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Tuning the chirality of Dirac electrons in van der Waals heterostructures[1]

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Chirality is fundamental for the Dirac quasiparticles in graphene and topological insulators. It plays a crucial role in such relativistic phenomena, as Klein tunneling, the absence of backscattering in graphene p-n junctions, and a peculiar half-integer quantum Hall effect. However, it has proved difficult to image directly the chirality in transport measurements. I will present the direct observation and manipulation of chirality and pseudospin polarization in the tunneling of electrons between two almost perfectly aligned graphene crystals. To this end, a strong in-plane magnetic field was used to resolve the contributions of the chiral states – a new technique for preparing graphene Dirac electrons in a particular quantum chiral state in a selected valley. The technique can be extended to tunneling devices in which surface states of topological insulators are used as electrodes, allowing for an all-electrical injection of spin-polarized currents.

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