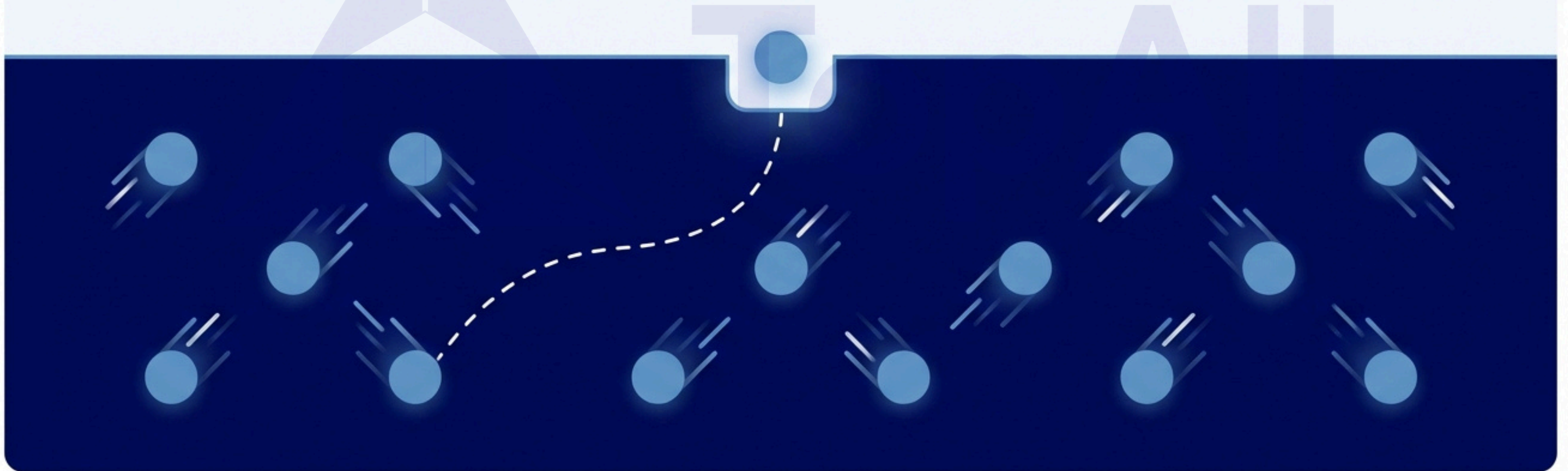


Electron Emission

Why electrons need energy to leave a metal.



The “Sea” of Free Electrons

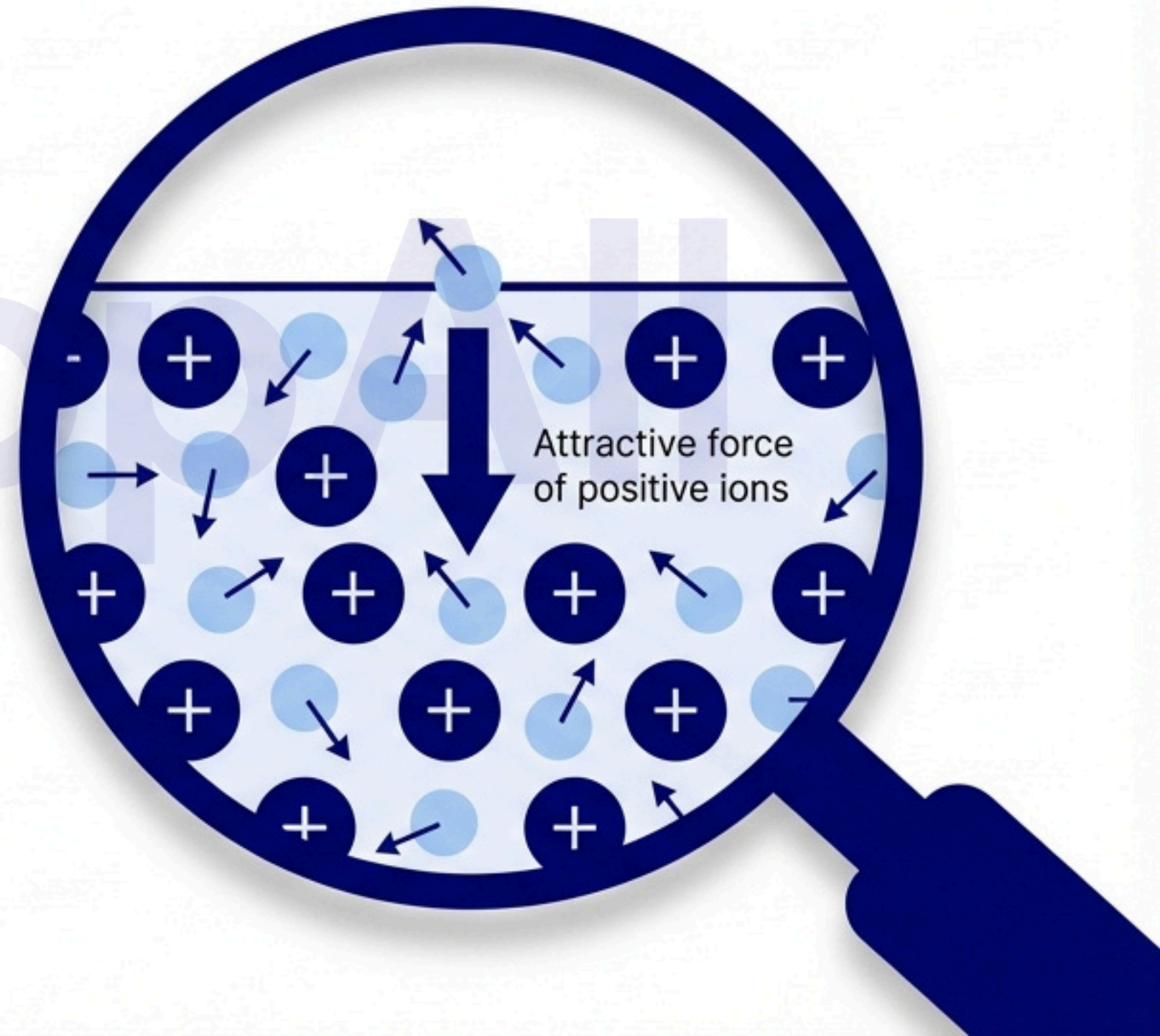
Metals conduct electricity because their outer electrons are free to move—but they cannot normally escape the surface.

Free to Move

Electrons drift easily within the metal lattice, responsible for the metal's high conductivity.

Trapped at the Surface

If an electron attempts to escape, the metal surface acquires a net positive charge and immediately pulls the electron back.





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$$E=mc^2$$



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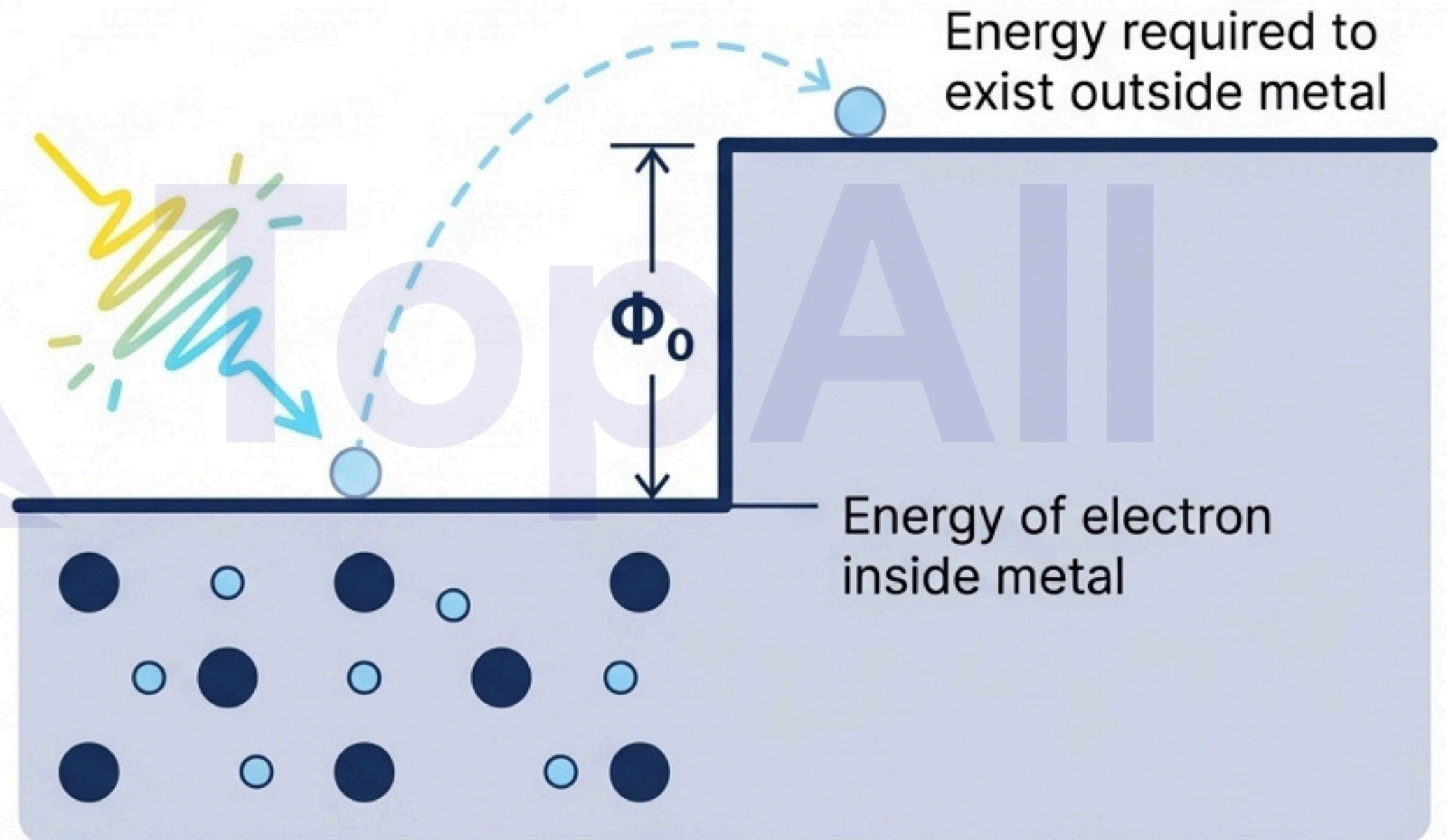
The Work Function (Φ_0)

The absolute minimum energy required to break the surface barrier.

Definition: The **minimum** amount of energy required by an electron to escape from the metal surface.

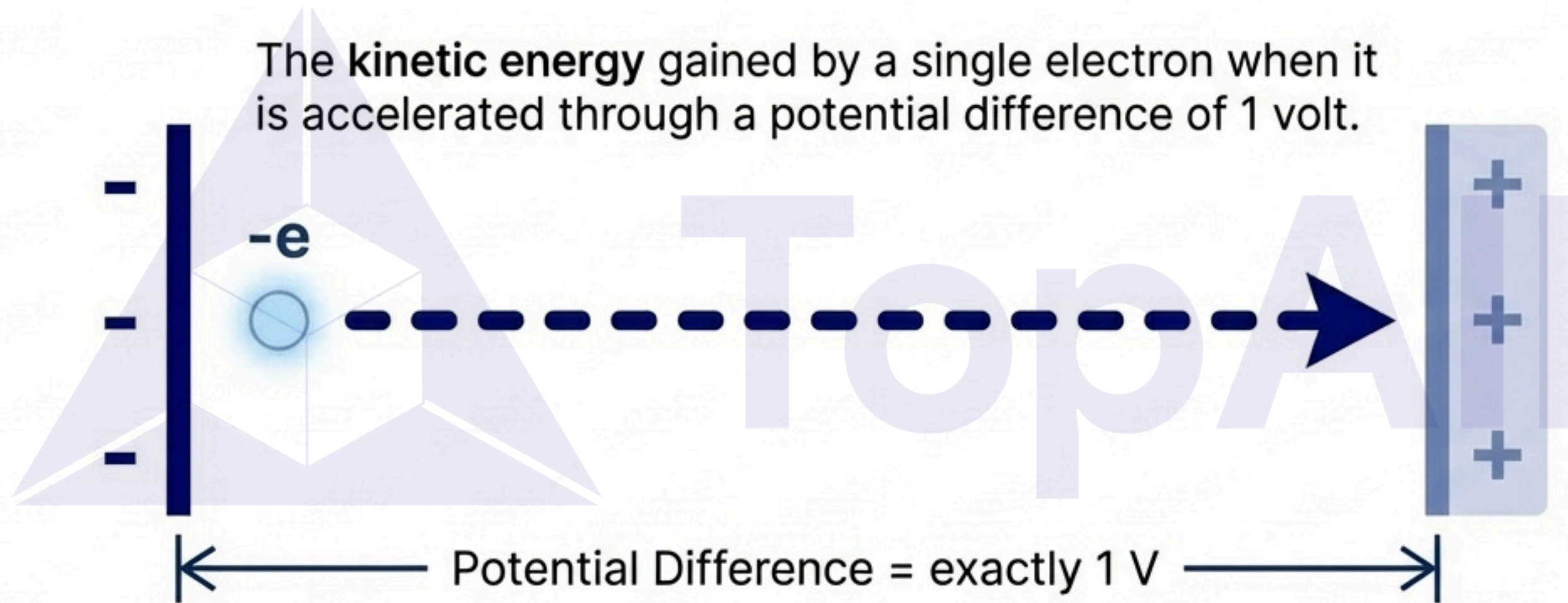
Variable: Denoted by Φ_0

Property: Depends entirely on the nature of the metal and its specific surface conditions.



Measuring Microscopic Energy

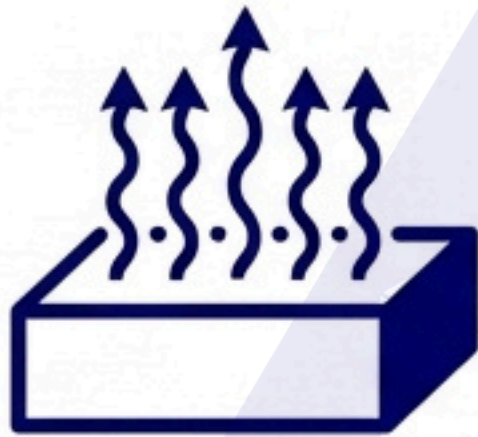
Joules are too large for atomic physics. We measure work function using the Electron Volt (eV).



$$1 \text{ eV} = 1.602 \times 10^{-19} \text{ Joules}$$

Overcoming the Barrier

Three physical processes to supply the required escape energy to free electrons.



Thermionic Emission

Suitably heating the metal imparts sufficient thermal energy to the free electrons, enabling them to break the surface barrier.



Field Emission

Applying a massive electric field (of the order of 10^6 V/m) to a metal physically pulls electrons out, similar to a spark plug.



Photoelectric Emission

Illuminating the surface with light of a suitable frequency generates emissions. These light-generated electrons are called photoelectrons.

Summary & Next Steps

The foundational rules of electron emission.

1. Electrons are trapped by positive ion attraction at the metal's surface.
2. A strict minimum energy—the Work Function (Φ_0)—is required to escape.
3. Work function is measured in eV and varies depending on the metal type.
4. Escape energy can be supplied via heat (Thermionic), strong electric fields (Field), or suitable light (Photoelectric).

→ Up Next: The Photoelectric Effect

How does light specifically knock electrons loose? We will explore Hertz, Hallwachs, and Lenard's historic experiments and uncover the threshold frequency.



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