Carrier Drift Velocity and Edge Magnetoplasmons in Graphene

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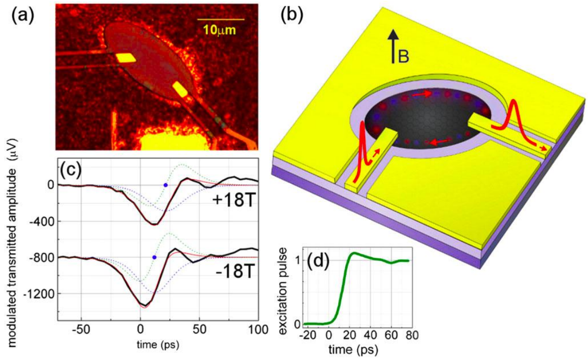
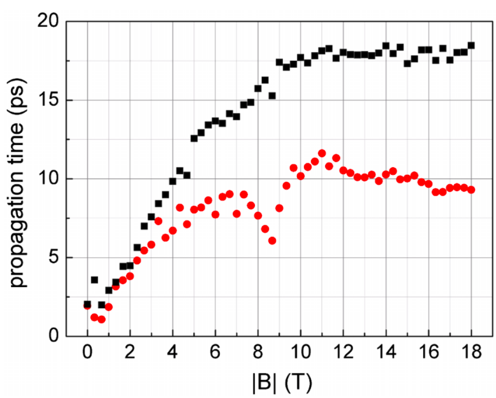
We investigate electron dynamics at the graphene edge by studying the propagation of collective edge magnetoplasmon excitations. By timing the travel of narrow wave packets on picosecond time scales around exfoliated samples, we find chiral propagation with low attenuation at a velocity that is quantized on Hall plateaus [1]. We extract the carrier drift contribution from the edge magnetoplasmon propagation and find it to be slightly less than the Fermi velocity, as expected for an abrupt edge. We also extract the characteristic length for Coulomb interaction at the edge and find it to be smaller than that for soft depletion-edge systems. The ERC Advanced grant 228273 MeQuaNo is acknowledged.

[1] I. Petkovic, F.I.B. Williams, K. Bennaceur, F. Portier, P. Roche and D.C. Glattli, Phys. Rev. Lett. 110, 016801 (2013).





<u>Upper figures</u>: (a) Optical photograph of a graphene sample coupled to coplanar wave guides.
(b) Measurement configuration: An EMP wave packet excited by a 7 or 11 ps rise time 100 mV step function propagates along the edge.
(c) Demodulated responses, offset for clarity, constructed by subtraction of waveforms at a +/-15 V side gate potential for an 11 ps excitation. The arrival time difference arises from unequal left and right path lengths for oppositely directed magnetic fields.
(d) Direct measurement of the 7 ps rise time excitation pulse broadened to 13 ps by the receiver amplifier.

<u>Lower figure</u>: Propagation times between emitter and receiver structures as a function of the perpendicular magnetic field for opposing orientations..