TIME-RESOLVED NUCLEAR FORWARD SCATTERING: BRINGING PUMP-PROBE SPECTROSCOPY INTO THE GAMMA-RAY REGIME

DUGAN HAYES, CALI ANTOLINI, *Department of Chemistry, University of Rhode Island, Kingston, RI, USA*; MICHAEL Y. HU, *X-ray Science Division, Argonne National Laboratory, Lemont, IL, USA*; GILLES DOUMY, ANNE MARIE MARCH, *Chemical Sciences and Engineering Division, Argonne National Laboratory, Lemont, IL, USA*; BENJAMIN T. YOUNG, *Department of Physical Sciences, Rhode Island College, Providence, RI, USA*.

Over the last several decades, the development of time- and frequency-domain nuclear resonance spectroscopies that take advantage of the tunability and pulsed nature of synchrotron radiation at storage ring facilities has greatly expanded both the portfolio of routinely accessible nuclei and the range of material properties that may be probed via the Mössbauer effect. Continuing in this tradition, we recently developed a method to probe the photophysical dynamics of solid-state materials using a pump-probe implementation of time-domain Mössbauer spectroscopy that we refer to as time-resolved nuclear forward scattering (TRNFS). After introducing this novel technique and discussing its challenges, I will present our measurements of tin(II) oxide to showcase the power and unique opportunities of TRNFS. In particular, I will demonstrate how variable repetition rate TRNFS may be used to distinguish between electronic and thermal contributions to laser-induced difference spectra and how small contributions to the quantum beating signal originating from the photoexcited material may be clearly identified using reference scatterers.