Seminář odd. 26
Tenkých vrstev a nanostruktur

Fyzikální ústav AVČR, Cukrovarnická 10, Praha 6

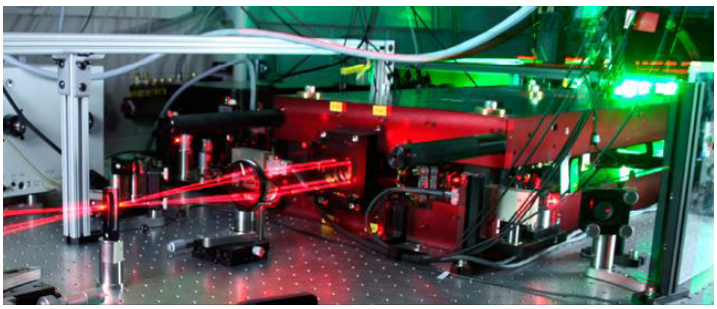
datum: 7. 7. 2015 úterý
čas: 10:00
místnost: knihovna, budova A, 1.p.

TÉMA

Coherent Spectroscopy for Quantum Control of Matter

Alan D. Bristow

Department of Physics & Astronomy, West Virginia University, Morgantown, USA



Quantum control can be achieved in many atomic and chemical settings, for example to enhance product or byproduct branching ratios, direct photocurrents or photoionization channels and enhance mechanisms in photocatalysis. Quantum control primarily uses constructive and destructive interference of quantum pathways between initial and final states to select and controlled the desired process with the amplitude and phase of the incoming light. In this talk, a simple quantum control scheme based on two harmonically related pulses is demonstrated to drive and direct photocurrents in semiconductors[1] and topological insulators.[2]

In practice, quantum control is often hindered by insufficient information about the target states. Calculation of the system's Hamiltonian can even be impossible. In this talk, multidimensional coherent spectroscopy is also used to acquire the Hamiltonian for potassium vapor.[3] This method yields line centers and line widths for all the quantum pathways for a three-level atomic system, such that the full Hamiltonian can be modeled empirically. Multidimensional coherent spectroscopy paves the way for measuring the desired properties of any system in situ, prior to the implementation of a deterministic quantum control scheme. Preliminary results on semiconductors will are also presented.[4]

[1] Costa, L., Betz, M., Spasenovic, M., Bristow, A. D. & Van Driel, H. M. All-optical injection of ballistic electrical currents in unbiased silicon. Nat. Phys. 3, 632–635 (2007).

[2] Bas, D. A. et al. Coherent control of injection currents in high-quality films of Bi2Se3. Appl. Phys. Lett. 106, 041109 (2015).

[3] Li, H., Bristow, A. D., Siemens, M. E., Moody, G. & Cundiff, S. T. Unraveling quantum pathways using optical 3D Fourier-transform spectroscopy. Nat. Commun. 4, 1390 (2013).

[4] Cundiff, S. T., Zhang, T., Bristow, A. D., Karaiskaj, D. & Dai, X. Optical Two-Dimensional Fourier Transform Spectroscopy of Semiconductor Quantum Wells. Acc. Chem. Res. 42, 1423–1432 (2009).

Alan D. Bristow received his Ph.D. in Physics from the University of Sheffield (UK) in 2004. He was a Postdoctoral Fellow at the University of Toronto from 2003-2006 and a Research Associate at JILA (a division of National Institute of Standards and Technology on the campus of the University of Colorado - Boulder) from 2006 and 2010. He was an Adjunct Instructor at Colorado School of Mines in 2009 and has been an Assistant Professor at West Virginia University since Fall 2010. Dr. Bristow leads the Ultrafast Nanophotonics Group at WVU, studying light-matter interaction in nanoscale materials with the aim to understand and control electron dynamics and coherences. Dr. Bristow is a member of the American Physical Society and the Optical Society of America.

odborný garant: *Ing. Pavel Jelínek, PhD.*