Electronic structure of mono- and bilayer graphene investigated by scanning tunneling spectroscopy

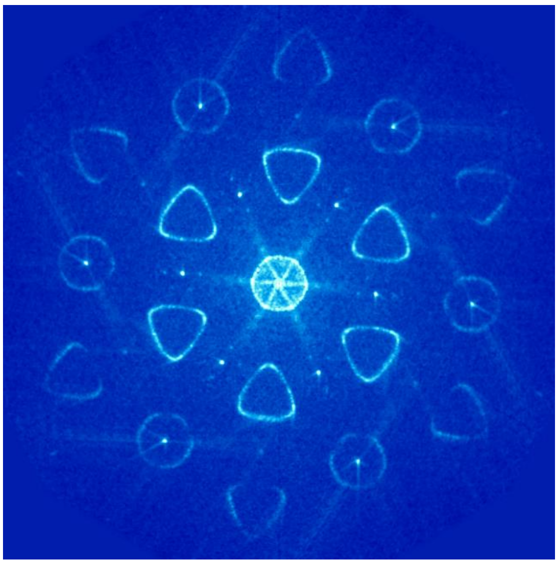
Carsten Busse (Universität Münster)

Using scanning tunneling microscopy and spectroscopy (STM/STS), we visualize electronic properties of mono- and bilayer graphene (MLG, BLG). We study interference patterns arising from scattering of charge carriers, thereby bestowing STM with sensitivity on the wave vector $\boldsymbol{k}$. However, the often complicated physics of the scattering process makes a direct interpretation of the interference pattern difficult, but at the same time provides the means to study deeper electronic properties.

Our measurements on Cs-intercalated MLG/Ir(111) show very good agreement with theoretical calculations for free-standing graphene, and illustrate the importance of higher order electron hopping processes for a correct description of the band structure. In addition, we present direct experimental evidence of broken pseudospin conservation caused by these processes. We identify a new intravalley scattering channel activated in case of a strongly trigonally warped constant energy contour, which is not suppressed by pseudospin conservation [1].

For the case of BLG/Ir(111), intercalation of Cs acts like a gate voltage and thus breaks inversion symmetry, leading to the opening of a band gap. We find that not all possible scattering vectors contribute to quasiparticle interference, and attribute this to a localization of different states in one of the two graphene layers.

[1] D. Dombrowski, W. Jolie, M. Petrović, S. Runte, F. Craes, J. Klinkhammer, M. Kralj, P. Lazić, E. Sela, C. Busse, Phys. Rev. Lett. 118, 116401 (2017)



Fourier transform of an STS map of gr/Cs/Ir(111). Different scattering processes (inter-, intravalley) give rise to the hexagonal and trigonal features and allow a determination of the band structure as well as the pseudospin properties.