

From PIPT1 to PIPT7: structural phase transition experimenter's viewpoint

Herve CAILLEAU*

Institute of Physics, University Rennes1, Rennes, 35042, France

*E-mail: herve.cailleau@uni-rennes1.fr

20 years ago many of us were enthralled by new observations that gave roots to the field of Photo-Induced Phase Transition. At that time, we were toddling. Since then many concepts and unprecedented ultrafast experiments have been developed. An intrinsic difficulty of the PIPT field, but also its great richness, is that it requires a deep understanding of practically every part of condensed matter physics. It also sheds new light on these different parts.

Looking back at the last 20 years, from the viewpoint of structural phase transitions, I would like to make some comments and raise open questions and challenges :

- From thermal phase transitions to PIPT : What lessons to draw from the universal concepts of phase transitions at thermal equilibrium and the power of symmetry analysis? To which extent comparisons between a photoinduced phase and those at thermal equilibrium are valid? Any universality in light-driven phase transition from quantum materials to cooperative molecular switching? What lessons for condensed matter physics from revealing the multiscale dynamics?

- Coherent manipulation of a material for driving non-thermal phase transition: What is the nature of the potential energy driving coherent dynamics? What scale difference from local precursor phenomena to macroscopic phase transition? How to direct materials along a non-thermal pathway to transform them from one phase to another? What is the role of volume and other crystal deformations? The role of sample morphology? What challenges to stabilize the photoinduced phase in a non-volatile state? To des photoinduce a reverse phase transition?

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