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## Carrier dynamics in Landau-quantized graphene featuring strong Auger scattering

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### NATURE PHYSICS

Volume: 11 Issue: 1 Pages: 75-81

DOI: 10.1038/NPHYS3164

Published: JAN 2015

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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.

### Keywords

**KeyWords Plus:** DIRAC FERMIONS; MULTIPLICATION; SUPERLATTICES

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### Funding

Funding Agency	Grant Number
German Science Foundation DFG	
European Community's Seventh Framework Programme (FP7)	226716
MOMB project	ERC-2012-AdG-320590

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**Categories / Classification**

**Research Areas:** Physics

**Web of Science Categories:** Physics, Multidisciplinary

**Document Information**

**Document Type:** Article

**Language:** English

**Accession Number:** WOS:000346831100027

**ISSN:** 1745-2473

**eISSN:** 1745-2481

**Journal Information**

**Table of Contents:** [Current Contents Connect](#)

**Impact Factor:** [Journal Citation Reports](#)

**Other Information**

**IDS Number:** AX3HQ

**Cited References in Web of Science Core Collection:** **45**

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