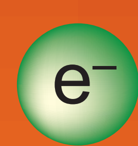
BEYOND BOHR

Comparing the Bohr and Quantum Models of the Atom

Niels Bohr proposed his model of the atom—the idea of electrons orbiting the nucleus and jumping from one energy level to another—in 1913. The model explains many observations that past models could not, but even Bohr himself knew that it was incomplete. Here's how research in quantum mechanics has moved us beyond Bohr.

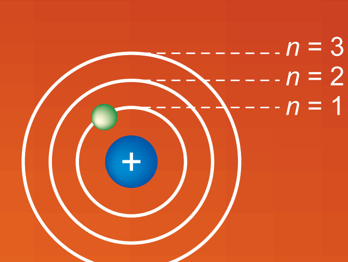
BOHR MODEL

Electrons are modelled as classical particles that take up space and have definite locations.

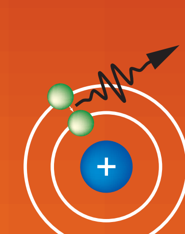


Electrons travel around the nucleus in well-defined circular trajectories.

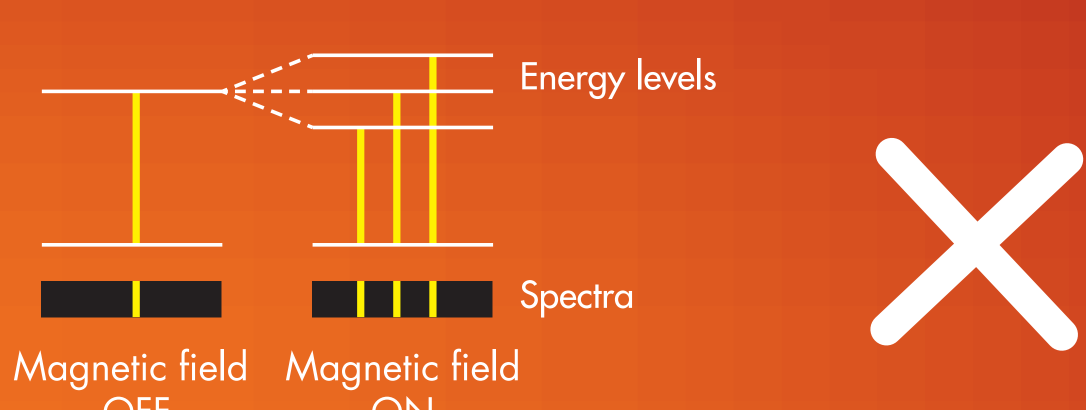
Electrons are differentiated by one number, n. This number describes the energy shell (n = 1, 2, 3, …) the electron occupies.



Electrons jump from one energy shell to another and, somehow, know where to stop.



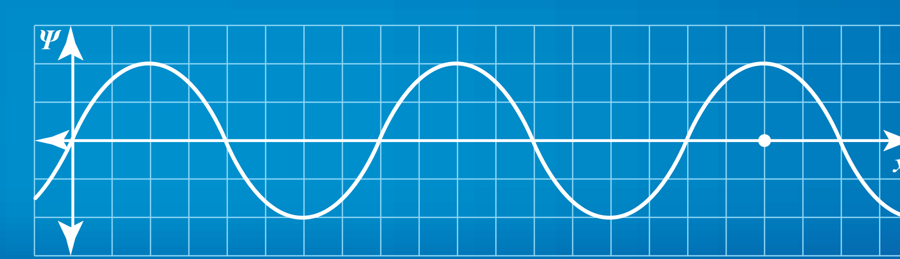
Does *not* explain why spectral lines split when we apply a magnetic field.



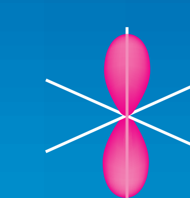
Successfully explains the spectrum of atomic hydrogen only.

QUANTUM MODEL

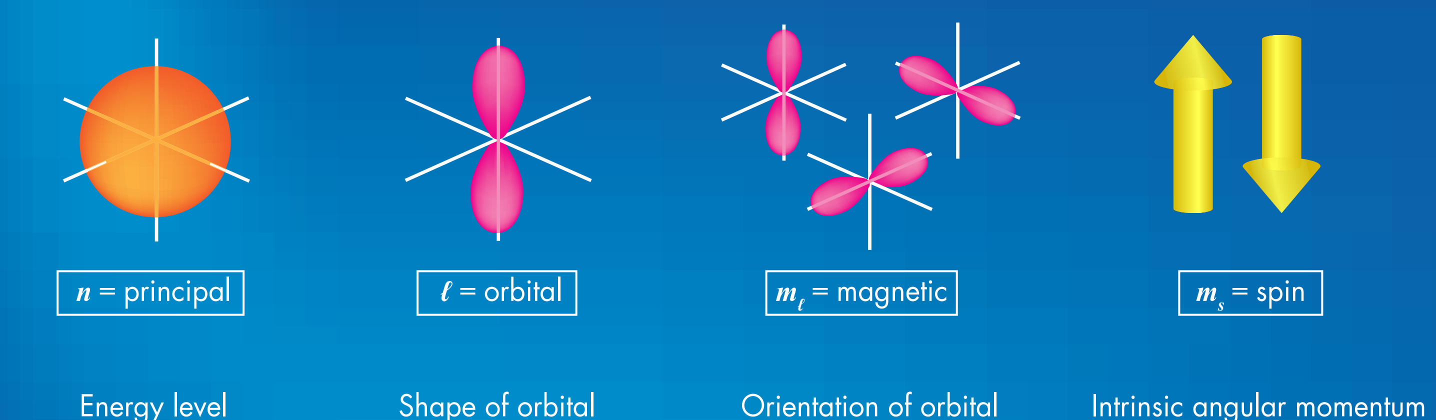
Before being detected, electrons don't have definite locations. They are modelled using a mathematical tool called the wave function, ψ. The square of the amplitude of an electron's wave function ($|\psi|^2$) at each point gives the probability of detecting the electron at that location.



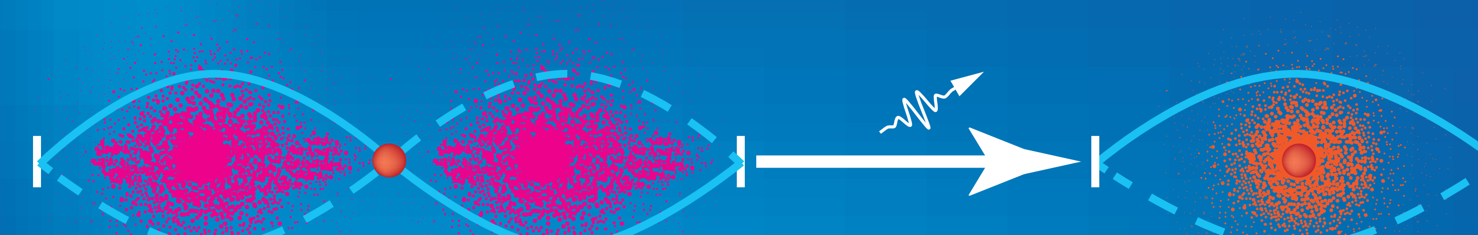
Electrons do *not* have definite locations or trajectories. Atomic orbitals define the regions where the probability of finding an electron is high.



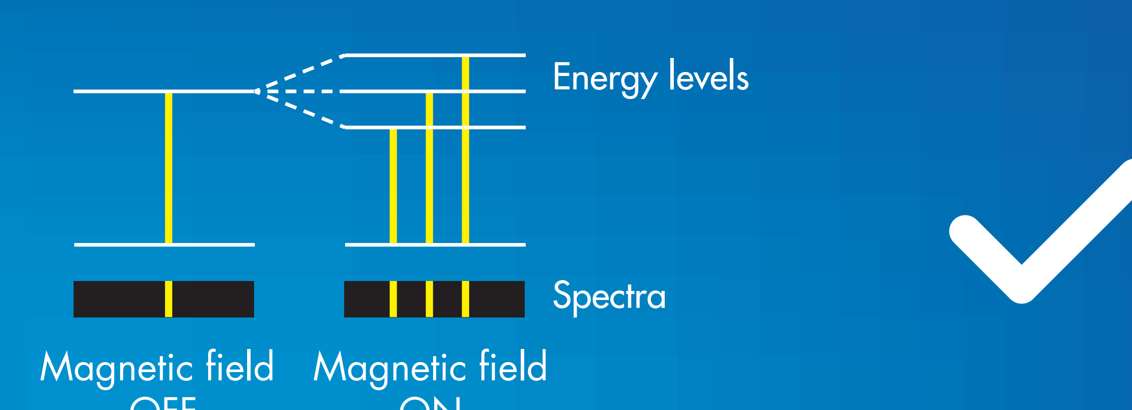
Four quantum numbers, n, ℓ, m_ℓ, and m_s, differentiate electrons from each other.



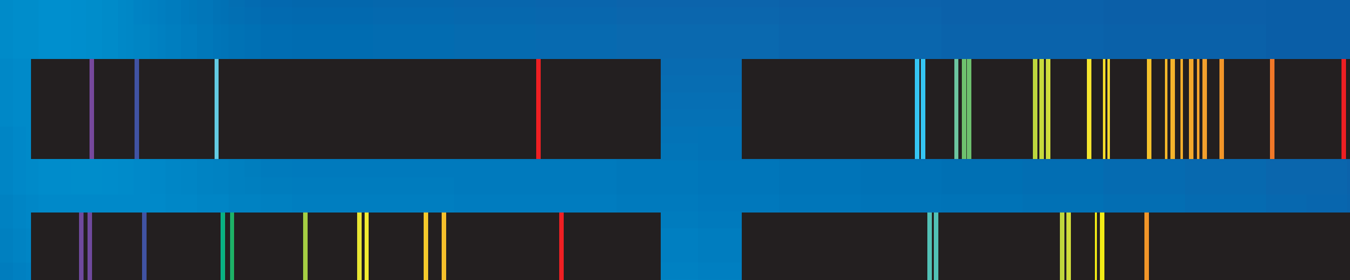
When an electron transitions from one energy level to another, its wave function transitions from one harmonic, or orbital, to another.



Explains why spectral lines split when we apply a magnetic field by assigning magnetic moments to electrons. Applying a magnetic field produces more energy states, and thus more transitions are observed.



The model successfully explains the spectrum of every element.



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