Exploring the Non-equilibrium Phases of Complex Oxide Heterostructures

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Functional oxides based on the transition metal series display a wide spectrum of remarkable electronic properties including magnetism, superconductivity and metal-insulator transitions, which offer potential important properties for practical applications including colossal responses to external fields, switchable conductivity, and efficient energy conversion. However, under these conditions for application, these systems tend to be driven far away from the equilibrium ground-state. In order to harness these materials for the future, one of the grand challenges is to understand how to map the non-equilbrium phase space both to seek conditions where new states emerge but also as a basis for the design of materials that will help meet the energy needs of the future. In this talk, I will touch on recent work combining forefront X-ray tools with ultrafast optical excitation to help us to scratch the surface of this problem.

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John W. Freeland: Since 1998, John has been a physicist at the Advanced Photon Source in the Magnetic Materials Group. He received my Ph.D in Physics from Johns Hopkins University in 1996 followed by a National Research Council (NRC) Fellowship at the Naval Research Laboratory. He is a Fellow of the American Physical Society and this year he was appointed a senior fellow of the Northwestern Argonne Institute for Science and Engineering. His research is focused on the application of advanced x-ray probes to understand surfaces and interfaces. His current interests lie in understanding electronic and magnetic properties at the interface between dissimilar complex oxides. The broken symmetry at the interface and altered environment is an interesting area to explore what happens to the ground-state of competing strongly correlated electron systems. In recent, work he is now using in-situ techniques to follow real-time phenomena ranging from optical control of oxides to catalysis on perovskite surfaces to watching materials grow to understand how interfaces form.