

Que. : if we use de Broglie wave condition, then why the energy levels in hydrogen atom are separate?

Answer:

For a circular orbit, **constructive** interference occurs when the electron's wavelength fits neatly into the circumference, so that wave crests always align with crests and wave troughs align with troughs. More precisely, when an integral multiple of the electron's wavelength equals the circumference of the orbit, constructive interference is obtained. In equation form, the condition for constructive interference and an allowed electron orbit is $n\lambda = 2\pi r$ where $n = 1, 2, 3, \dots$, λ is the electron's wavelength and r is the radius of that circular orbit. If the wavelength does not fit into the circumference, the electron interferes **destructively**; it cannot exist in such an orbit. That's why the energy levels in hydrogen atom are separate.