

Abstract

What's a physicist doing studying biology? As you will hopefully see in today's talk, there is new physics that enable one to see biology with ever increasing clarity.

We study single molecules with fluorescence microscopy that can achieve nanometer accuracy—called FIONA— or similarly, nanometer resolution—called PALM or STORM. This is 10-100x better than conventional fluorescence. Using this technique, we show that molecular motors, such as kinesin, “walk” on tiny “roadways”, with steps of 16.8 nm, much below the diffraction limit of light. When kinesin works in groups to carry cargoes, especially when faced with detours and roadblocks like those found in the cell, we find that one of the kinesins rapidly detaches when blocked by a roadblock, allowing the cargo to continue with essentially unhindered speed. We also study nerves and attempt to understand how we remember and forget. We have taken the first (of many) steps to understand how many “memory molecules” (called AMPA Receptors) it takes to remember something. And, in general, in order to apply fluorescence microscopy to cell-based systems, one needs new techniques for labelling. We show, for the first time, that intracellular proteins can be labelled with external fluorophores with high throughput and without significant harm to cell health. Application to p53, a protein involved in a number of cancers, is highlighted.