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Physical chemistry with free electron Lasers (FEL) sources: A prospective view on some experiments and concepts

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The development of elaborate sustainable and regenerative energy concepts has reached a point at which scientist necessarily have to move beyond macroscopic descriptions and take the steps that enable the ability to probe and decode the microscopic quantum world. Chemical processes, involved in combustion, in atmospheric and in surface science have to be understood on a molecular level, at which energy transfers and rearrangements of nuclei dictate the chemistry. Excited molecules tend to rapidly distribute their energy on sub-ps timescales and monitoring of energy transfer requires ultrafast spectroscopy. Pump-probe techniques with temporal resolution of a few 10 fs are state of the art. Optical spectroscopy typically involves transitions of valence electrons within a molecular system, while X-ray spectroscopy is concerned with transitions of core electrons. New concepts of X-ray coherent nonlinear spectroscopic techniques have to be developed. I will give a short overview of the new SwissFEL free electron laser facility and discuss some prospective concepts of spectroscopic methods in physical chemistry in matters of their feasibility and practicability at advanced FEL light sources.

Primary author: Dr KNOPP, Gregor (Paul Scherrer Institute)

Co-authors: PATTERSON, Bruce (Paul Scherrer Institut); Dr MILNE, Christopher (Paul Scherrer Institut); Dr SZLACHETKO, Jakub (Paul Scherrer Institut); Dr ABELA, Rafael (Paul Scherrer Institut); PENFOLD, Thomas

Presenter: Dr KNOPP, Gregor (Paul Scherrer Institute)

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