Modelling Light-Driven Micro-Machines - Project Plan

Minutes for November 29, 2017

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1. Investigate the effects of optics on a fixed particle system

- Using DDA calculate the forces and torques on the macroscopic particle
  - Use ADDA
- Apply T-Matrix theory for rotationally symmetric particles
- Use both Gaussian and Planar beams (Planar beams will allow us to clarify our force calculations with those calculated within ADDA)
- Evaluate the optimum calculation of forces and torques, removing truncation errors
- Vary the propagation direction of the beam for a non realistic system
- Use the following objects in this sequence, to illustrate evolution of understanding:
  1. Sphere
  2. Rotationally symmetric object (simple)
  3. Rotationally symmetric object (complex)
  4. Non Rotationally symmetric object

2. Investigate external effects on particles

- Taking the simple spherical particle and seeing how it behaves as a under different conditions (i.e. Friction, Gravity, etc.)
- Vary environmental conditions (i.e. Temperature, Refractive index of the medium, etc.)
- Vary the propagation direction of the beam for a real system
- Consider how to translate between the different reference frames of the:
  - Particle
  - Beam
  - Laboratory
- Consider more complex objects within the same scenarios illustrated above

3. Investigate realistic systems

- Replicate an experiment currently being undertaken by postgraduate students, to determine the extent to which microscopic arrow heads are moving in a system. Compare and contrast our results with the physical results attained in the laboratory

- Consider an optical tweezer arrangement to manipulate realistic particles, compare to previous experiments
- Create a propeller system that replicates physical motion to an applied particle
- Create a drill simulation, whereby we move a formed drill bit to create holes in a material using a beam or optical beams arrangement