Cyclotron resonance of multi-layered epitaxial graphene under very high magnetic field

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We have performed mid-infrared measurements on multi-layered epitaxial graphene probing the fundamental cyclotron resonance

Recent infrared spectroscopy measurements on epitaxial graphene have confirmed the square-root dependence of various intra- and interband transitions with respect to an external magnetic field. So far, these measurements have not included an extended study of the fundamental cylcotron resonance which is obscured by the opacity of the SiC substrate in the relevant energy range. Here we present first results obtained with a CO-laser while using semi-destructive magnetic fields up to 120 T generated with a single-turn-coil. A schematic drawing of the setup is shown in figure 1. Figure 2 shows experimental data which exhibit two prominent features :

1. The absorption peaks marked by black arrows correspond to the cyclotron resonance of graphene, the energy transition from the zeroth to the first Landau level. The position of absorption lines has a square-root dependance with the magnetic field. The measured Fermi velocity is in good agreement with previous measurements [1][2][3].

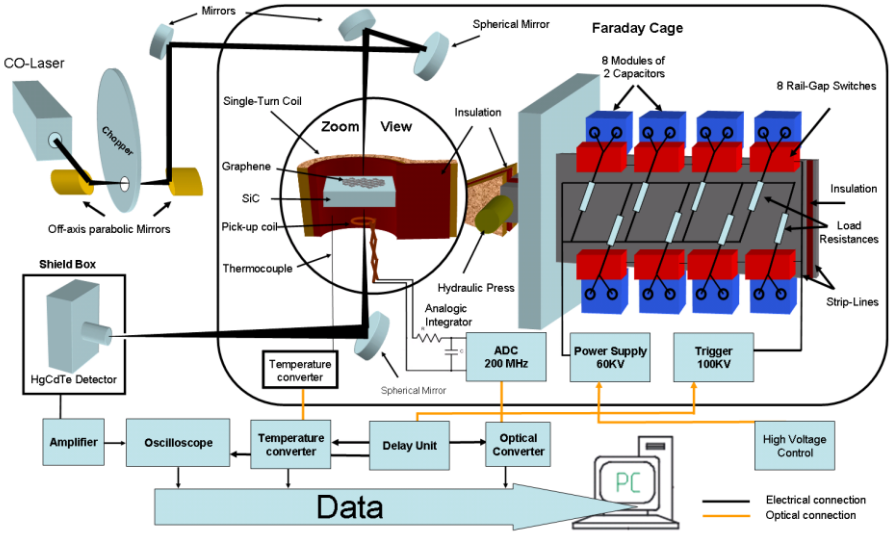
$$\Delta E_{(L_{-1(0)}\rightarrow L_{0(1)})} = v_f \sqrt{2\hbar eB}$$

2. One broad additional absorption line, marked by gray arrows, around 100 Tesla is observed. There is no theoretical predicted transition for single-layer graphene at this magnetic field and this energy excitation.

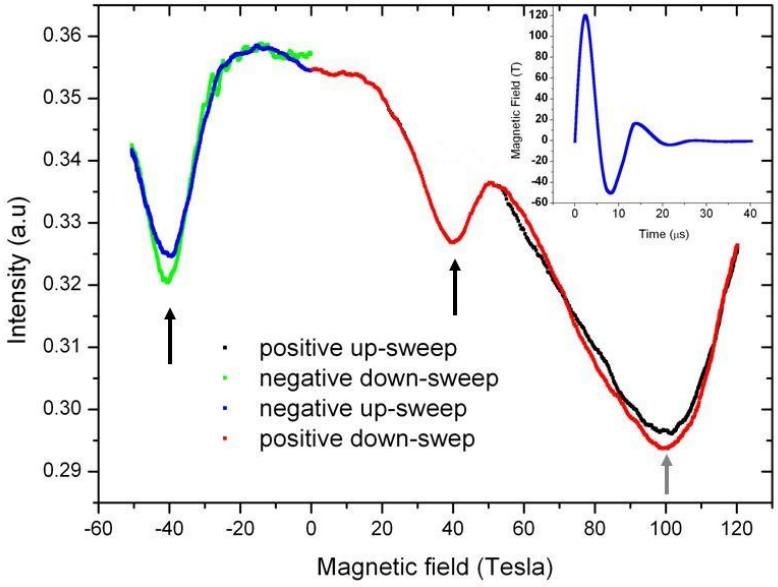
In this contribution, we present a detailed discussion of the temperature and radiation energy dependence of the observed transitions, which will be substantiated by further experiments.

References

[1] M.L. Sadowski and al, *Solid State Comm.* **143**, 123-125 (2007).
[2] P. Plochocka and al, Physical Review Letters, **100,** 087401 (2008)
[3] N. Ubrig and al (in progress)



<u>Figure 1 :</u> Experimental set-up for cyclotron resonance measurements.



<u>Figure 2 :</u> Transmission of multi-layered epitaxial graphene grown on Si-C. The incident energy is 229 meV. The magnetic field as a function of time is plotted in the inset. Black arrows are the absorption for the fundamental Landau level transition and gray arrows are an additional observed absorption.