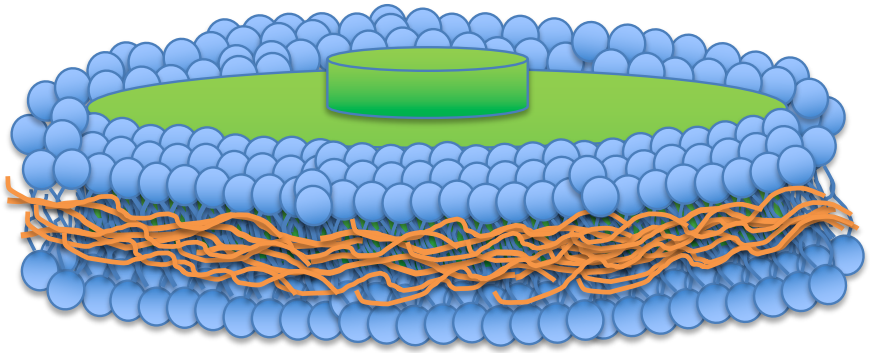
Nathan G. Brady et al. October 2019. *RSC Advances.*

SMA 1440: A unique SMA for a peculiar membrane

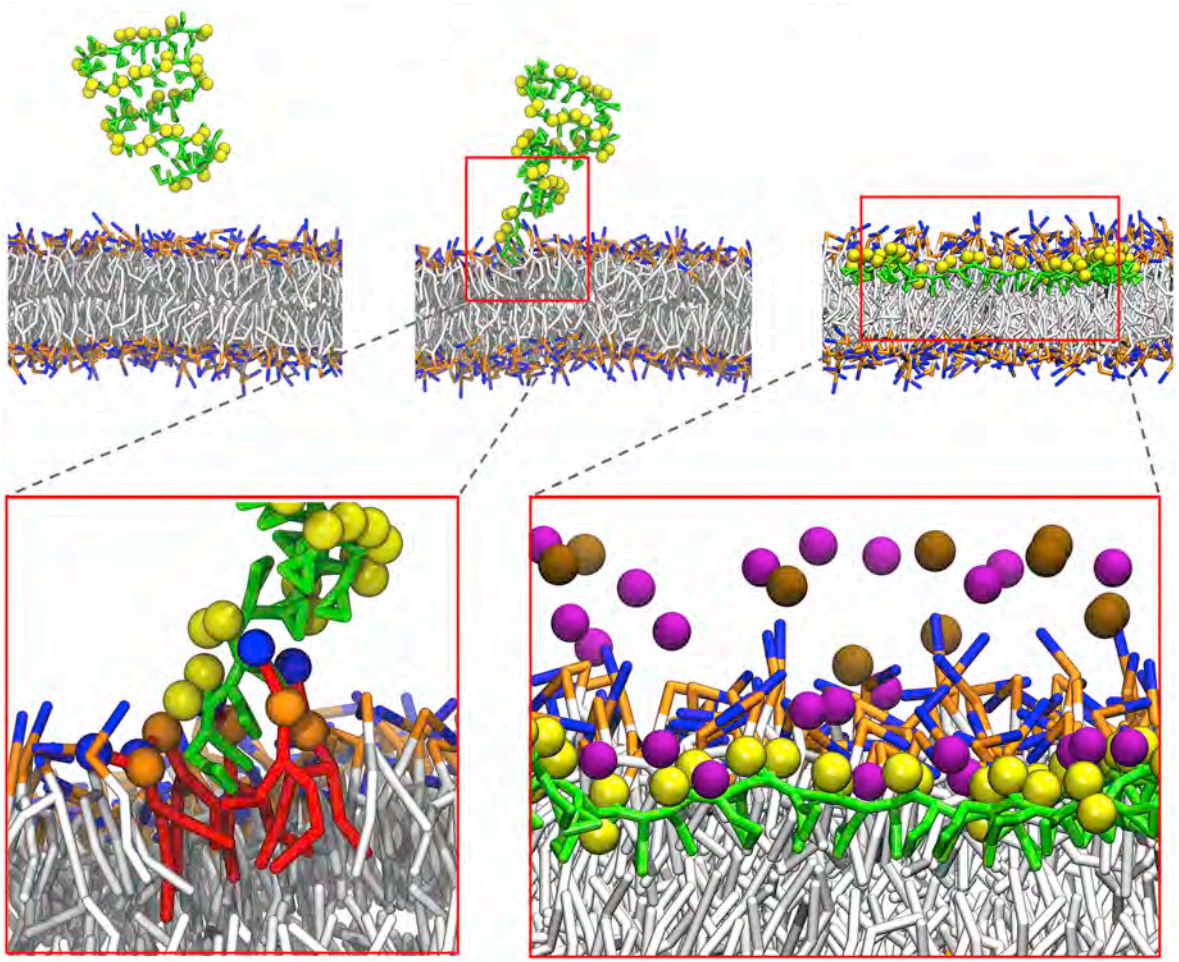
SMA 1440



SMALP

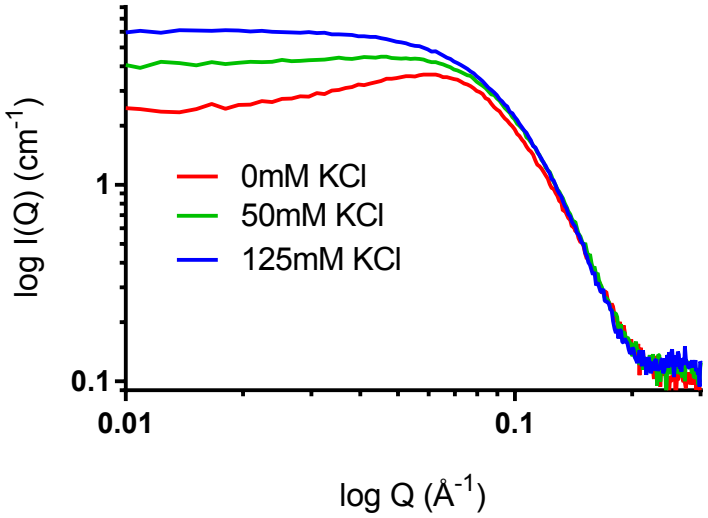


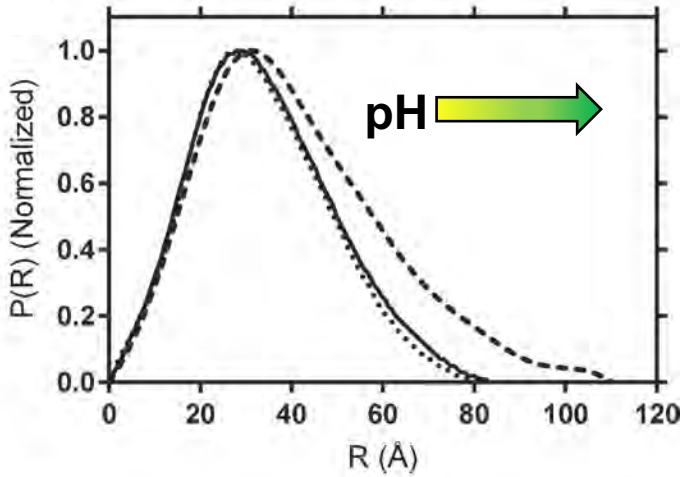
SMA Fragment

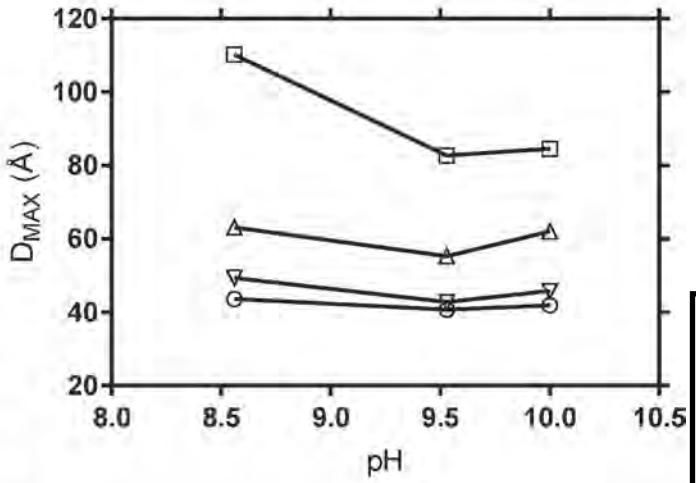


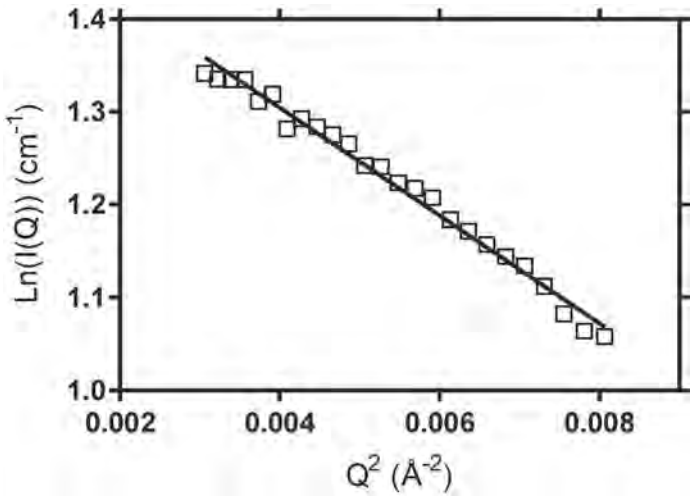
Minmin Xue et al. August 2018. *Biophysical Journal.*

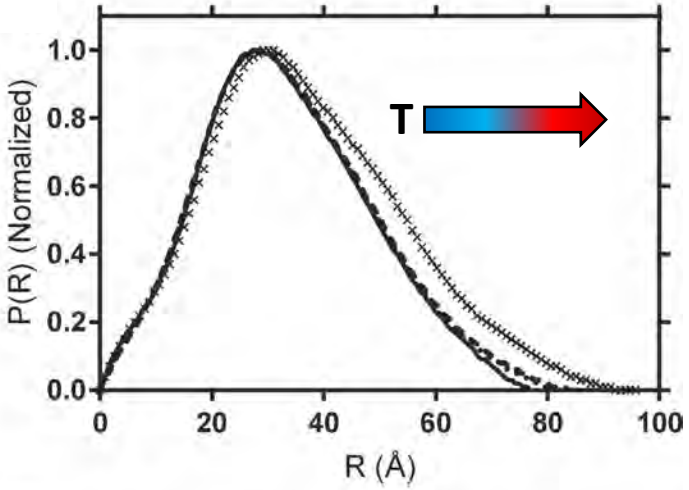
Collapsed SMA free in solution exhibits prolate ellipsoidal geometry by SAXS

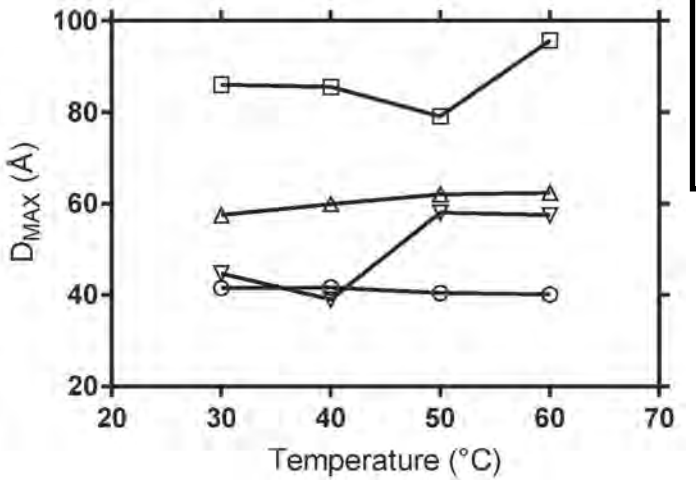


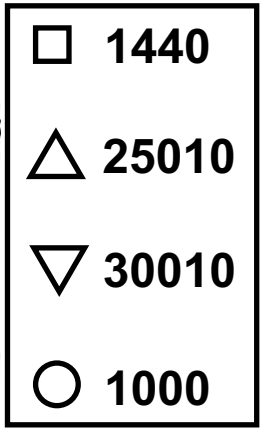






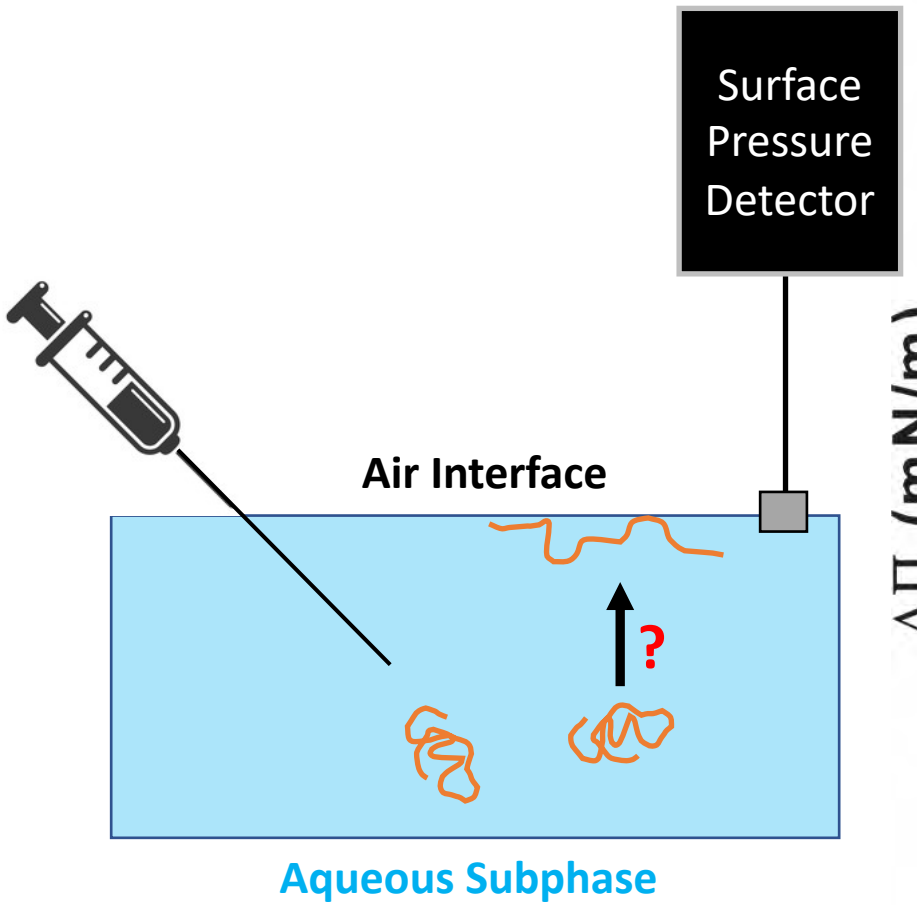


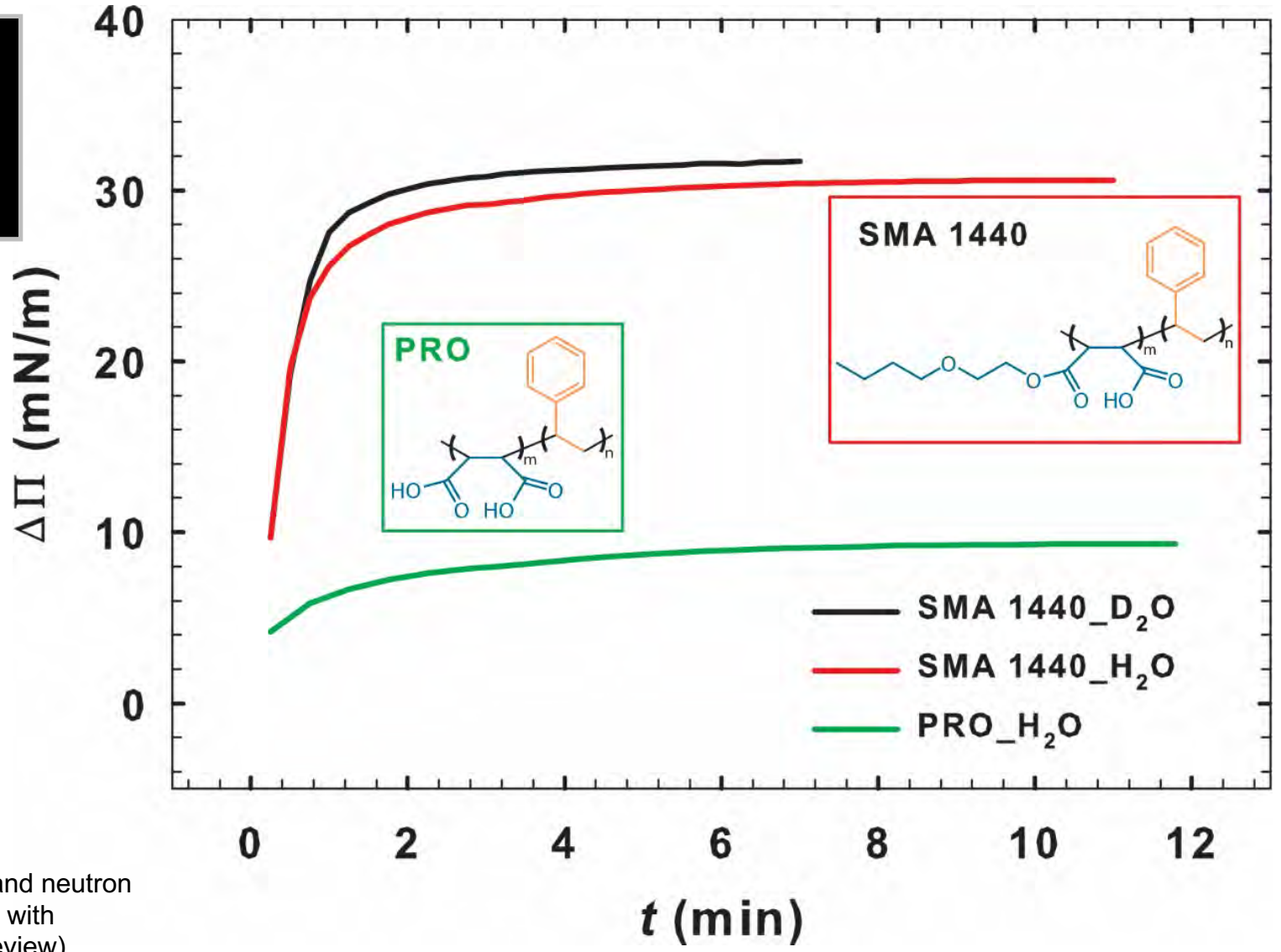




Nathan G. Brady, Shuo Qian and Barry D. Bruce. Analysis of styrene maleic acid alternating copolymer supramolecular assemblies in solution by small angle X-ray scattering. November 2018. *European Polymer Journal.*

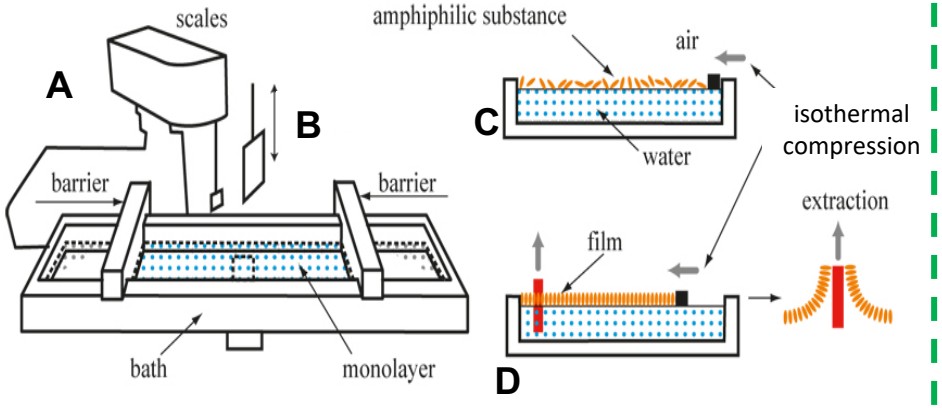
Butoxyethanol functionalization increases hydrophobicity and surface activity of SMA 1440

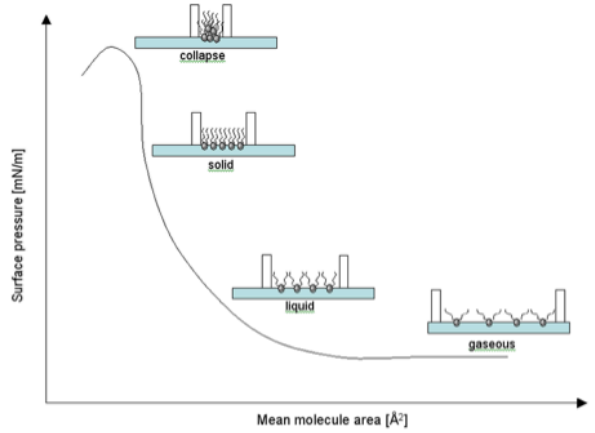


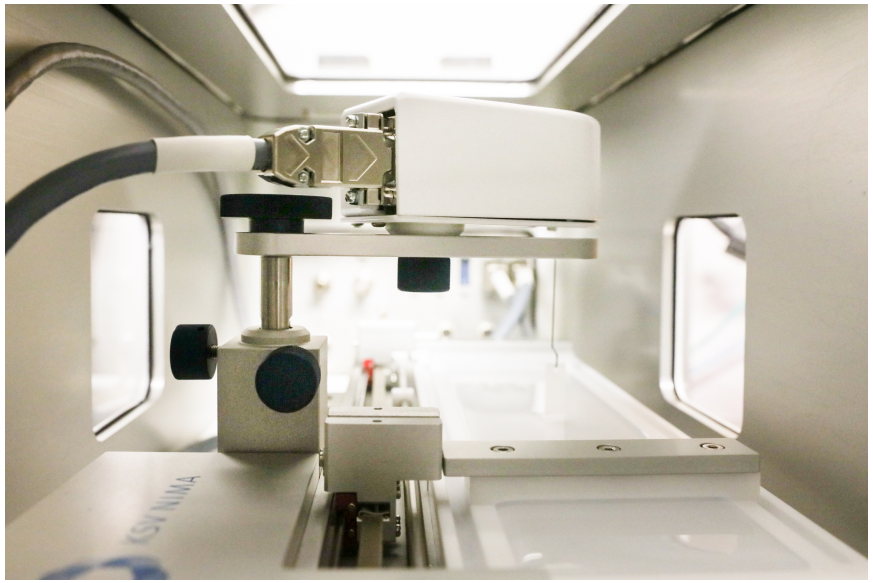


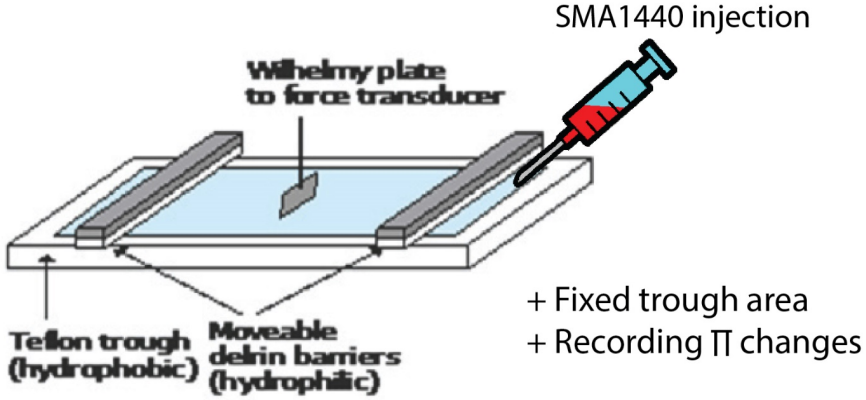
Minh D. Phan, Olena I. Korotych, Nathan G. Brady et al. X-ray and neutron reflectivity studies of styrene-maleic acid copolymer interactions with galactolipid-containing monolayers. *Langmuir.* (In Secondary Review).

Neutron and X-ray reflectometry allow us to observe the initial insertion event in detail

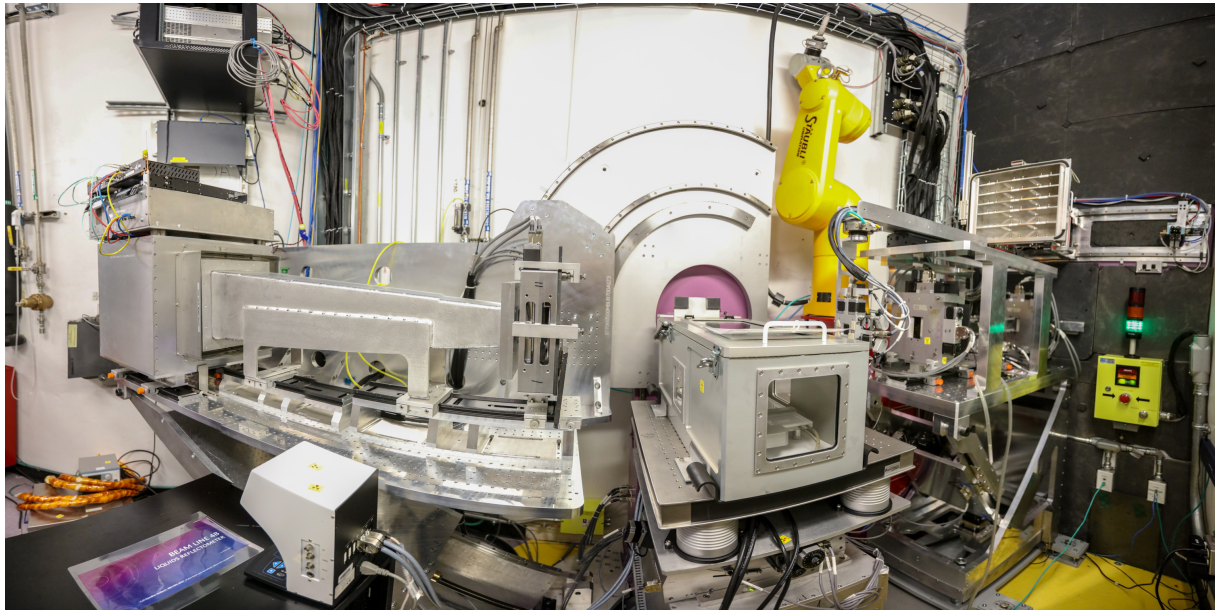






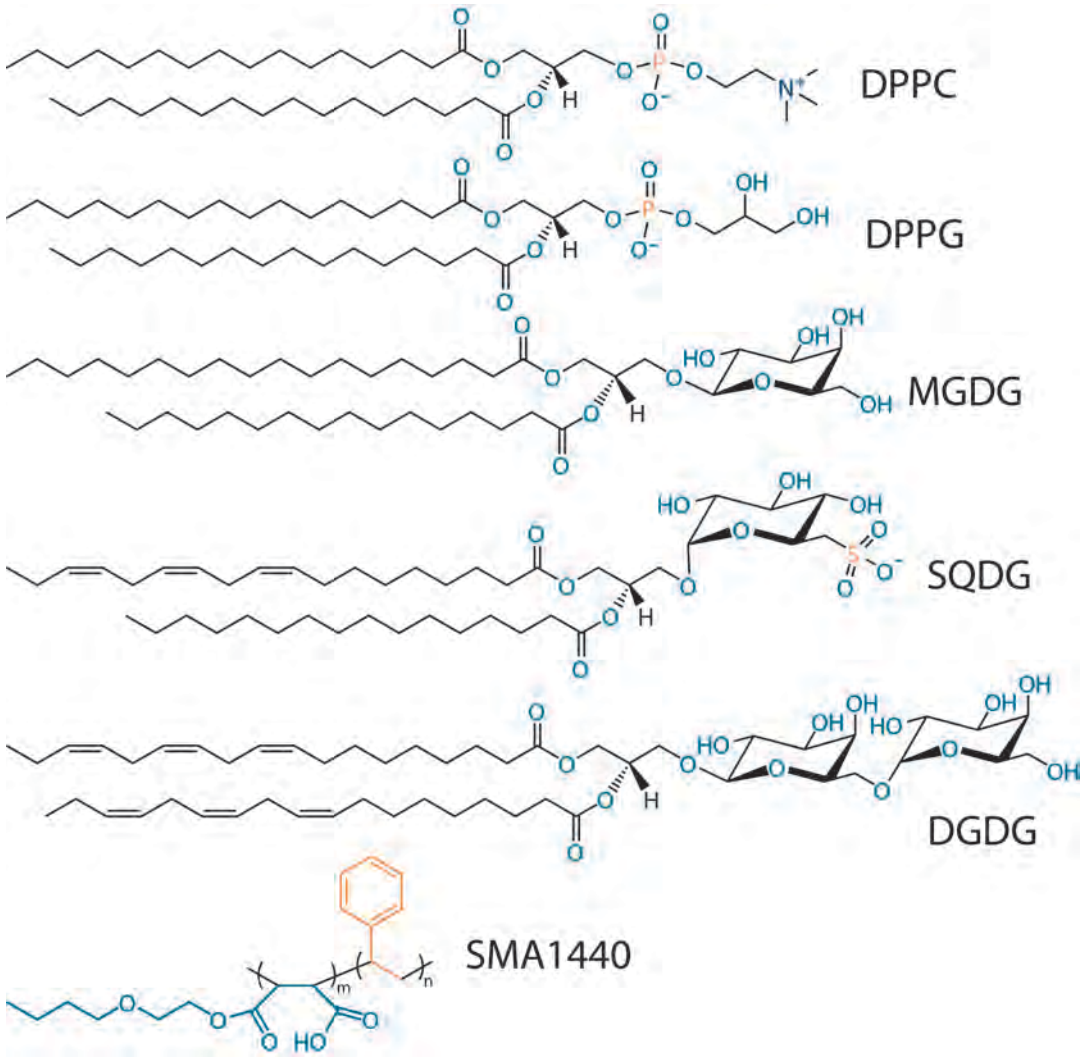


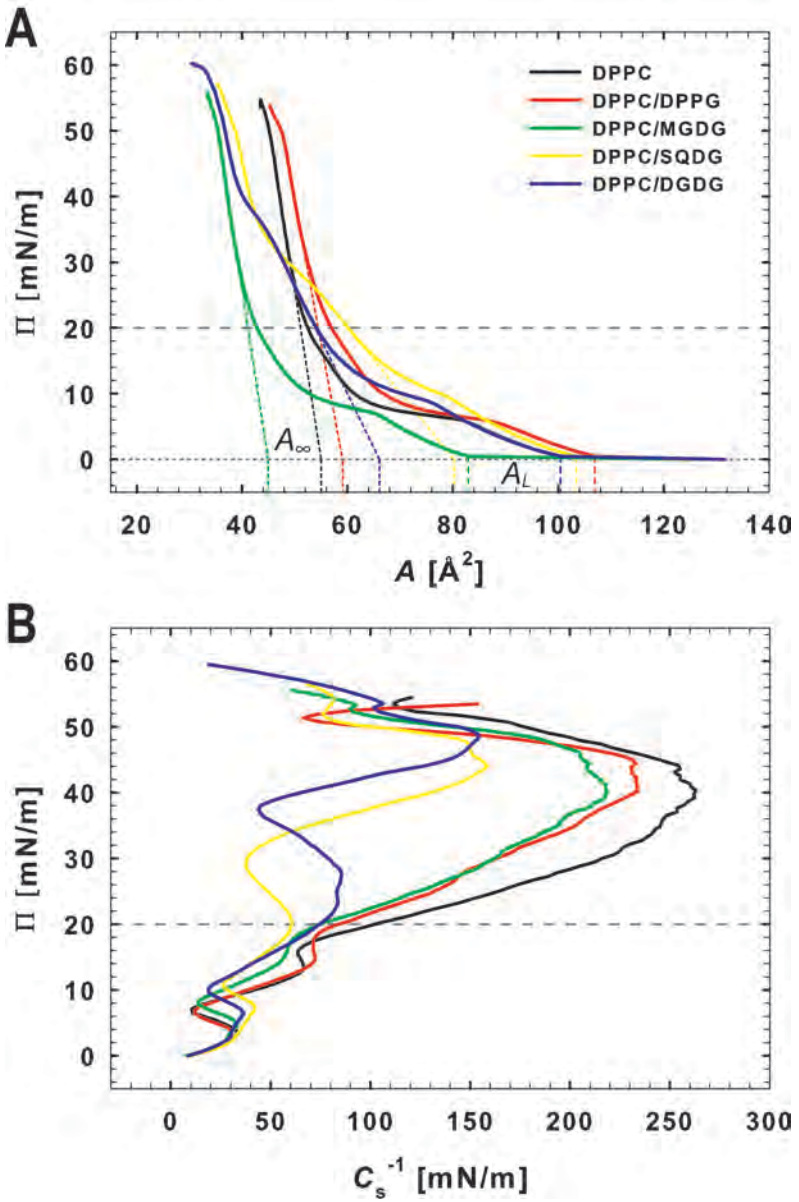
+ Fixed trough area
+ Recording Π changes



Minh D. Phan, Olena I. Korotych, Nathan G. Brady et al. X-ray and neutron reflectivity studies of styrene-maleic acid copolymer interactions with galactolipid-containing monolayers. *Langmuir.* (In Secondary Review).

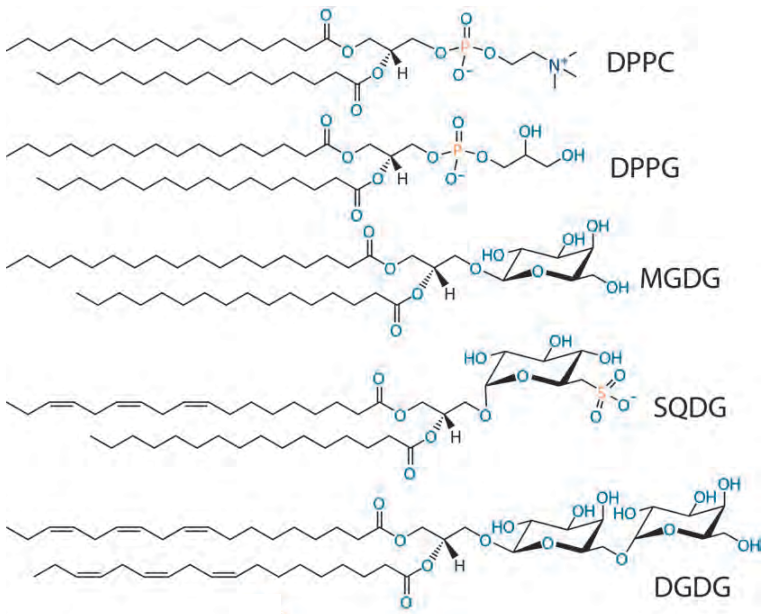
Elastic modulus of galactolipid rich monolayers shows transitions at higher pressure compared to phospholipid monolayers

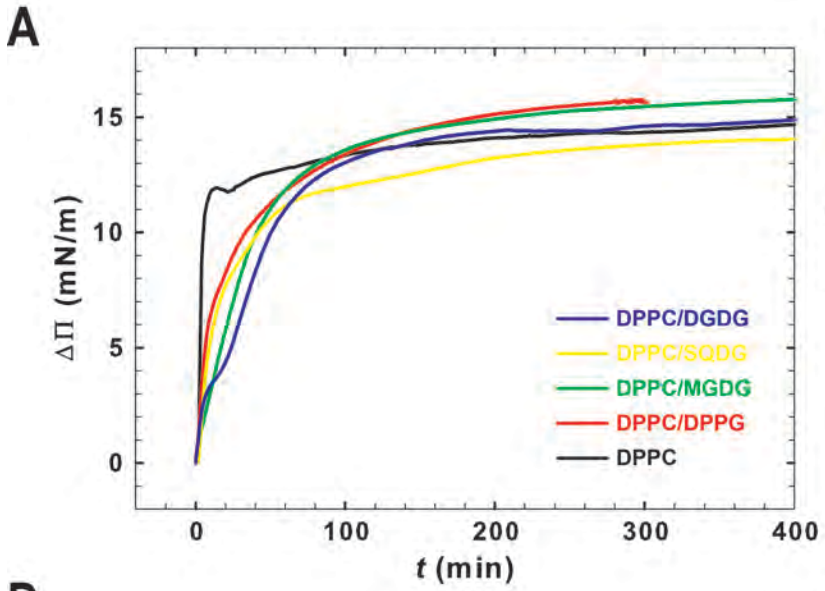


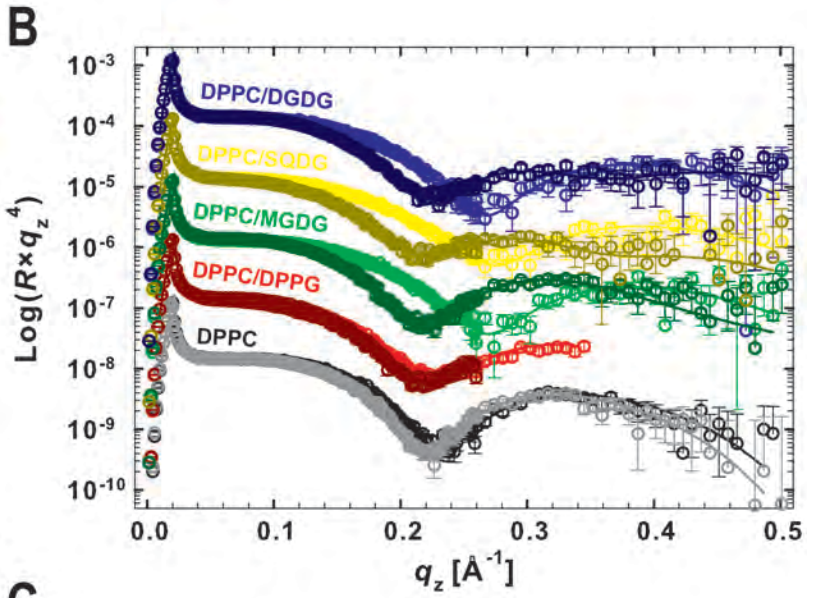


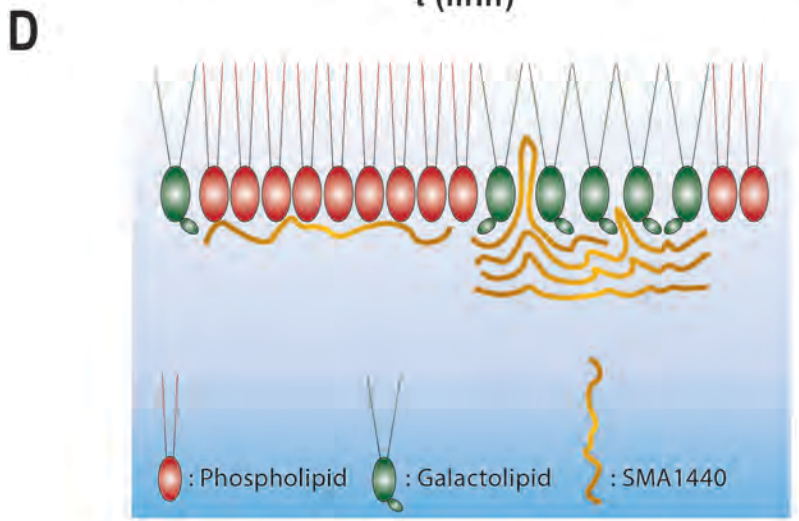
Minh D. Phan, Olena I. Korotych, Nathan G. Brady et al. X-ray and neutron reflectivity studies of styrene-maleic acid copolymer interactions with galactolipid-containing monolayers. *Langmuir.* (In Secondary Review).

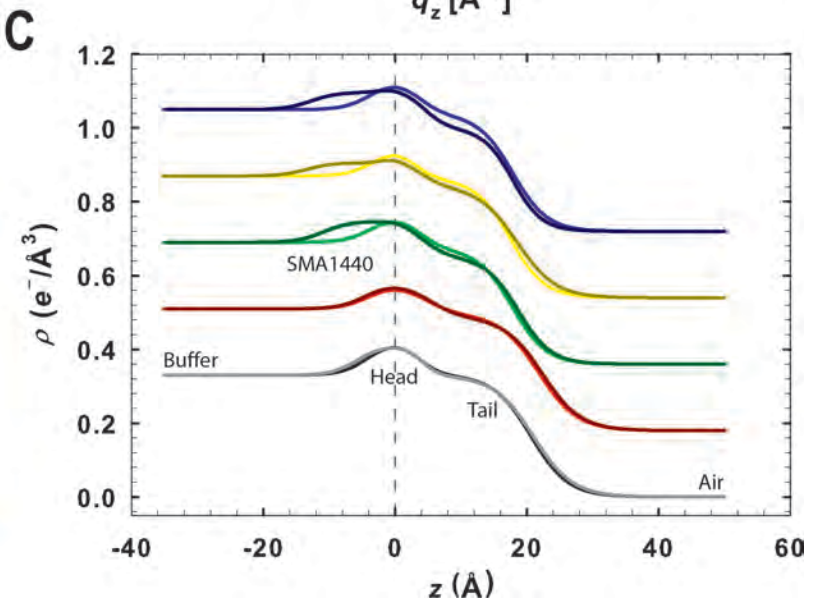
XRR shows galctolipid-rich membranes start thinner and become thicker after addition of SMA





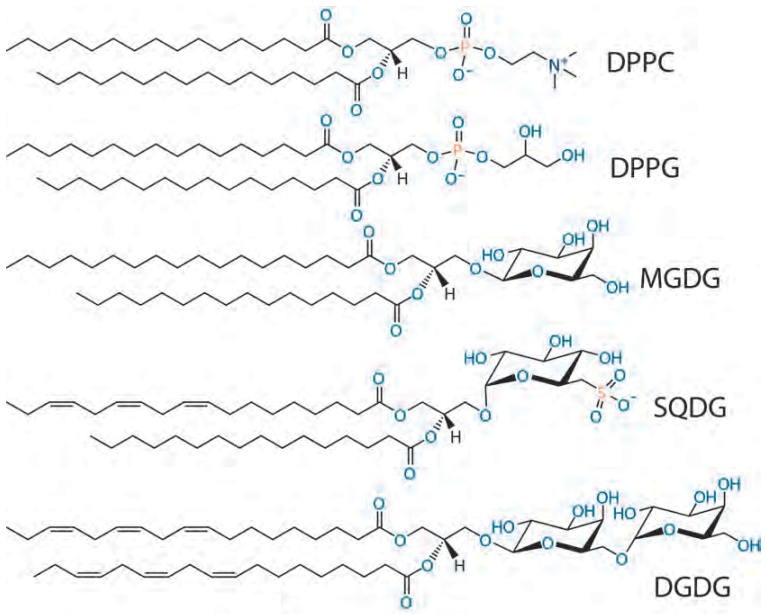


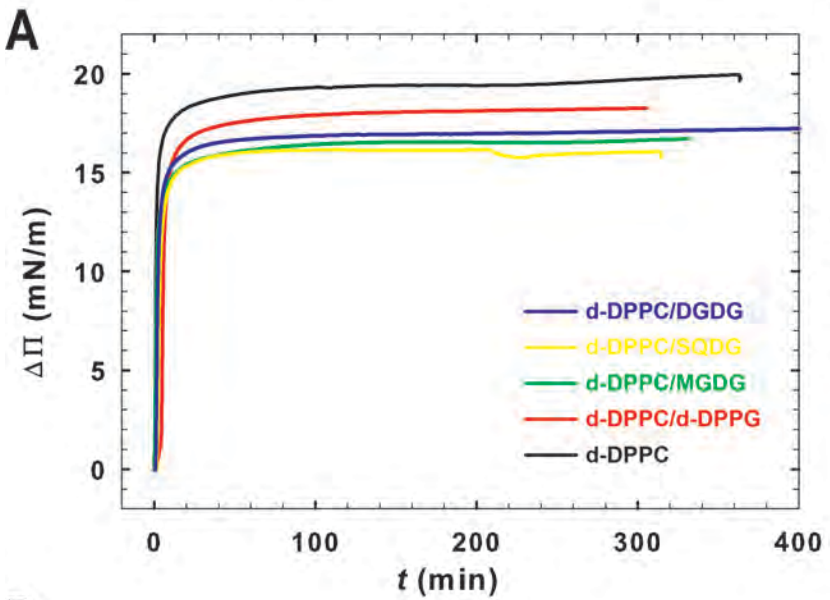


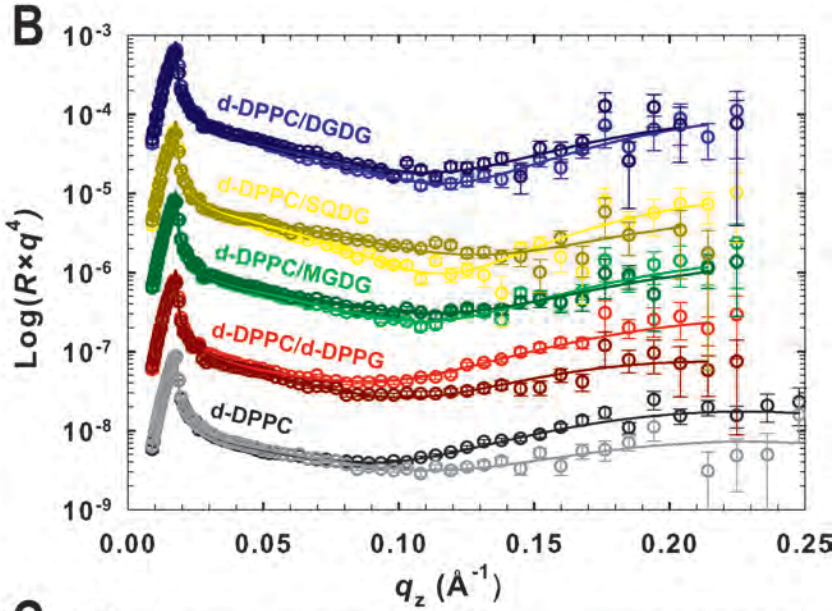


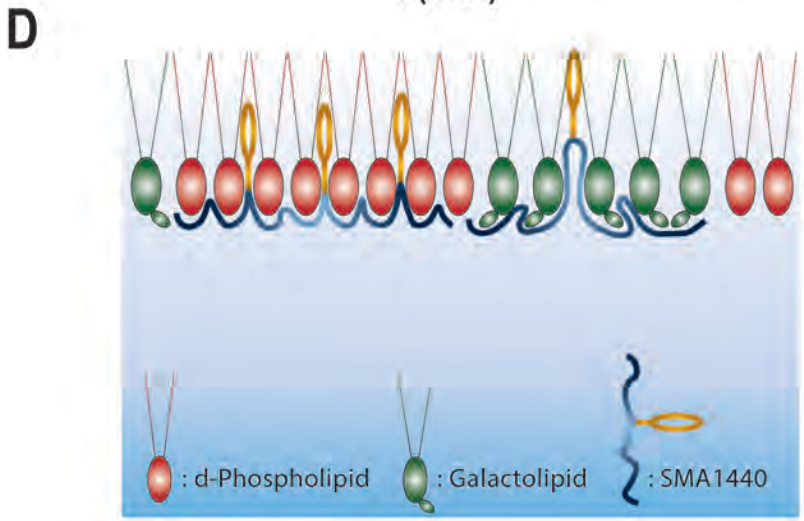
Minh D. Phan, Olena I. Korotych, Nathan G. Brady et al. X-ray and neutron reflectivity studies of styrene-maleic acid copolymer interactions with galactolipid-containing monolayers. *Langmuir.* (In Secondary Review).

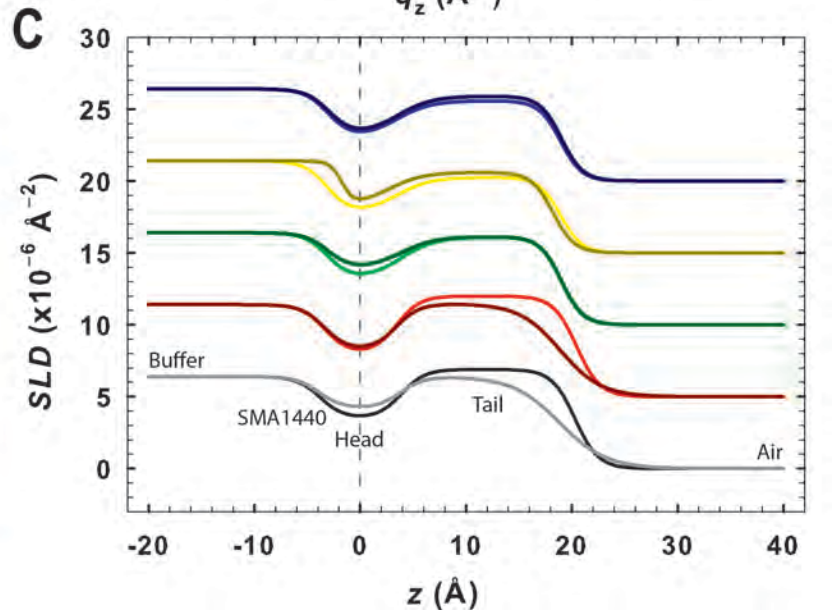
NR suggests deeper insertion of butoxyethanol into acyl region for galactolipid-rich monolayers











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Thank you!

PI

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BIOCHEMISTRY & CELLULAR AND MOLECULAR BIOLOGY

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OAK RIDGE National Laboratory