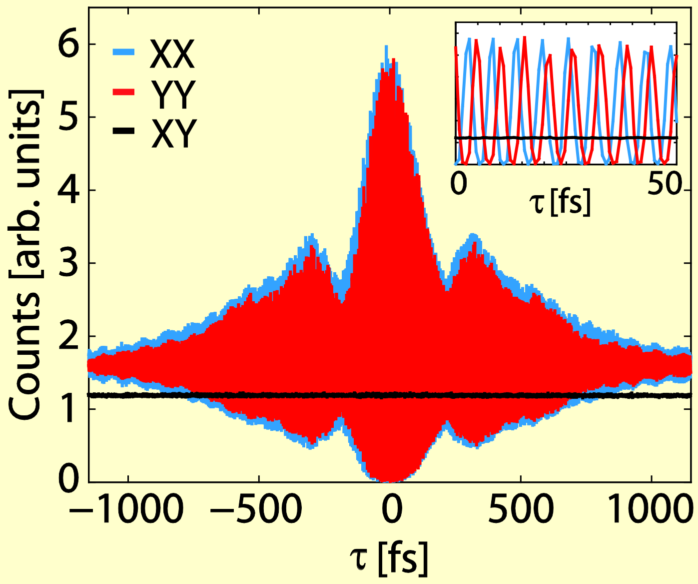
# ZERNIKE INSTITUTE COLLOQUIUM

## Thursday, March 10th, 2016

**16:00h, Lecture Hall: 5111.0080** **Coffee and cakes from 15:30h**

# Coherence in Modern Optics


**Ari T. Friberg**
**Institute of Photonics**
**University of Eastern Finland**
**Joensuu, Finland**


Coherence manifests itself in many ways in optics and photonics. Well known are the classic phenomenon in which light from stellar objects gains coherence by mere propagation, the measurement of coherence by observing fringe visibility, coherence-induced change of the spectrum even in free space, the intriguing polarization states and geometric phases of light beams, and many other fascinating effects. With the rapid development of near-field optics and nanophotonics, the theory of optical coherence has undergone important refinements so as to account for the various vectorial features of the light. In many instance the electromagnetic coherence properties have to be measured by means of nanoscatterers.

Partially polarized and temporally partially coherent light beams play central roles in metrology and optical instrumentation. Even fully unpolarized beams of light experience rapid polarization-state fluctuations that convey information about the source or the transmitting medium. Such ultrafast polarization dynamics and temporal coherence can be modelled theoretically and measured in a polarization-selective Michelson interferometer by using two-photon absorption. The so-called supercontinuum generated in a nonlinear optical fiber has an ultrabroad spectrum. Under wide circumstances its coherence characteristics can be represented as a superposition of two contributions, a nearly coherent part and an almost incoherent component. These contributions can be controlled by the pump pulse, thereby leading to supercontinuum of tailored coherence.

Some novel imaging techniques involve intensity correlations. Optical coherence tomography is a versatile biomedical imaging method based on the interference of low-coherence light. The resolution could be improved through the use of intensity correlations, but the rapid intensity fluctuations in incoherent light cannot be measured. A novel quantum-inspired spectral intensity correlation approach only utilizes mean intensities, resulting in enhanced image resolution and dispersion cancellation. A remarkable intensity-based technique called ghost imaging utilizes two beams neither of which contains image information but their correlation makes the image of the target magically appear. This method has been transcribed into the time domain enabling fully distortion-insensitive ghost imaging of ultrafast temporal signals.