MAP-fis Essay Proposal, 2013-2014

Supervisor

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Title

2 dimensional photon echo spectroscopy

Area

(*Materials, Optics, Condensed Theory, High Energy Theory,....*);

Optics and materials science

Summary of Proposal

Two-dimensional photon echo spectroscopy (2D PES) is a powerful technique capable of measuring inter- and intra-molecular couplings on an ultrafast time scale. In particular, 2D PES is advantageous in the presence of inhomogeneous broadening owing to the ability to rephase dipole oscillations resulting from a distribution of energies in the ensemble. This so-called static disorder is oftentimes responsible for the extremely broad spectral features in the linear absorption spectrum. Furthermore, 2D PES can identify electronic or vibrational couplings, which only manifest themselves as slight changes in peak position in the linear absorption spectrum, but are easily observable as off-diagonal peaks in the two-dimensional spectrum.

Setting up a 2D PES experiment is especially challenging as it requires interferometric phase stability between several beams in a four-wave mixing geometry and a broadband heterodyne detection scheme. The task proposed in this project is to undertake a critical review of the literature in order to understand the fundamental theory behind 2D PES spectroscopy, learn what physical processes can be probed, as well as to understand the key experimental requirements and innovations that allow successful measurements of the dynamics of molecular systems.

References

(*to allow students first look at topic*)

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3. T. Brixner, T. Mancal, I. V. Stiopkin, G. R. Fleming, Phase-stabilized two-dimensional electronic spectroscopy. Journal of Chemical Physics 121, 4221 (Sep 1, 2004).

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