PHYSICS AND ASTRONOMY COLLOQUIUM

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New Approaches to Nonlinear Optical Imaging Improve Cancer Diagnosis and Materials Characterization, and Increase Cultural Heritage Appreciation

Abstract

Advances in ultrafast lasers, and in technologies to control those lasers, have led to methods which image intrinsic nonlinear optical signatures that were not previously observable in complex materials (such as tissue or Renaissance paintings). Contrast comes from effects such as excited state absorption, ground state depletion, and cross phase modulation-with much less power than a laser pointer. An emerging medical application is in melanoma, which presents serious diagnostic challenges today. More patients die from melanoma after a Stage I diagnosis than after a Stage IV diagnosis, because Stage I cancers (which are treated only by excision) occasionally are actually aggressive tumors-but conventional pathology cannot tell which ones are dangerous. We have shown that femtosecond pump-probe microscopy can distinguish between early-stage tumors which went on to metastatic cancer, and those which did not; and extended studies have unraveled the underlying physical mechanism. I will also present closely related work on nonlinear imaging of perovskites to understand grain boundary effects, and of historical pigments to infer the artist's original colors and intent.

Wednesday, December 4, 2019
3:30 p.m.
Bob Wright Centre A104