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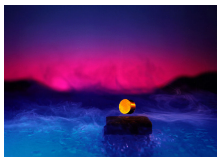

A magnet levitating above a high-temperature superconductor, cooled with liquid nitrogen.

A 20-year-old Superconductor Mystery Solved

The greatest advancement in superconductors

Superconductors are a class of materials that display exactly zero electrical resistance and the exclusion of the interior magnetic field (the Meissner effect) at extremely low temperatures, usually below -140 degrees Celsius. They are used in many applications, like MRI medical imaging scanners, levitating trains and power lines.A team of researchers at the University of British Columbia achieved a breakthrough in the field. The most important problem of superconductors is the fact that they can't function at temperatures higher than 100 degrees Celsius below zero. "Up to now, it was unclear whether these materials were metals or insulators," said UBC Physics Prof. Douglas Bonn, adding that the materials are extremely sensitive to contamination - the slightest trace of dirt or impurity can alter their properties completely.Superconductivity occurs in a wide variety of materials, including simple elements like tin and aluminium, various metallic alloys and some heavily-doped semiconductors. Superconductivity does not occur in noble metals like gold and silver, nor in most ferromagnetic metals."We were able to supply our collaborators with the purest sample ever developed, leading to the discovery of quantum oscillations," said Bonn. "This provides unequivocal proof that these materials are metals." Quantum oscillations, called Shubnikov-de Haas oscillations, are oscillations in the conductivity of a material that occurs at low temperatures in the presence of very intense, time varying magnetic fields."The results are crystal clear," said Louis Taillefer. "High-temperature superconductors were discovered in 1987, and only now do we finally have concrete knowledge about their deep nature. This discovery gives both theorists and experimentalists something real to work with."This find opens up the way to room-temperature superconductors, which could find practical applications in MRI machines the size of a laptop and power lines with zero losses, as well as highly efficient computers and communications devices.