Demon Particle

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Why in News?

Recently, a team of researchers from the University of Illinois discovered a unique particle, **known as a "demon particle,"** within a **metal called strontium ruthenate.** This discovery has the potential to pave the way for the development of **superconductors capable of operating at room temperature.**

What is a Demon Particle?

- The demon particle is a name given to a type of **quasiparticle,** which is not a real particle, but rather a **collective excitation or vibration of many electrons in a solid.**
    - Quasiparticles are useful for describing the **complex behavior of electrons in solids, such as metals and semiconductors.**
- The demon particle was **first predicted by theoretical physicist David Pines in 1956**.
    - He believed that electrons would behave strangely when passed through a solid. **Electric interactions make electrons combine to form collective units. This can make them lose individuality in solids.**
        - However, with such a large mass, **plasmons (collective oscillation of conduction electrons in metals)** cannot form with energies available at room temperature.
    - However, **demons do not contain mass,** they can form with **any energy and at room temperature as well.**
- The demon particle could have many applications in computing, medical imaging, transportation, and energy.

Superconductors

- **About:**
    - A superconductor is a material that can **conduct electricity or transport electrons from one atom to another with no resistance.**
    - No heat, sound or any other form of energy would be released from the material when it has **reached critical temperature** (Tc), or the temperature at which the material becomes superconductive.
        - The critical temperature for superconductors is the **temperature at which the electrical resistivity of metal drops to zero.**
    - Superconductors also exhibit the **Meissner effect, which is the expulsion of a magnetic field from the interior of a material** during the process of becoming a superconductor.
- **Examples: Aluminium, niobium, magnesium diboride,** etc.
- **Applications:**
    - Superconductors are used in operations such as **levitating trains and highly accurate magnetic resonance imaging (MRI) machines.**
- **Limitations**:
    - Their usefulness is still **limited by the need for bulky cryogenics** (production of and behaviour of materials at very low temperatures) as the common superconductors **work at**

atmospheric pressures, but only if they are kept very cold.

- Even the most sophisticated ones like **copper oxide-based ceramic materials** work only below −140°C.