ICFO COLLOQUIUM MARGARET MURNANE 'Harnessing Quantum Light Science for Probing Quantum Materials'

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January 31, 2020

Friday, January 31, 2020, 12:00. ICFO Auditorium

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JILA, University of Colorado, Boulder, CO 80309-0440, USA / STROBE NSF Science and Technology Center, University of Colorado, Boulder CO, USA$$Margaret Murnane is a Fellow of JILA and a Distinguished Professor in Physics, ECE and Materials at the University of Colorado. She runs a joint, multi-disciplinary, research group with her husband, Prof. Henry Kapteyn. She received her B.S and M.S. degrees from University College Cork, Ireland, and her Ph.D. degree from UC Berkeley. Prof. Murnane with her students and collaborators use coherent beams of laser and x-ray light to capture the fastest dynamics in molecules and

materials at the nanoscale. She is a Fellow of the Optical Society of America, the American Physical Society, and the AAAS. She was elected to the National Academy of Sciences in 2004, and was awarded a John D. and Catherine T. MacArthur Fellowship in 2000. Margaret and Henry also shared the 2009 Ahmed Zewail Award of the American Chemical Society, the 2010 Schawlow Prize of the American Physical Society, and the 2010 R.W. Wood Prize of the Optical Society of America. Margaret is serving as the Director of the National Science Foundation STROBE Center on Real Time Functional Imaging.

X-ray science has undergone a revolution in the past decade. More than 50 years after the demonstration of the visible laser, it is finally possible to routinely generate laser-like beams spanning the extreme ultraviolet to the soft X-ray region. Large- and small-scale coherent X-ray sources, including high harmonic generation (HHG) and X-ray free electron lasers (XFELs) have enabled a broad range of applications. The past eight years in particular have seen breakthrough advances in the HHG source itself, as well as in new experimental methodologies and applications. The extreme quantum coherence of high harmonic light sources makes it possible to precisely control x-ray light using visible lasers -- enabling short wavelength waveforms with controlled spectral and temporal shape, polarization state, and beam structure extending into the zeptosecond regime (10-21 s). This is important because most advanced applications of lasers require precise control over light, and this has not been possible to date in the X-ray region to date due to limitations of the available optics. This talk will also review exciting applications in materials science. Exciting new capabilities include the ability to find hidden phases with new properties in quantum materials, the ability to probe thermal and elastic properties at the nanoscale, the ability to directly manipulate spin polarization in magnetic materials using light on few-femtosecond timescales, and the ability to implement the first near-perfect short wavelength microscopes.

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