A tiny instrument to measure the faintest magnetic fields

Research News Physics labs at the University of Basel have developed a minuscule instrument able to detect extremely faint magnetic fields. At the heart of the superconducting quantum interference device is two atomically thin layers of graphene, which the researchers combined with boron nitride. Instruments like this one are finding applications in a range of research areas.

To measure very small magnetic fields, researchers often are superconducting quantum interference devices, or SQUIDs. In order to do this, they have to cool their实验室 to millionths of a degree above absolute zero. SQUIDs are instruments able to detect extremely weak magnetic fields and are often used in medicine or to study the movement of heart, brain waves, nerve activity, or brain activity. In the new research, the researchers use SQUIDs to measure an extremely tiny magnetic field, which is only around 10 nanometers high—roughly a thousandth of the thickness of a human hair. The instrument can trigger measurements even when the distance between the graphene layers is just around 5 nanometers. The researchers describe their achievement in the scientific journal Nano Letters ("Compact SQUID realized in a double layer graphene heterostructure")

At a conventional superconducting quantum interference device (SQUID) consists of a superconducting ring interrupted at two points by an insulating layer (like an arrow), in which currents can flow. These points, known as weak links, must be so thin that the electrons gain phase information for superconductivity from one side to the other. In the new research, the researchers replaced the conventional superconducting ring in the SQUID with graphene. To do this, the researchers placed two graphene monolayers separated by a thin film of boron nitride (image: University of Basel, Department of Physics).

A superconducting ring interrupted at weak links.

In a SQUID, the graphene layers act as a superconducting ring interrupted at two points by an insulating layer which serves as a weak link. These points, known as weak links, must be thin enough that the electrons gain phase information for superconductivity from one side to the other. In the new research, the researchers replaced the conventional superconducting ring in the SQUID with graphene. To do this, the researchers placed two graphene monolayers separated by a thin film of boron nitride.

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