

Advances in Optical Microscopy

Professor Brian Wilson

(Division of BioPhysics and BioImaging, Ontario Cancer Institute & Department of Medical Biophysics, University of Toronto)

Abstract: Optical microscopy is an old science but is very much alive and at the cutting edge of optical hardware, software, wetware and bioware developments. The range of capabilities is already huge and ever expanding. Confocal techniques for 3D optical sectioning of cells and tissues, non-linear multi-photon imaging; single molecule imaging, Raman and Coherent Anti-Stokes Raman microscopies, MACROscopy of large tissue samples at sub-cellular resolution, live-cell and intravital microscopy, and endomicroscopy in the living patient illustrate this diversity. A major recent development is that of nanoscopy, allowing imaging at sub-wavelength resolution, apparently violating Abbe's Law, which is set to push optical microscopy into the domain once held only by electron microscopy. The application and impact of several of these techniques in the life sciences are heavily dependent on novel contrast agents that go far beyond traditional pathology 'stains', to include molecular targeted constructs, activatable and switchable dyes, and nanoparticle-based reporters. The challenge in effectively utilizing this panoply of technologies is not only scientific and technical but also organizational, financial and cross-cultural: how do we give the life sciences communities access to these capabilities that are so heavily dependent on advances from other fields beyond their ken?

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FRIDAY 20 November, 3-4PM

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