Spring 2024

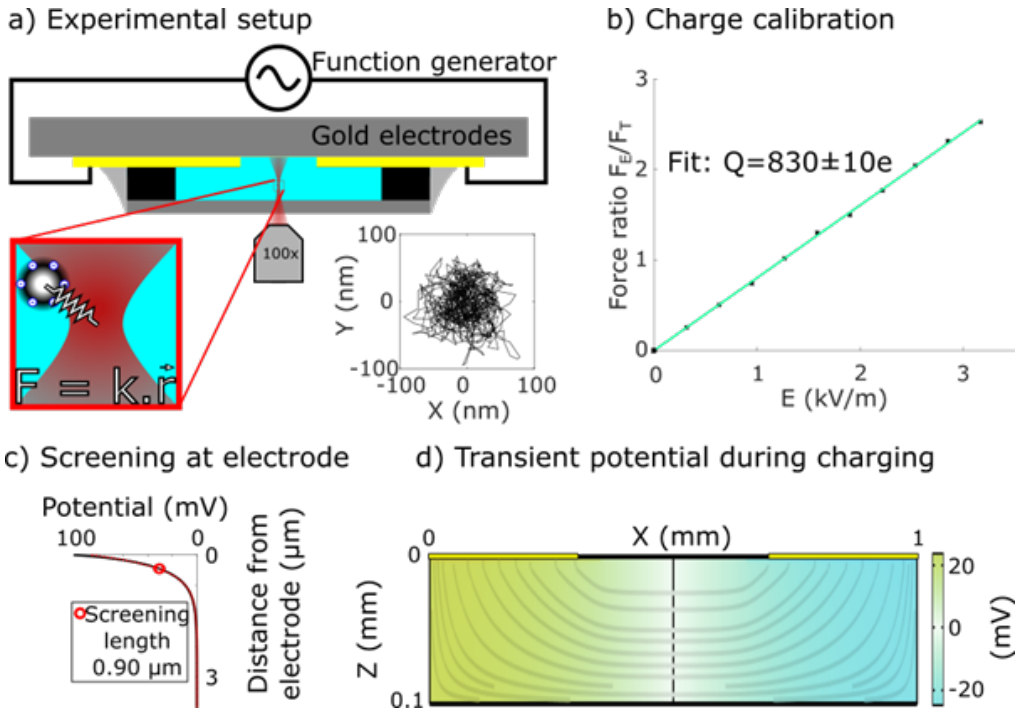
Optics & Photonics Group Lunchtime Seminar Series

University of Nottingham

Electric force sensing with optical trapping

William Hardiman

University of Nottingham



13:30 Wednesday 17 April 2024

Life Sciences Building - B3

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William Hardiman

Electric force sensing with optical trapping

Electrostatic interactions are essential to the function of the body, for example in the immune system where transmembrane potential is related to immune response, or even individual proteins where entering the active state can rely on ion binding. Despite this, little is known about the surface charge of individual cells and tissues due to a lack of techniques to measure this in three dimensions. Making such measurements is made more challenging by charge screening whereby mobile ions, attracted to a static charge, cause a rapid decay of the electric field with distance from the static charge.

Here I present a novel approach to measuring electric fields using an optically trapped microsphere as a sensor. The charge on an individual microsphere can be calibrated by analysing microsphere movement in response to sinusoidal waveforms of varying amplitude, where particle tracking statistics can be calculated to find the ratio of thermal to electric forces. Using optical trapping it is simple to manipulate the bead and bring it close to a charge surface where the displacement from the trap centre allows the static force to be measured with sub-piconewton sensitivity in all three directions. Shown are both experimental measurements and models of the static force between a trapped bead and a charge surface.

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All are welcome

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