Confining Brownian motion of nanoparticles and biomolecules in an ABELtrap

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Brownian motion renders observing dynamic behaviour of biomolecules in solution beyond tens of milliseconds a challenging task. Most techniques rely on immobilisation or transient diffusion through a confocal laser focus. We present an Anti-Brownian ELectrokinetic trap [1-3] to increase the observation time of individual proteoliposomes, DNA origami and nanoparticles [4]. We are able to trap single 10nm silver spheres up to a minute and biomolecules labeled with a single fluorophore beyond 2s. The ABELtrap is an active feedback system cancelling the nanoparticle's Brownian motion by applying an electric field. We show how the induced electrokinetic force confines the motion of nanoparticles and biomolecules to the centre of the trap. We are particularly interested in the conformational dynamics of individual FoF1-ATP synthase proteins. Monitoring sequential distance changes between two specifically attached dyes using single-molecule FRET allows us to observe this membrane-bound rotary protein in real time.

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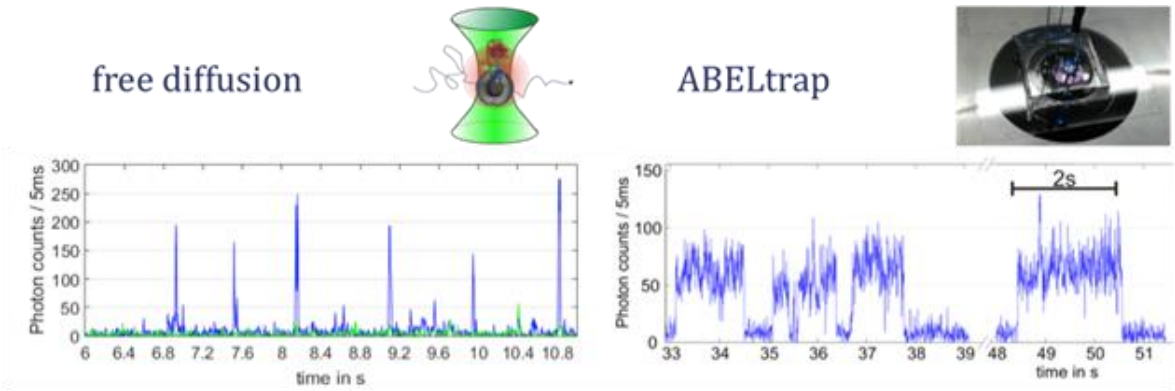

Fig. 1: The observation time of FoF1-ATP synthase molecules (E. coli, reconstituted in liposomes) increases from tens of ms for free diffusion through a laser focus to seconds holding the proteoliposome in an ABELtrap. A trap event starts with the sudden increase of emitted photons from the excited fluorophore and ends with fluorophore blinking or bleaching. We label each FoF1-ATP synthase with a single mNeonGreen fluorophore at the a-subunit of the rotor protein.

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