

Single molecule approaches for biophysics and bioengineering – Fundamentals and Applications

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Fall 2009 (MW, 4-6pm) curriculum

1. Introduction

Part I: Fundamentals

2. Review of the Physical Biology of the Cell

Structural organization and length scales, Energy and Entropy,
Forces and Timescales, Intro. to reaction kinetics,
Intro. to polymers (basic concepts, some scaling laws, FJC and WLC models)
Single molecule mechanics

3. Single Molecule (SM) methods (in vitro)

Fluorescence spectroscopy (FRET, Lifetime),
“super” resolution methods.
Force spectroscopy
(optical / magnetic traps), Nanopores.

4. Biomolecules in live cells

From FISH to Florescent Proteins
Enzyme kinetics in live cells
Probing transcription kinetics in real time

Part II: Applications

5. Applications of SM in Biophysics

Probing molecular motors in action, ion pumps, nucleic acid's and protein structure.

6. Nano-BioTechnology (NBT); SM meets nanomaterials

Nano- Pores, Slits and Cavities.

7. Some applications of NBT (to be refreshed each year):

Beyond micro-arrays: 3rd generation DNA sequencing

8. Group discussions and final students' presentations