Topological Phase Transition Induced by Partial Ordering of Adatoms in Graphene

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Topological insulators host robust, spin-polarized edge states, hence they are promising candidates for building of quantum computers and spintronics. Graphene is a two-dimensional semimetal with very weak intrinsic spin-orbit coupling. Stable topological phases, respecting time reversal symmetry can occur if the spin-orbit coupling is non-negligible, thus several approaches emerged to enlarge it in graphene. One of them is to dope it with heavy atoms.

In this presentation I will talk about the topological phases of adatom doped graphene. These adatoms can induce spin-orbit interaction and can partially self-organise themselves into a mosaic Kekulé pattern through the RKKY interaction at sufficiently low temperature, while at higher temperatures the distribution of adatoms becomes completely random. To investigate this phenomenon we developed a simple tight binding model, which was used for both the analytic derivations and numerical computations. To obtain the topological index of the system the spin Hall conductivity was computed.

I will discuss the topological flavour of the induced gap, and show the counterintuitive result, that the system can undergo a phase transition, where the lower temperature phase is trivial and the higher temperature phase is topological.