

Fritz-Haber-Institut der Max-Planck-Gesellschaft

Physikalische Chemie — Direktor: Prof. Dr. Martin Wolf



MAX-PLANCK-GESELLSCHAFT

Department Seminar:

Monday, January 21, 2018, at 11:00 a.m.;

— all are invited to meet at around 10:40 for a chat and coffee —

Dr. Álvaro Jiménez-Galán Max Born Institute for Nonlinear Optics and
Short Pulse Spectroscopy, Berlin.

Strong field topological and valleytronics physics on sub-laser cycle timescale

PC Seminar Room G2.06, Building G, Faradayweg 4

R. Ernstorfer

Abstract:

Attosecond science has made major recent progress in understanding ultrafast electron dynamics in solids. Yet, so far it has mostly focused on the role of the band structure. The role of the Berry curvature and its effects, which include topological properties and valleytronics, on the attosecond dynamics of electronic response has hardly been explored. Does the highly non-equilibrium electron dynamics in the bulk, driven by a strong laser field, encode the topological properties on the sub-laser cycle time scale? How does the Berry curvature affect the first step in the non-linear response - the field driven injection of electrons across the bandgap? Can we manipulate the electron injection to valley in a sub-laser cycle timescale?

In this talk, I will answer these questions. I will show how the topological state of the system controls its attosecond, highly non-equilibrium electronic response to strong low-frequency laser fields, in bulk. I will show how the harmonic emission displays Berry curvature-induced attosecond delays and how the helicities of the emitted harmonics of light can record the topological invariants in the Integer Quantum Hall insulator model of Haldane. Finally, I will show how one can achieve sub-cycle control of the electron populations in the K and K' valleys of hBN and MoS2 by using a combination of a strong circularly polarized field with its counter-rotating second harmonic.