Canadian Association of Physicists

Association canadienne des physiciens et physiciennes

Contribution ID: **614** Type: **Invited Speaker / Conférencier(ère) invité(e)**

(I) Quantum Theory of Polarized Light

Thursday, 10 June 2021 16:45 (5 minutes)

Polarimetry is a wildly-used measurement technique for inferring properties of a sample by observation of the changes in the polarization of the light transmitted or reflected by the sample. One of the impediments to wider use of the technique, especially in bio-medical applications such in-vivo biopsy, is that it can require very high laser intensities, leading to collateral tissue damage. As has been known for some time, by using quantum states of light, in which the individual photons are correlated rather than being independent of one another, one can in principle dramatically improve the signal to noise ratio in optical interferometry. Since polarized light can be understood as an interference phenomenon involving two light modes (i.e. the two orthogonal directions of field oscillation), it is natural to suppose that perhaps such a quantum advantage might apply to polarimetry as well.

In this presentation I will discuss my group's recent work aimed at understanding, characterizing and exploiting the quantum polarization properties of light. The work is set in the context of leveraging the technology developed for quantum communications and quantum information processing and offers at least a chance for a truly useful and widely deployable application of the current revolution in quantum technologies.

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Session Classification: R4-2 Quantum Information: Theory (DTP) / Information quantique: théorie (DPT)

Track Classification: Theoretical Physics / Physique théorique (DTP-DPT)