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Ballistic Optical Tweezers for Measuring Fast Protein-Receptor Binding Dynamics

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Despite significant advances in molecular biology and microscopy techniques, many questions remain regarding the interactions between a single cell and its environment. In particular, understanding protein-membrane binding is vital for optimising the delivery of vaccines and medicines. By studying these transmembrane behaviours, we can improve drug delivery and increase the specificity of cell targeting. A powerful tool for probing these interactions is optical tweezers, which allow for the precise control and tracking of microparticles. However, conventional optical tweezers used in biological settings are limited by the slow tracking of diffusive Brownian motion, which prevents the observation of binding dynamics at their native rates. I will present the use of state-of-the-art ultrafast optical tweezers that resolve the ballistic Brownian motion of functionalized microspheres, enabling the measurement of local viscosity changes and, thus, the binding dynamics of single protein-receptor pairs with up to three orders of magnitude higher temporal resolution.

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