Fermi Energy and Fermi Level

Why in news?

More research in quantum physics in recent times have shown that the fermi energy are significant and produce high energy.

What is fermi energy?

- Fermi energy is defined as the highest occupied energy level of a material at *absolute zero temperature (-273º C or 0K).*
- In other words, all electrons in a body occupy energy states at or below that body's Fermi energy at 0K.
- It is an energy difference of the kinetic energy of a system containing fermions.
- Fermi energy is *constant* for each solid.

What are fermions?

- Fermion is any member of a group of subatomic particles having odd *half-integral angular momentum* (spin 1/2, 3/2).
- Fermions mainly include *quarks and leptons* along with electrons, protons, and neutrons.
- Fermions obey ***Fermi-Dirac statistics***, which means that when one swaps two fermions, the wave function of the system changes sign.
- Fermions obey the ***Pauli exclusion principle*** - no two fermions can exist in the same quantum state at the same time.

What is fermi level?

- Fermi level is the measure of the energy of the least tightly held electrons within a solid.
- It is the surface of that sea at absolute zero where no electrons will have enough energy to rise above the surface.
- The fermi energy levels enable us to
    - Calculate the density of electrons
    - Number of holes in the material
    - Relative proportion of holes and density with respect to temperature

What are the applications of fermi energy?

- Fermi energy is

- Applied to Determine the electrical and thermal characteristics of solids
- Important in nuclear physics to understand the stability of white dwarfs
- Used in semiconductors and insulators
- Used to describe insulators, metals, and semiconductors

References

1. The Hindu | Electrons And Fermi Energy
2. Britannica | About Fermi Energy And Fermi Level
3. Hyperphysics | Fermi levels

