Strongfield Physics Inside of Graphene and at a Needle Tips

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In the first part, we will show our recent results on strongfield physics inside of graphene. After an introduction to Landau-Zener-Stückelberg-Majorana physics (repeated coherent Landau-Zener transisitions) and the coherent electron dynamics resulting from strongly driving electrons in graphene, we will show work on two-color driving. Specifically, we will show that we can turn graphene into a Floquet-topological insulator (FTI) state with the help of a circular driving field. With a second harmonic field, we can stroboscopically probe the FTI state. We observe the anomalous Hall effect resulting from the Berry curvature of the FTI state.

In the second part of the talk, we will show attosecond physics effects resulting from the quickly varying spatio-temporal nearfield in front of a metal needle tip. We observe a strong carrier-envelope phase depencence not only in the rescatted part of the electrons, responsible for the plateau, but also in the direct part. We will explain this new CEP dependence and discuss its ramifications for forming intense isolated attosecond electron pulses.