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Symmetry, Aperiodicity and Ultrafast Photo-Switching in Spin-Crossover Compounds

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The optical control of materials and related physical properties (electronic state, magnetic, optical...) by laser irradiation has gained tremendous interest within the emerging field of photoinduced phase transitions. Light-induced changes of molecular systems involve subtle coupling between the electronic and structural degrees of freedom, which are essential to stabilize the photo-excited state, different in nature from the stable state. Therefore the new experimental field of photocrystallography plays a key role. Its outreach goes far beyond simple structural analysis under laser excitation. By playing on different physical parameters and developing the techniques and analysis, one can investigate new out of equilibrium physics through light-driven cooperative dynamics and transformations in materials, or follow a chemical reaction in real time [1]. The use of photo-crystallography allows to investigate the nature, the mechanisms and the dynamics of photoinduced phase transitions. Here we will present photocrystallography studies of the photo-switching process in spin-crossover materials. On the one hand, ultrafast diffraction allows to follow the structural dynamics [2] and to probe the different processes following femtosecond laser excitation. Recent studies performed on the LCLS X-FEL have shown that the structural molecular changes, with the characteristic Fe-N bond elongation, occur within 160 fs. On the other hand, we will present investigations on the effect of light excitation on spin-state concentration waves, which may be of aperiodic nature (Figure, [3]). Time-resolved x-ray diffraction studies reveal that the high symmetry phase is reached only after milliseconds.

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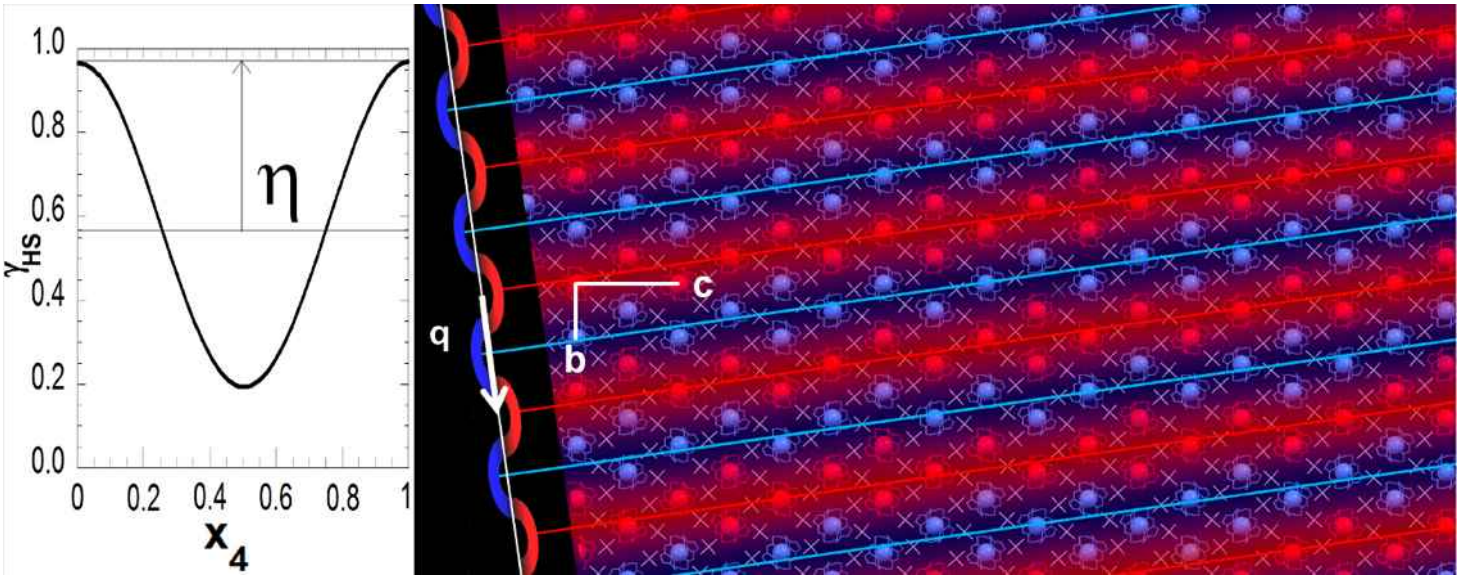

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