

The Ultrafast electron Imaging Laboratory

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Atomistic views of chemical processes and phase transformations have long been the exclusive domain of computer simulations. The advent of femtosecond (fs) hard X-ray and fs-electron diffraction techniques has made it possible to bring such a level of scrutiny to the experimental arena.

Our research program lies in the investigation of dynamical phenomena and structure-function correlations relevant to the fields of condensed matter physics, solution chemistry, and molecular biology. To achieve this goal, we implement homebuilt femtosecond (fs) spectroscopic and electron imaging methods that provide us with the requisite temporal and spatial resolutions to observe atoms in motion; i.e., sub-picosecond temporal and ångström spatial resolutions. It was only thirty years ago that these types of experiments were thought to be impossible.

The Ultrafast Electron Imaging Lab (UeLL) at Waterloo hosts unique homebuilt infrastructure for the dynamic characterization of molecular structure and material properties. Research topics range from the study of carrier dynamics, electron-phonon and phonon-phonon interactions, excitons, and laser-induced phase transformations in crystalline low-dimensional materials to excited-state dynamics and electron transfer reactions in the solution phase.

In addition, a new and rapidly growing research direction involves the study of nanoparticles and biospecimens by in-liquid electron microscopy. We have developed our own specialized sample delivery methods for in-liquid electron microscopy and diffraction, which will soon enable groundbreaking discoveries through the investigation of ultrafast structural processes in the solution phase. I will present an overview of our group's efforts and discuss future directions.

Biography

Sciaini received his PhD with distinction from the University of Buenos Aires in 2006. He joined the Department of Chemistry of the University of Waterloo in January 2014 as an Associate Professor and a Tier II Canada Research Chair after holding a postdoctoral position at the University of Toronto and a Group Leader position at the Max Planck Institute for the Structure and Dynamics of Matter (MPSD), Hamburg, Germany.

Sciaini is currently heading the Ultrafast electron Imaging Laboratory (UeLL); a multidisciplinary team with the goal of investigating structure function correlations in complex materials and molecular systems from the most fundamental level of inspection. His group develops a variety of ultrafast imaging techniques and specialized electron microscope accessories, which are applied to investigate molecular structure and dynamical processes with *atomic spatial* and *sub-picosecond temporal* resolutions.

