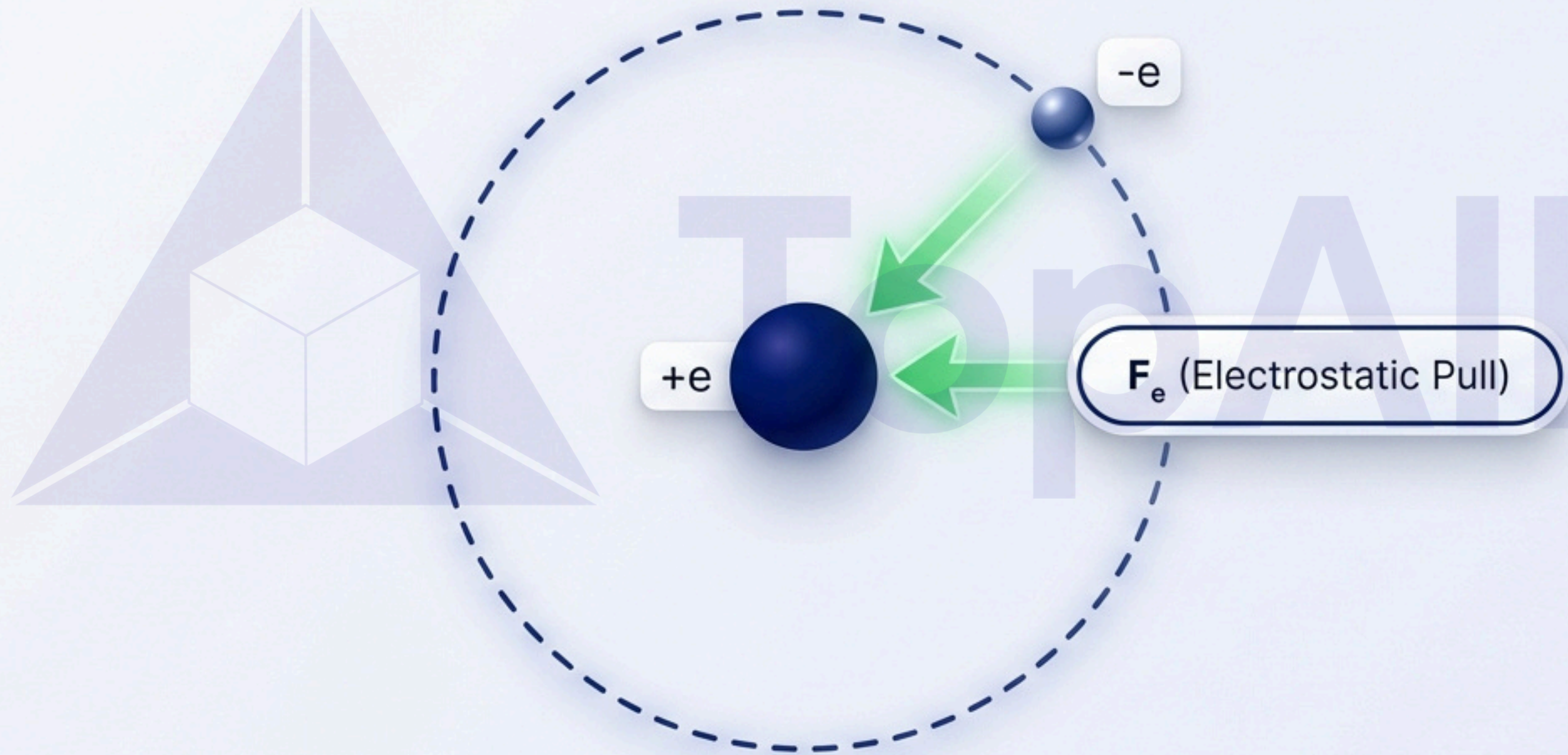
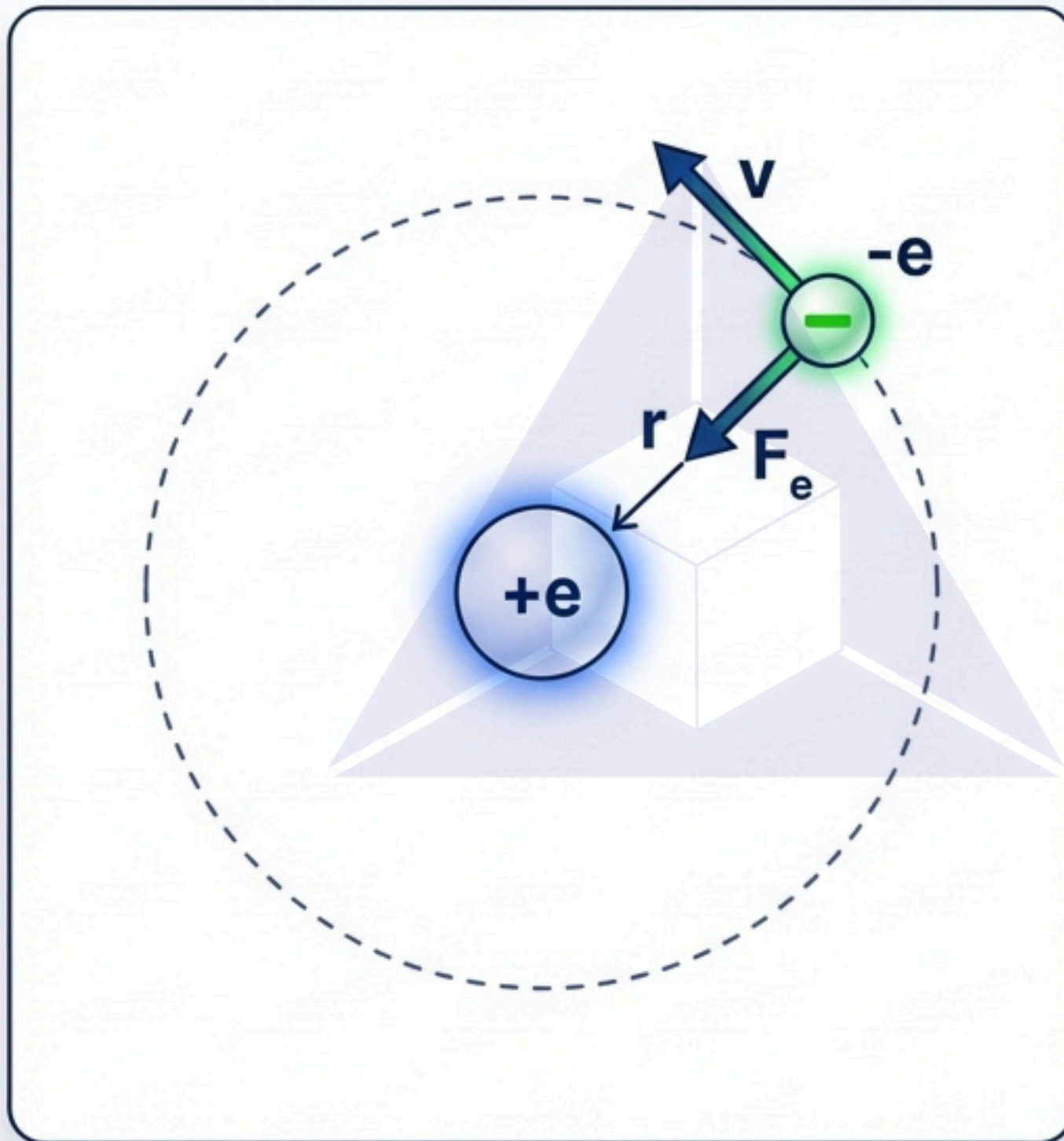


Electron Orbits

How the electron remains bound to the nucleus in the Rutherford model.



The Engine of the Orbit



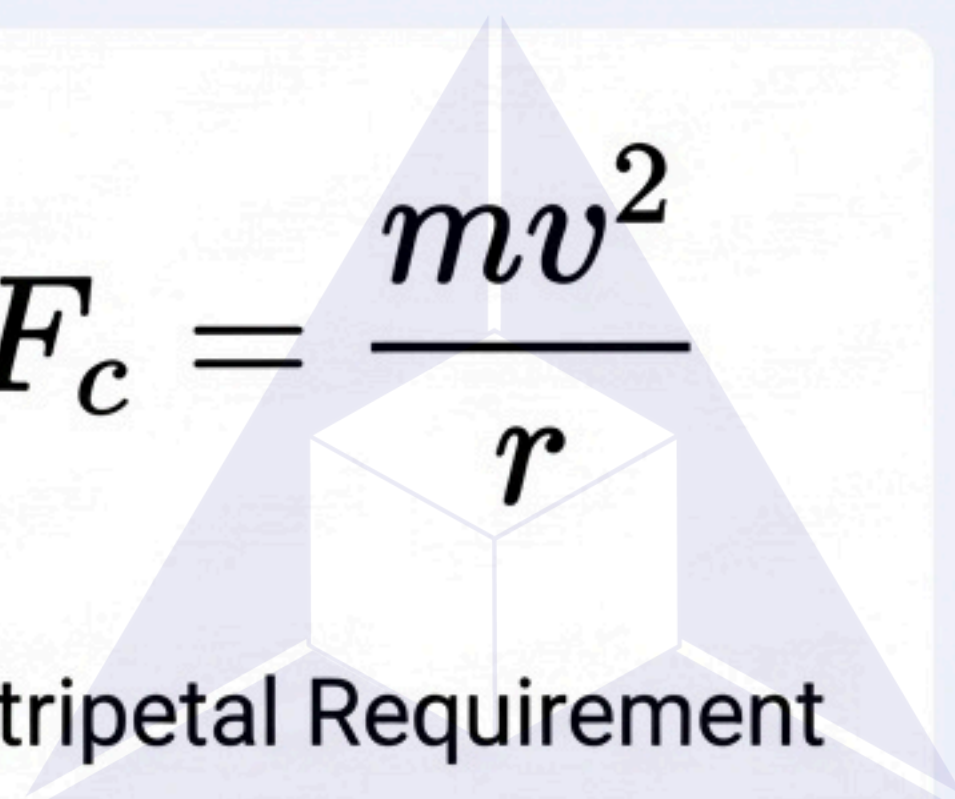
**Coulomb's
Electrostatic
Pull**

acts as the

**Centripetal
Force**

In a dynamically stable orbit, the inward electrostatic attraction provides the exact centripetal force required to keep the electron turning.

Balancing the Forces


$$F_c = \frac{mv^2}{r}$$

Centripetal Requirement

=

$$F_e = \frac{1}{4\pi\epsilon_0} \frac{e^2}{r^2}$$

Electrostatic Attraction

$$\frac{mv^2}{r} = \frac{1}{4\pi\epsilon_0} \cdot \frac{e^2}{r^2}$$



You've Learned the Theory. Let's Test Them Now.

$$E=mc^2$$



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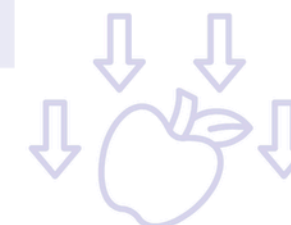
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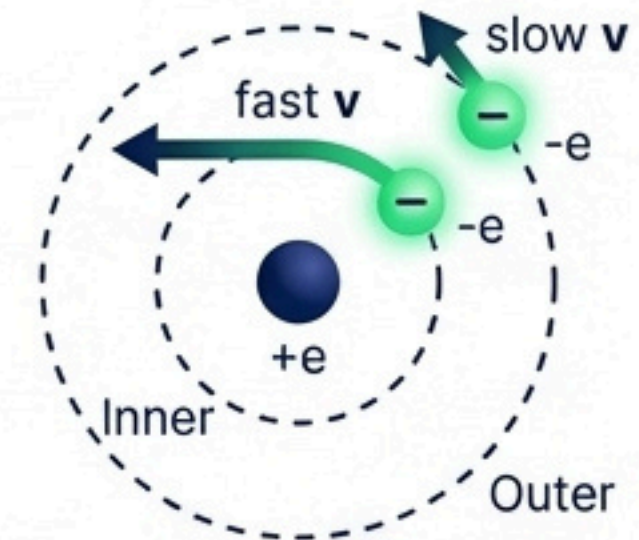
Linking Radius and Speed

$$r = \frac{e^2}{4\pi\epsilon_0 m v^2}$$

v is in the denominator, squared.



As velocity increases, the required
orbit radius decreases.



The Energy of the Orbit

Kinetic Energy (K)

$$K = \frac{e^2}{8\pi\epsilon_0 r}$$

(Positive)

Potential Energy (U)

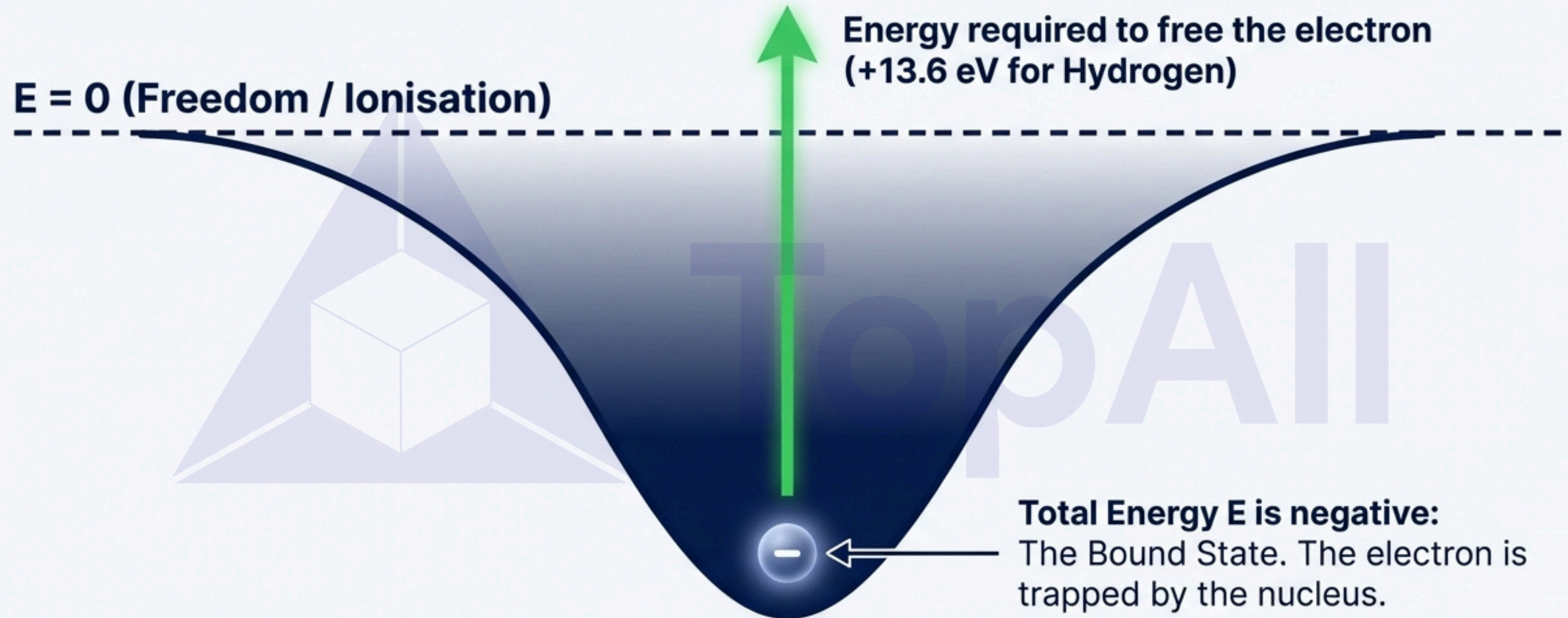
$$U = -\frac{e^2}{4\pi\epsilon_0 r}$$

Twice as large as K, but negative.

Total Energy (E)

$$E = K + U = -\frac{e^2}{8\pi\epsilon_0 r}$$

The Meaning of Negative Energy



If E were positive, the electron would fly away (an unbound orbit).

Chapter Checkpoint

Key Takeaways

Electrostatic attraction (F_e) provides the required Centripetal force (F_c).

Potential energy is exactly twice the magnitude of Kinetic energy, but negative ($U = -2K$).

Total Energy (E) is negative, defining the Bound State of the atom.

Check Your Understanding

Q1: If the electron's orbit radius decreases, what happens to its kinetic energy?

Increases (since $K \propto 1/r$)

Q2: True/False: A positive total energy indicates a highly stable orbit.

False. Positive energy means the electron is unbound and has escaped the nucleus.



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