Carrier dynamics in Landau-quantized graphene featuring strong Auger scattering

By: Mittendorff, M (Mittendorff, Martin)[1,2] ; Wendler, F (Wendler, Florian)[3] ; Malic, E (Malic, Ermin)[3] ; Knorr, A (Knorr, Andreas)[3] ; Orlita, M (Orlita, Milan)[4,5] ; Potemski, M (Potemski, Marek)[4] ; Berger, C (Berger, Claire)[6,7] ; de Heer, WA (de Heer, Walter A.)[6,8] ; Schneider, H (Schneider, Harald)[1] ; Helm, M (Helm, Manfred)[1,2] ...More

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Abstract

The energy spectrum of common two-dimensional electron gases consists of a harmonic (that is, equidistant) ladder of Landau levels, thus preventing the possibility of optically addressing individual transitions. In graphene, however, owing to its non-harmonic spectrum, individual levels can be addressed selectively. Here, we report a time-resolved experiment directly pumping discrete Landau levels in graphene. Energetically degenerate Landau-level transitions from n = -1 to n = 0 and from n = 0 to n = 1 are distinguished by applying circularly polarized THz light. An analysis based on a microscopic theory shows that the zeroth Landau level is actually depleted by strong Auger scattering, even though it is optically pumped at the same time. The surprisingly strong electron-electron interaction responsible for this effect is directly evidenced through a sign reversal of the pump-probe signal.

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Author Information

Reprint Address: Mittendorff, M (reprint author)

Helmholtz Zentrum Dresden Rossendorf, POB 510119, D-01314 Dresden, Germany.

Addresses:

[1] Helmholtz Zentrum Dresden Rossendorf, D-01314 Dresden, Germany

[2] Tech Univ Dresden, D-01062 Dresden, Germany

[3] Tech Univ Berlin, D-10623 Berlin, Germany

[4] CNRS UJF UPS INSA, Lab Natl Champs Magnet Intenses, F-38042 Grenoble, France

[5] Charles Univ Prague, Fac Math & Phys, Prague 12116, Czech Republic

[6] Georgia Inst Technol, Atlanta, GA 30332 USA

[7] CNRS, Inst Neel, F-38042 Grenoble, France

[8] King Abdulaziz Univ, Dept Phys, Jeddah 22254, Saudi Arabia

E-mail Addresses: mhm@umd.edu; s.winnerl@hzdr.de

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