

Ultrafast fluorescence spectroscopy "lights up" biomolecular systems

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Enormous advances in the fields of photophysics and photochemistry have been made possible by ultrafast laser spectroscopy. In this presentation I will focus on one particular technique: fluorescence upconversion (FU), which allows the recording of emission kinetics with a temporal resolution limited only by the temporal width of the laser pulse itself. FU is unsurpassed in informing on the ultrafast dynamics of the directly excited bright state(s). It brings valuable information on non-radiative processes such as energy and charge transfer as well as conformational changes, all of which control the temporal evolution of the non-equilibrated excited state.

A brief overview of the technique will be given with special emphasis on applications in the UV spectral region. In order to illustrate the advantage of the FU technique, three recent examples of particular interest will be described in more detail. These are related to (i) photodynamics of melanine, (ii) drug-protein interactions and (iii) drug-DNA interactions. I will emphasize the crucial role of the ultrafast fluorescence, but also illustrate the multi-scale approach, including other techniques, needed in order to get a more complete understanding of these very complex systems.

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