# Physical studies of cell membrane and membrane protein biophysics

Collaboration between
Catherine Crouch (Physics)
and Kathleen Howard (Chemistry)

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# Cell membrane curvature

- Membrane shapes change in many critical cellular processes (such as movement, division)
- How are such changes caused by:
  - Protein structure
  - Membrane structure

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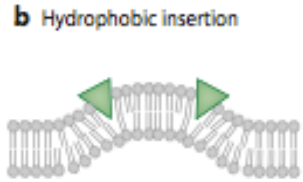
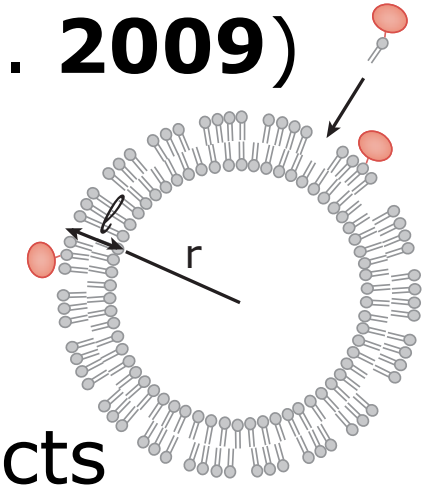
# Possible simple mechanism




Proposed mechanism for surface binding proteins

(Bhatia, Stamou, *et al*, EMBO J. **2009**)




- Hydrophobic part wedges into membrane defects
- Higher curvature (bending membrane more) → more defects

Do membrane proteins use this mechanism?

Figures from Baumgart et al (2011), Bhatia et al (2009).

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# Experiments

- Need to understand and optimize physical properties of simple model system (vesicle with just the membrane protein of interest)
  - Light scattering
  - Fluorescence correlation spectroscopy

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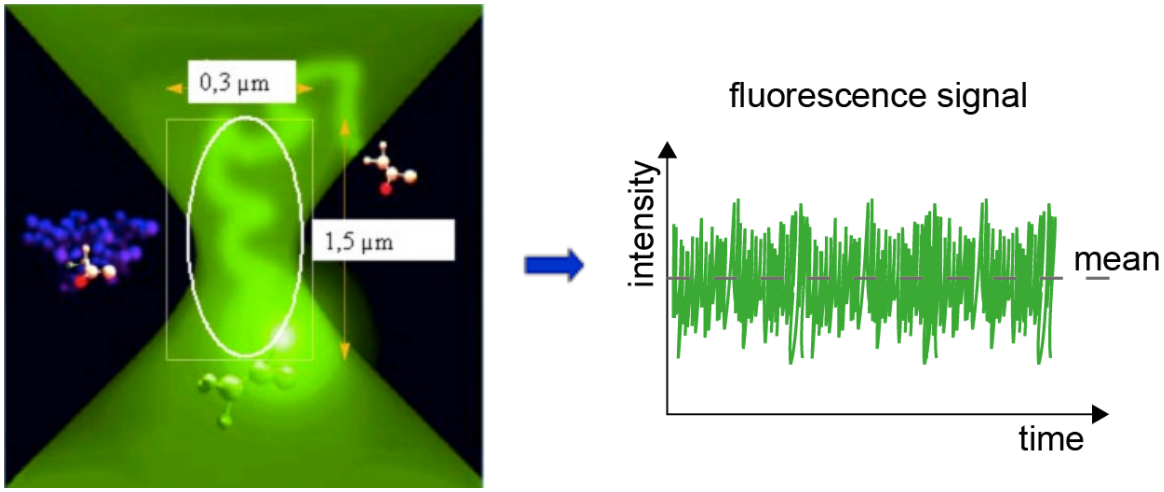
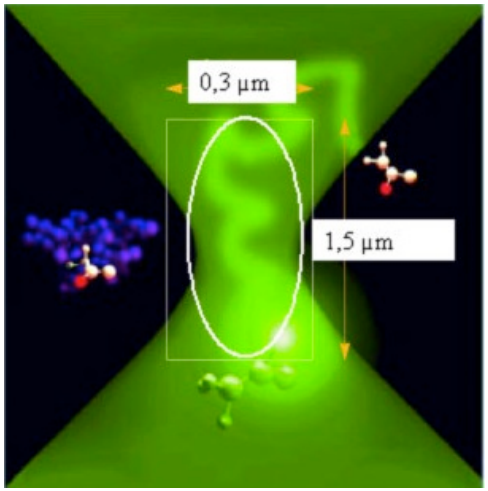
# Fluorescence correlation spectroscopy

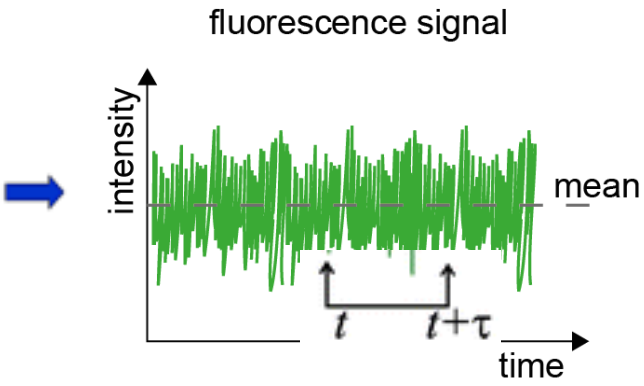
## Probes diffusion of single fluorescent objects

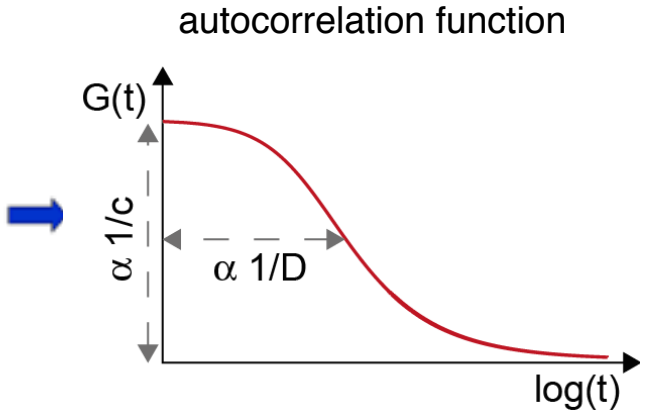


# Fluorescence correlation spectroscopy

## Probes diffusion of single fluorescent objects

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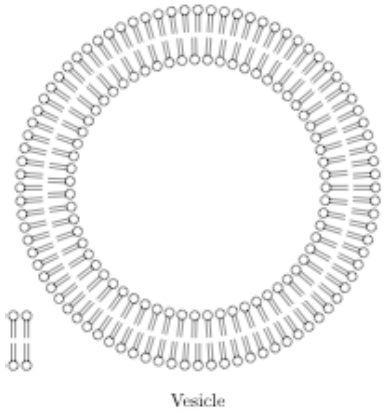
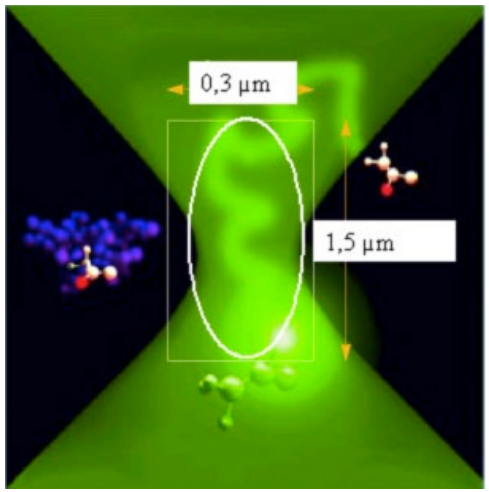
# Vesicle dynamics

Can we observe *rotational* diffusion in vesicles with only a few fluorescent molecules?




Involves:

- Bench chemistry preparing vesicles
- Optical experiments
- Data analysis

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# What makes teaching physics effective for life science students?

**Collaboration with colleagues at University of Maryland and Ben Geller and Ann Renninger (Education)**

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# Research questions

- Do students carry what they learn in physics forward into later biology courses and research?
- What aspects of a physics course support students to do so?

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# To learn more ....

**I'm always happy to talk about these exciting questions!**

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