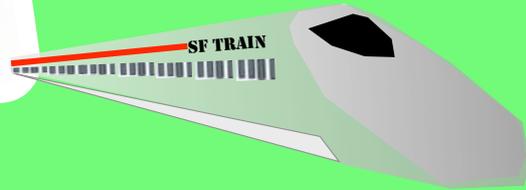


Superconducting magnetic levitation train

SF TRAIN



Q: Why does this train levitate?

Why does this train not derail even when tilted?

A: The tape-shaped superconductor (Yttrium-based superconducting tapes) is attached to the bottom of the **SF TRAIN**. The **SF TRAIN** runs on magnetic rails.

When a superconductor is placed on a magnet it does not fall but defies gravity by floating above the magnet (superconducting magnetic levitation). This is called the **Meissner effect** (perfect diamagnetism), and is a peculiar characteristic of superconductors. The **Meissner effect** is the complete expulsion of a magnetic field from a superconductor in the presence of an applied magnetic field. In other words, the magnetization always occurs in the direction where the magnetic fields cancel each other resulting in a repulsive force, just like when a N-N magnet is placed close to each other. This results in the levitation force.

However, stable levitation cannot be achieved by the **Meissner effect** alone. Actually, when a superconductor and a magnet are forced in close proximity, the magnetic field partially penetrates the superconductor and is pulled towards weaker superconducting areas caused by a high degree of impurities. The magnetic field is unable to leave, but instead becomes pinned in the superconductor – a phenomenon referred to as **flux pinning**; it is as if the movement of the magnetic field (magnetic flux line) was partially attached by a pin. It is this pinning effect that helps stabilize the position of a superconductor above a magnet. The **SF TRAIN** thus remains suspended at the same height and does not derail even when tilted.

Q: Does superconducting maglev train levitate using the same principles?

A: Superconducting maglev train is different to a **SF TRAIN**. A levitation force results from the repulsion between coils that have been energized by the principle of electromagnetic induction. In order to levitate a heavy train, a superconducting electromagnet is utilized because it requires very strong magnetic field.

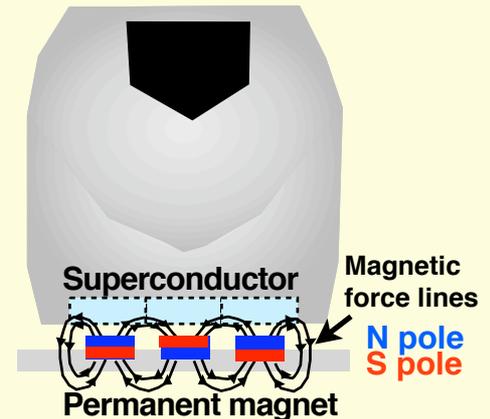


Fig. 1 Schematic diagram of a **SF TRAIN**

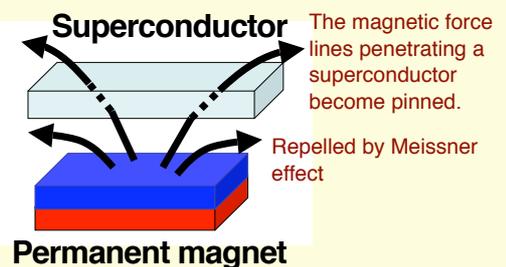


Fig.2 Force generated between a permanent magnet and a superconductor



Fig.3 Running **SF TRAIN**