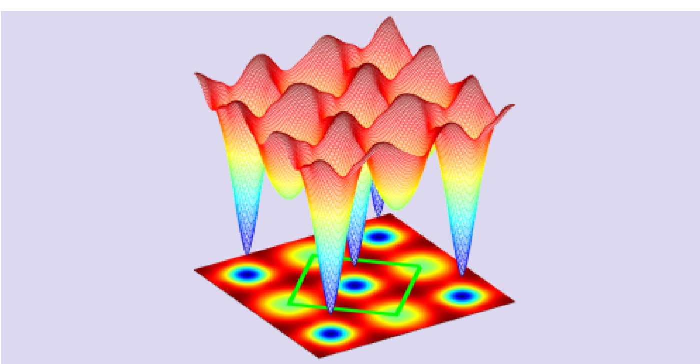
Acoustic Twist Reveals Flat Bands

A characteristic feature of twisted graphene bilayers has now been seen in an analogous acoustic system.

By **Ryan Wilkinson**

Stacking two sheets of graphene and slightly rotating one relative to the other can induce unconventional superconductivity and other exotic phenomena. Many of the peculiarities in these twisted graphene bilayers are closely tied to the presence of flat, or momentum-independent, energy bands. Now Chunyin Qiu and his colleagues at Wuhan University in China have directly observed such bands in acoustic—that is, mechanical—analogues of twisted graphene bilayers [1]. The researchers say that their findings, which can be extended to other analogous systems, offer new ways to control classical waves.

In a twisted graphene bilayer, each of the two sheets consists of a honeycomb lattice of carbon atoms linked by chemical bonds, with the sheets coupled through electrostatic forces. Flat bands are seen in the energy–momentum spectra of propagating electrons when the twist angle between the sheets is about 1°. In the researchers' acoustic analogue, the sheets instead consist of a square lattice of identical air chambers linked by square tubes, with the sheets coupled through vertical disks connected to each chamber. The team observed flat bands in the energy–momentum spectra of propagating sound waves when the twist angle was roughly 20°.



Credit: X. Zhang *et al.* [**1**]

The flat bands require specific angles for twisted graphene bilayers but exist for a broad range of angles in the acoustic analogue. According to the researchers, this contrast highlights fundamentally distinct mechanisms for flat-band formation. The mechanism in the graphene system relies on quasiparticles called Dirac fermions that have no band gap, while the one in the acoustic system relies on gapped bands.

Ryan Wilkinson is a Corresponding Editor for ***Physics Magazine*** based in Durham, UK.

REFERENCES

1. X. Zhang *et al.*, "Observation of ultraflat bands in gapped moiré metamaterials," **Phys. Rev. B 111, 125143 (2025).**