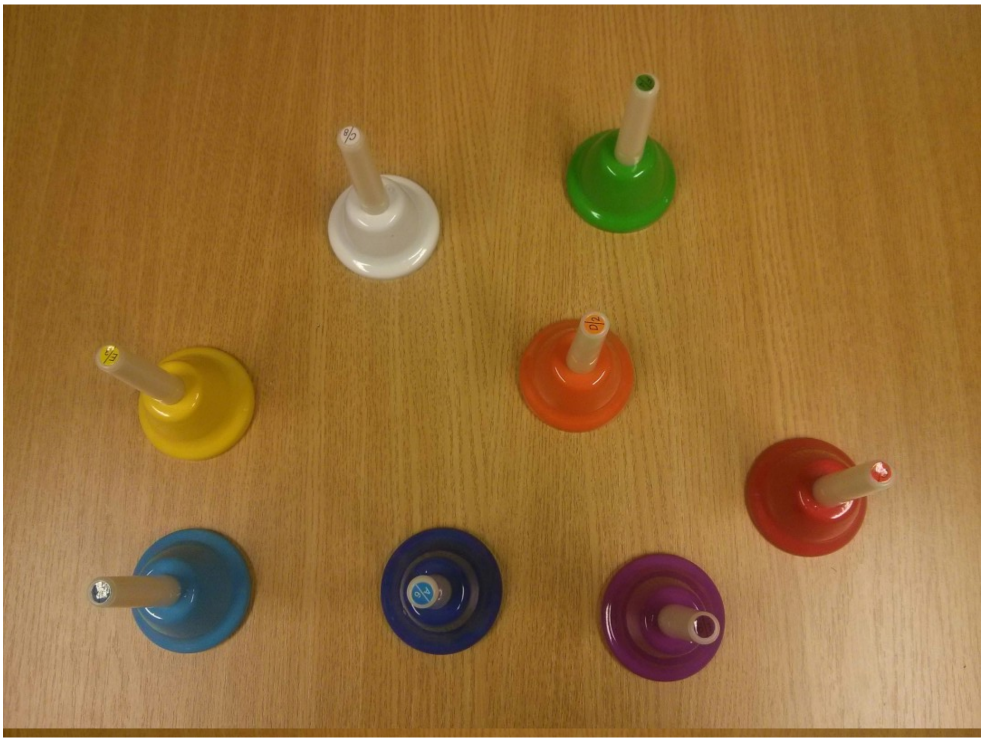
Optics and Photonics Group
Lunchtime Seminar

"High resolution imaging with sound"

Matt Clark



1:00pm Thursday 9th November 2017
203 Tower Building
All Welcome

Abstract

http://optics.nottingham.ac.uk/wiki/Talks_2017

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Ultrasonics offers an intriguing route to high resolution imaging: the speed of sound is typically above orders of magnitude lower than the speed of light and, at optical wavelengths, ultrasonic frequencies are in the GHz range (as opposed to 500THz for light) which are directly accessible using optical pump-probe techniques. At GHz frequencies and above, ultrasound has the potential to provide higher resolution imaging than optical microscopy. Many small-scale biological objects, such as cells, exhibit very little intrinsic optical contrast and look like little more than transparent bags of water in a pool of water. Consequently many biological objects require staining (often with cytotoxic dyes) in order to be imaged. In ultrasonic imaging the strongly varying mechanical properties of cellular structures may produce useful intrinsic mechanical contrast without staining or labelling. Imaging of this mechanical contrast could aid the study of complex cell processes such as mitosis, division, differentiation, migration, force production, mechano-sensitivity and dynamic events. While the energy carried by visible photons of light, especially in the blue, is high enough to cause chemical changes (and damage) to biological specimens, the energy carried by a acoustic phonons of the same wavelength is very small making acoustic imaging attractive in circumstances where damage must be minimised. The principle barrier to using high frequency ultrasound as an imaging tool is the extremely high attenuation at high frequencies which limits the distance that sound travels in biological samples to a few um at GHz frequencies. The use of laser ultrasound techniques means that the sound can be generated and detected at very high frequencies, very close to, or within the sample itself, and this (partially) overcomes the attenuation problem. In this talk we will explore the use of very high frequency ultrasound as a microscopy tool especially for the imaging of live biological cells at resolutions beyond the Rayleigh limit for optical microscopy.