Departmental Colloquium

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11am Friday 11th November 2016

Room: JA5.05

DEPARTMENT OF PHYSICS

University of Strathclyde Science

Quest for Higher Sensitivity in Fluorescence Based Detection

From Ultrasensitive Biomedical Assays to Super-resolution Imaging

Background is a fundamental problem restricting sensitivity of biomedical assays and imaging. The limiting factors are sample autofluorescence (fluorescence of inherent components of cells, tissue, and fixatives) and scattering of excitation that can produce secondary unwanted excitations or may simply leak into the detector. Bright probes emitting in the red and NIR range significantly improved detection limit. Since background emission is dominated by short-lived components long-lifetime probes offer additional possibility for enhancing signal-to-background ratio by applying time-gated detection. Also, we recently realized that detection can be highly improved when using multi-pulse pumping excitation technology. Implementation of multi-pulse pumping and use of time-gated detection allows for high (few orders of magnitude) enhancement of the fluorescence signal of the probe over the autofluorescence. We will discuss applications of our new pumping technology in combination with time-gating and total internal reflection fluorescence (TIRF) to increase sensitivity of biomedical assays while decreasing the sample volume. We will present assays ranging from DNA detection, traumatic brain injuries (TBI), to possible Zika detection.

The possibility to highly enhance signal from an object by simple electronic pulse sequence manipulation opens a new way for obtaining subwavelength resolution images. Just changing from single pulse excitation to multiple-pulse excitation within one excitation trace will instantaneously increase (many-fold) the intensity of a subwavelength size object labeled with a long-lived probe, allowing for its quick localization. In such a way we can highly increase imaging speed as compared to stochastic methods allowing for dynamic imaging of physiological processes. I will present imaging with 50 nm resolution and applications to biological systems.

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