PHYS498 EBP: Paper Reading Assignment for Optical Trap Module

First, you should also feel free to contact Paul (selvin@illinois.edu), Rohit (rohitmv2@illinois.edu) or Yeoan (yyeoan4@illinois.edu). We are available by email, or by Zoom. Our office hours will be posted on the Physics 498EXB. In general, they will be flexible. (Our priority is with YOU, to try and make this a reasonable experience.) Now, on to details of the reading….

Read the following papers (according to your group), write a report and prepare an oral presentation according to the questions given below. You are also encouraged to look up further references in these papers that can give you a better idea and help answer the questions.

1. Killian et al., "Optical Tweezers: A Force to Be Reckoned With" Cell, Volume 175, Issue 6, 29 November 2018, Pages 1445-1448. **[Common for both groups]**
2. Mehta et al., "Single molecule biochemistry using optical tweezers" FEBS Letters, Volume 430, Issues 1–2, 23 June 1998, Pages 23-27. **[Group 1—read this additional article (only)]**
3. Wang et al., "Force and Velocity Measured for Single Molecules of RNA Polymerase" Science, Vol. 282, Issue 5390, 30 October 1998, pp. 902-907. **[Group 2—read this additional article (only)] [You don't have to focus on "comparisons with theory" section and anything after that.]**

Format of the report:

.Use single spaced, normal margin (1" for all 4 sides), Arial font size 11 or Times font size 12, and do not exceed 10 pages. Diagrams and Pictures are not included in the total length. We recommend discussing with others in your group. However, everyone must prepare and turn in your own report by yourself.

Format of the oral presentation:

The oral presentation is 15 minutes long followed by additional 5 minutes of discussion. Prepare the presentation remotely (via Skype, Zoom, or etc.) Important thing is that we want every group member to participate equally (in terms of effort, presentation time, etc.). In general, each person should plan on 5 minutes of presentation. Sample formats for the presentation are given below. They are given just as an example, feel free to vary it based on your strategy.

All oral presentations should start with the title of the two articles, and then have a one sentence or phrase of what the general subject is (e.g. Optical trap studies of the molecular motor Myosin II involved in muscle contraction), and then a one sentence or phrase of what the conclusion is (e.g. Myosin II is a non-processive motor that takes a 5 nm power-stroke).

The very last slide (of presenter 3) should have the summary and conclusion slide presented again, so that the other students (and TAs and Professors) who are evaluating you, have the main results staring at them,

Group 1 (Nikhila, Sara and Sepehr)
1st Person: Using optical trap to study processive molecular motors
2nd Person: Using optical trap to study non-processive molecular motors
3rd Person: Using optical trap to study proteins under mechanical strain

Group 2 (Ali, Michael, Satvik)
1st Person: RNAP introduction and experimental set up
2nd Person: The need for feedback controller and how force and transcript size information can be obtained as a function of time
3rd Person: Force vs time, transcript size vs time and from that, force vs velocity information and interpretation of the results

Questions (You should answer these in your written report and address them in your presentation)

- Group 1
  1. What are "processive" molecular motors?
  2. Describe how an optical trap experiment is set up to study processive motors. What kind information can be extracted from these experiments?
  3. Describe how the number of rate-limiting processes is found out from dwell time information. Most mechanical steps of processive motors are rate-limited by how many processes?
  4. What are "non-processive" molecular motors?
  5. Describe how an optical trap experiment is set up to study non-processive motors. What kind information can be extracted from these experiments?
  6. Why do the experimental set-ups for processive and non-processive motors have to be different?
  7. Describe how an optical trap experiment is set up to study proteins under mechanical strain. How do you obtain a force-extension curve?
  8. What does the hysteresis in the force-extension curves of titin tell you about its behavior under mechanical strain?

- Group 2
  1. What are RNAPs?
  2. Describe how the optical trap experiment is set up for studying RNAPs.
  3. What is the need for a feedback controller in the optical trap set up for studying RNAPs?
  4. How do you obtain force vs time and transcript size vs time curves? What do they tell you about the behavior of RNAPs?
  5. How do you obtain single-molecule force vs velocity curve (fig. 4A in the paper)? What does it tell you about the behavior of RNAP?