If <u>potential energy</u> (i.e. the attraction of the negatively-charged electron to the positively-charged nucleus) is all the e^- had to worry about, e^-'s would collapse into the nucleus instantaneously!

But now we have to worry about e^- KE as well:

$$\lambda = \frac{2L}{n}$$

Assume $n = 1$

If e^- collapsed into nucleus,

$$L = 2\pi r = 2\pi (\text{radius of nucleus})$$

$$L \cong 2\pi (1 \times 10^{-15}\ m) \cong 6 \times 10^{-15}\ m$$

so $\lambda = 2(6 \times 10^{-15}\ m) \cong 1 \times 10^{-14}\ m$

and $\lambda = \frac{h}{mV} \Rightarrow V = \frac{h}{m\lambda}$

$$V = \left(\frac{6.6 \times 10^{-34}\ \cancel{J \cdot s}}{\cancel{\text{particle}}}\right)\left(\frac{\cancel{\text{particle}}}{9.1 \times 10^{-31}\ \cancel{kg}}\right)\left(\frac{1}{1 \times 10^{-14}\ \cancel{m}}\right)\left(\frac{kg\, m^2 s^{-2}}{1\ \cancel{J}}\right)$$

$V = 7 \times 10^{10}\ m\, s^{-1}$ vs. speed of light $(3 \times 10^8\ m\, s^{-1})$

↑ impossible to move this fast!

∴ because an e^- is a standing wave, it cannot be confined to the nucleus

- So, where is the electron?

  Wherever the electron wave is oscillating ... simultaneously!

  - the only thing we know for sure is where the e^- cannot be found (i.e. at a node)
  - the fact that an e^- is a wave means that it is <u>delocalized</u> ... it cannot be pinned down to any one spot

C. What's Wrong with de Broglie?

⊖ Still can't predict the properties of atoms/ions with more than 1 e^- ...

∴ need a <u>three-dimensional</u> version of de Broglie's theory, that is, <u>quantum mechanics</u>