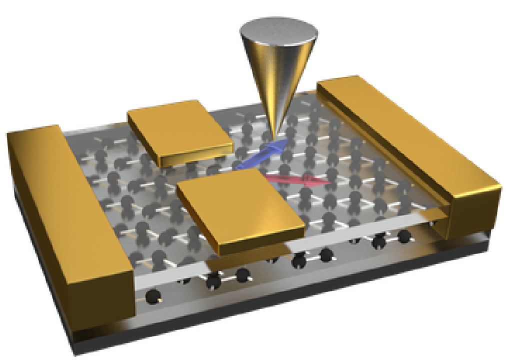
Valley-Polarized Jets in Graphene

Studying the current that flows in bilayer graphene, researchers have isolated electron jets associated with specific valley states.

By **Michael Schirber**

The electrons in graphene—and in other 2D materials—can be in one of two momentum states, or "valleys." Researchers are interested in controlling these valley states in order to store and process information within the states. One difficulty in achieving that goal is producing valley-polarized currents in the first place. Now Carolin Gold from the Swiss Federal Institute of Technology (ETH) in Zurich and her colleagues have found a way to isolate a pair of electron jets—one for each valley—in a bilayer sheet of graphene [**1**]. The technique could one day be incorporated into "valleytronic" devices to sort electrons by their valley state.

Normally, the valley states in graphene are indistinguishable, but under certain circumstances, the electronic band structure becomes asymmetric, or "trigonally warped," leading to unique momentum profiles for each valley. Theorists predicted that this warping should produce several valley-polarized jets flowing in different directions along a single graphene sheet. But isolating these jets has proven difficult.



Credit: C. Gold/ETH Zurich

Gold and her colleagues used a sheet of bilayer graphene, which they predicted should also harbor valley-polarized jets. On top of the bilayer, they placed two metallic gates separated by a small channel 50 nm wide. They applied a voltage across the bilayer and measured the current flowing through the aperture. They mapped the path of this current using a metallic tip, which produces an interference signal in the current measurements. The data showed a pair of jets separated by an angle of 60°, as expected from theoretical models.

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REFERENCES

1. C. Gold *et al.*, "Coherent jetting from a gate-defined channel in bilayer graphene," **Phys. Rev. Lett. 127, 046801 (2021).**