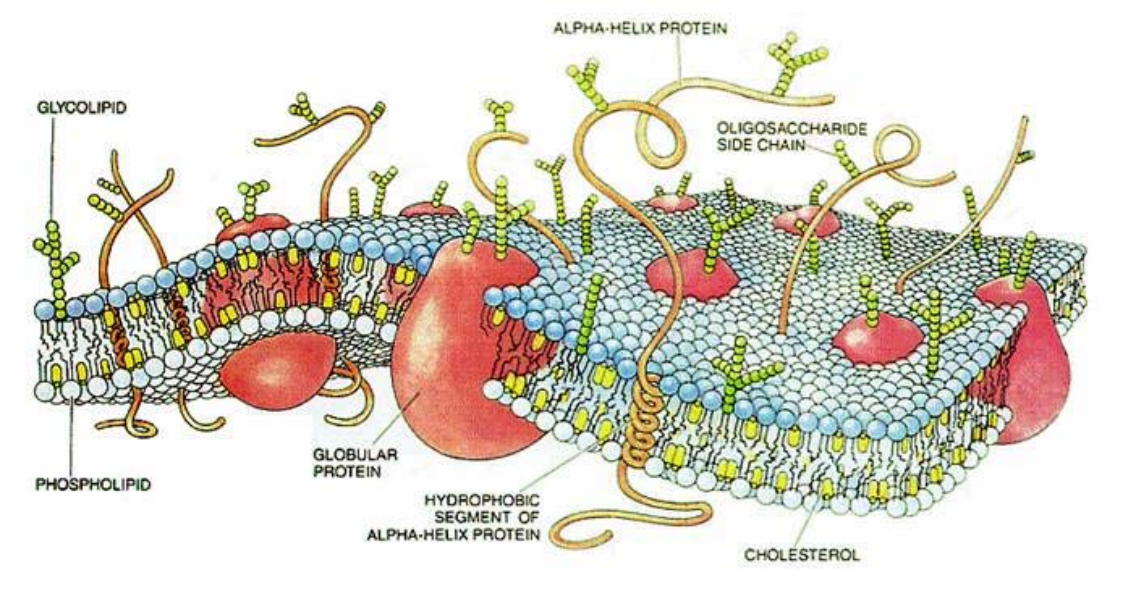
Large-scale Deformation of Giant Unilamellar Vesicles

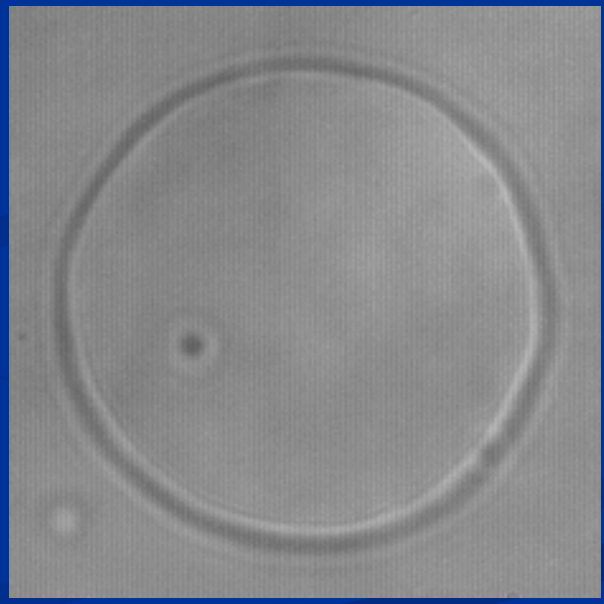
TREND 2008

Alex Steinkamp, Wolfgang Losert,
Willem van de Water, Beatriz Burrola

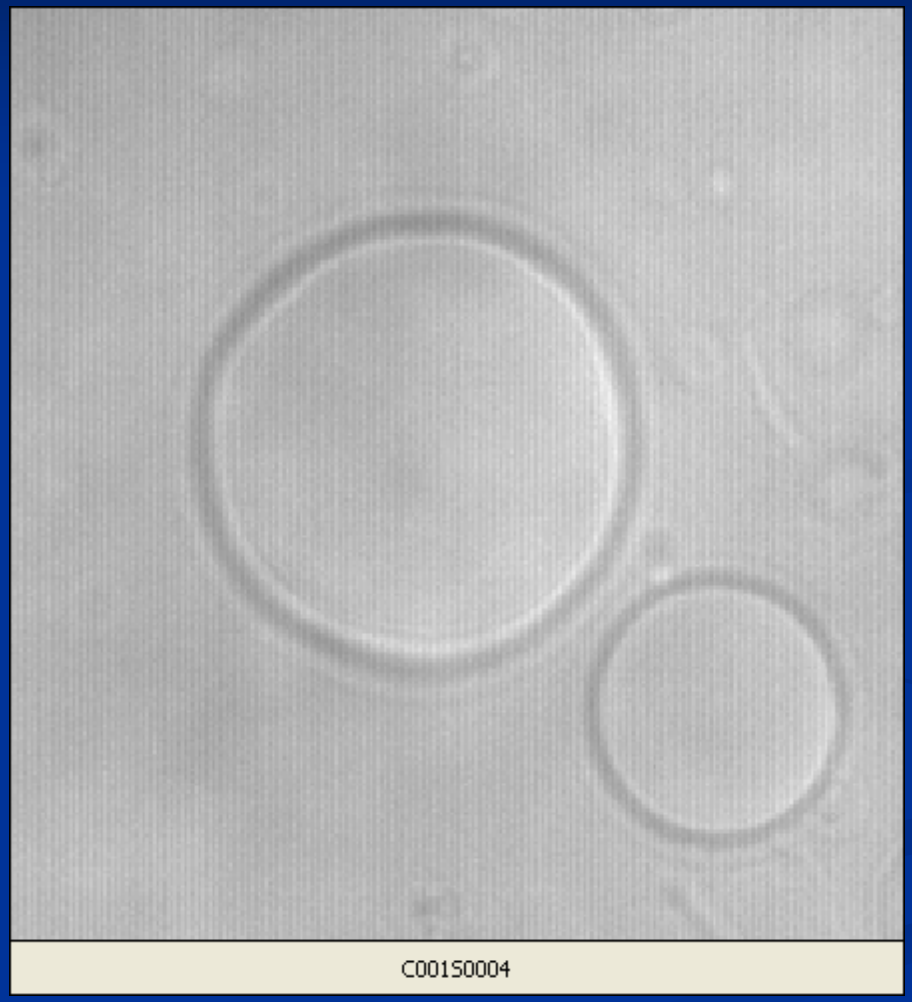
What is a vesicle?

- Self-assembled lipid bilayer
- 10 – 100 μm diameter





Experiment



Theory

$$r(\theta,\phi) = r_0(1+u(\theta,\phi))$$

$$V = \frac{4}{3}\pi r_0^3$$

$$A = (4\pi + \Delta)r_0^2$$

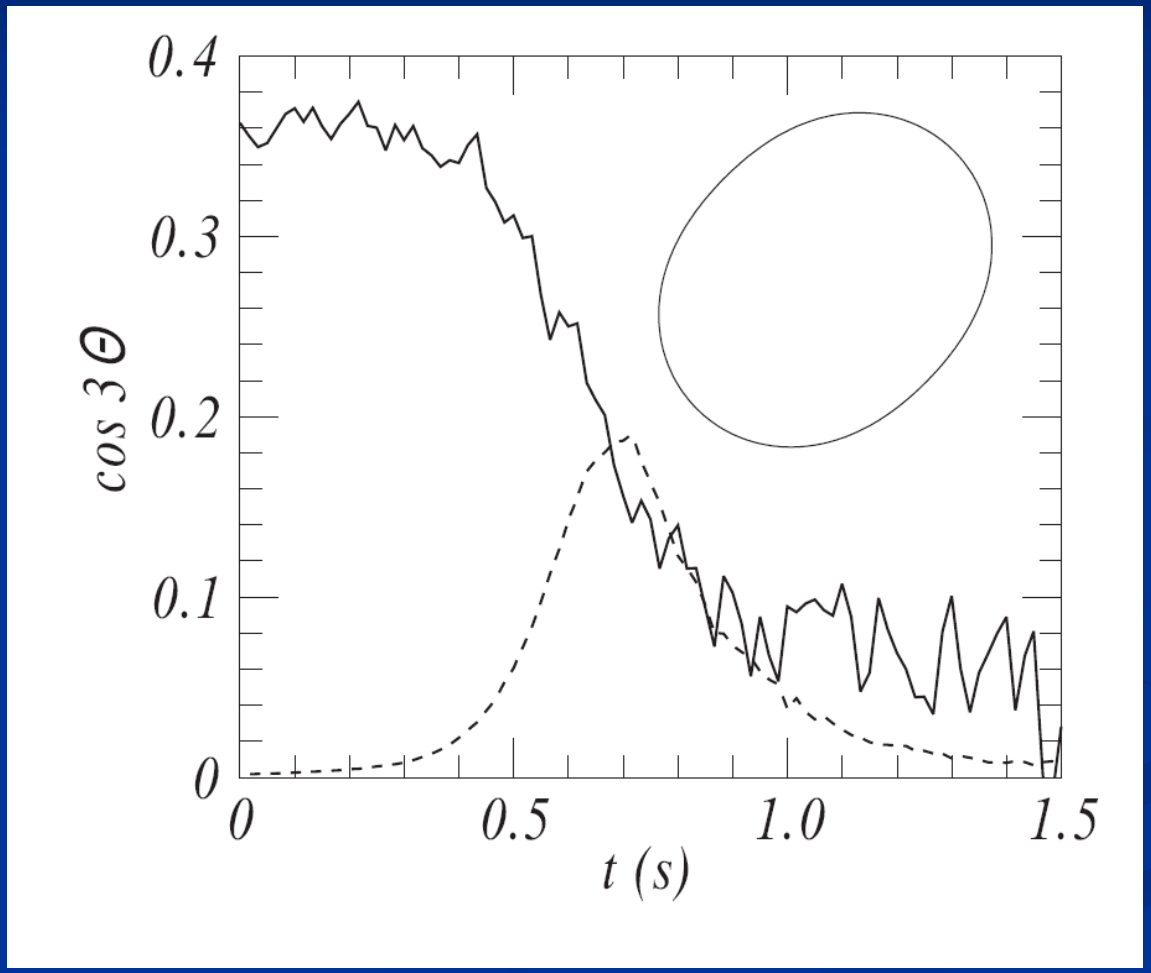
Theory

$$\tau \frac{d\Theta}{dt} = \cos(3\Theta)$$

$$\tau = \frac{1}{\kappa\sqrt{\Delta}}\left(1.7\eta r_0^3 + 1.3\tilde{\eta} r_0^3 + 0.9\zeta r_0^2\right)$$

Θ is a measure of how ellipsoidal the vesicle shape is.

Initial results



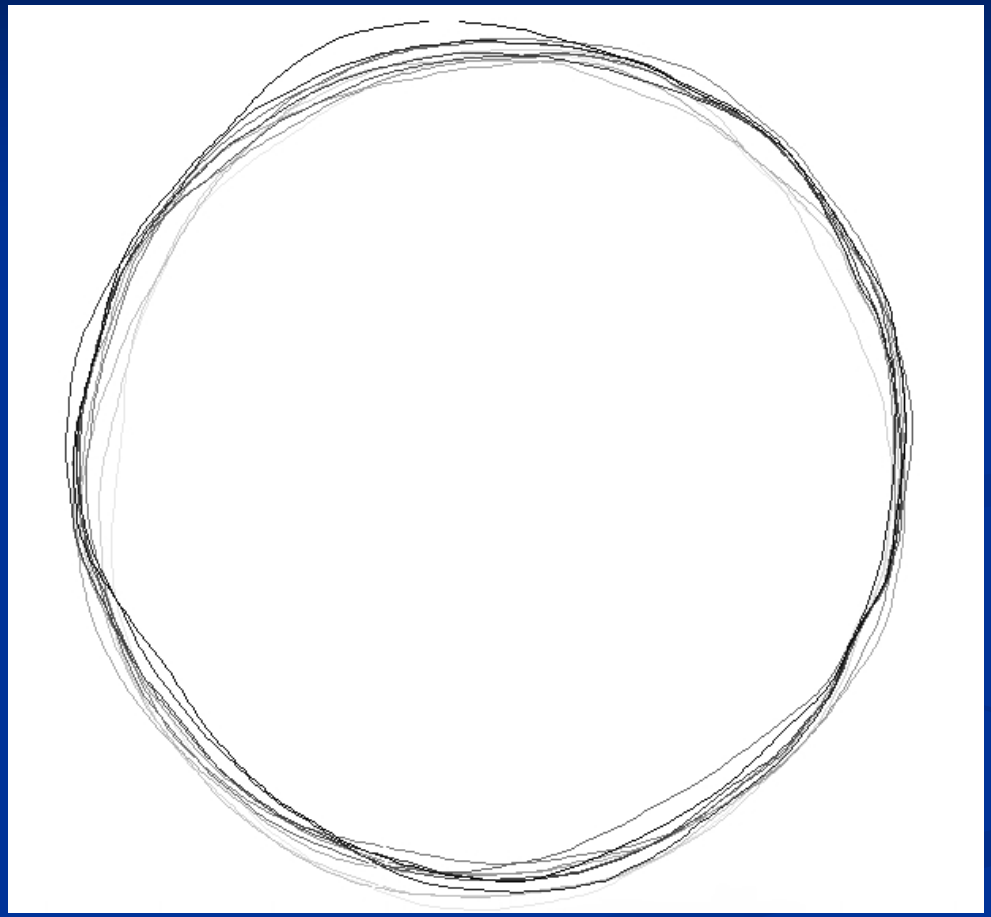
Problems in implementation

-Volume conservation

-Excess area conservation

-Rotational symmetry

Thermal Fluctuations



In brief: will allow for extraction of bending elasticity and membrane tension.

Work Remaining

Re-approach relaxation theory.

Fully implement fluctuation analysis.

Increase experimental complexity.