Contribution ID: **1** Type: **Invited**

# Genzel Prize: Terahertz magneto-optics and magneto-plasmonics of graphene and graphite

*Tuesday, 24 July 2012 10:45 (40 minutes)*

A.B. Kuzmenko, I. Crassee, J. Levallois, and D. van der Marel

DPMC, University of Geneva,
Quai Ernest Ansermet 24, 1211 Geneva 4, Switzerland

Graphene attracts a lot of attention as a novel optical and plasmonic material. Its optical response is exceptionally sensitive to a magnetic field due to the small cyclotron mass of the Dirac-like charge carriers. This does not only make magneto-optics a useful tool to study this material but also gives rise to giant magneto-optical effects, potentially useful for terahertz applications. In this talk, I'll overview our magneto-optical studies of large-scale single- and multilayer graphene grown epitaxially on the Si- and C-faces of silicon carbide respectively [1,2,3]. In the highly doped monolayer graphene we observe a strong Drude peak at zero field and a quasiclassical, field-linear, cyclotron resonance at finite fields, which gives rise to a giant Faraday rotation exceeding 0.1 radians at modest fields [1]. In this type of graphene we also found an unexpectedly strong terahertz plasmonic absorption [3] due to natural defects such as terrace steps in SiC. When a field is applied, the plasmon peak splits in two modes, which is a hallmark of the magnetoplasmon physics found earlier in 2D electron gases in semiconductors [4] and on the surface of liquid helium [5]. In quasineutral twisted multilayer graphene, often regarded as a set of decoupled monolayers, we observe quantum LL transitions with the expected square-root like dependence on magnetic field. However, the optical intensity of these transitions is several times smaller than the Kubo formula predicts and its field dependence is not square-root like, as one would expect in ideal and decoupled monolayers [2]. I'll contrast this serious discrepancy to our recent magneto-optical Kerr rotation spectroscopy experiments in Bernal stacked graphite [6], where a very good agreement between the experiment and the tight-binding Kubo formula is achieved in a broad range of magnetic fields.

[1] I. Crassee, J. Levallois, A.L. Walter, M. Ostler, A. Bostwick, E. Rotenberg, Th. Seyller, D. van der Marel, and A.B. Kuzmenko, Nature Physics 7, 48 (2011).
[2] I. Crassee, J. Levallois, D. van der Marel, A. L. Walter, Th. Seyller, and A. B. Kuzmenko, Phys. Rev. B 84, 035103 (2011).
[3] I. Crassee et al., submitted.
[4] S.J. Allen, H.L. Stormer, and J.C.M. Hwang. Phys. Rev. B 28, 4875 (1983).
[5] D.B. Mast, A.J. Dahm, and A.L. Fetter, Phys. Rev. Lett. 54, 1706 (1985); D.C. Glatti, E.Y. Andrei, G. Deville, J. Poitrenaud, and F.I.B. Williams, Phys. Rev. Lett. 54, 1710 (1985).
[6] J. Levallois, M.K. Tran, and A.B. Kuzmenko, arXiv: 1110.2754; Solid State Communications, Special Issue on Graphene (2012), DOI: 10.1016/j.ssc.2012.04.036.

**Primary author:** KUZMENKO, Alexey (University of Geneva)

**Co-author:** CRASSEE, I. (University of Geneva)

**Presenter:** KUZMENKO, Alexey (University of Geneva)

**Session Classification:** Graphene II

**Track Classification:** Graphene