Single-molecule insights for drug discovery and development: the next level of resolution

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Biophysics is an interdisciplinary field where tools from physics are used to help answer questions relevant to biology. Today, I will talk about how we apply these tools to single-molecule microscopy in order to study molecular interactions. Understanding these interactions is crucial to advancing biotechnology, therapeutics, and diagnostics. Most existing biological tools make “ensemble” measurements of interactions, typically averaging over millions of molecules or more. But molecules are complicated. They can transition quickly between states, or rare molecules can exist in a mixture that get missed when the ensemble is measured. Single-molecule microscopy allows us to study these rare events and multi-state reactions one molecule at a time. Through studying their motion and optical properties, we can learn more about how they work and why they sometimes don’t. I will discuss using “CLiC” imaging to trap and image single molecules for long times. By directly imaging many single molecules simultaneously, CLiC allows us to investigate how therapeutic molecules interact with nucleic acids, and how lipid nanoparticles transport and release drugs. This exciting interdisciplinary work will show how statistical mechanics, optics and material science come together to help us better understand how drugs and genetic medicines work.

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