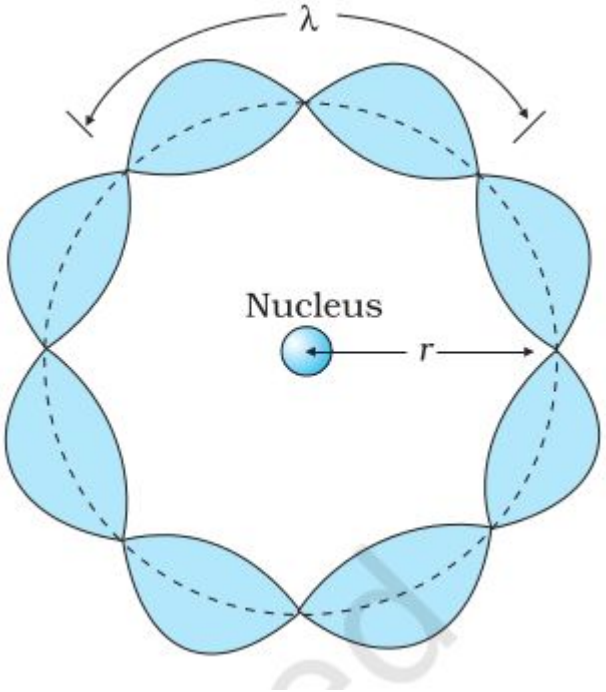
DE BROGLIE ’S EXPLANATION OF BOHR’S SECOND POSTULATE

Formation of Standing Waves

de Broglie realized that if you use the wavelength associated with the electron, and assume that an **integral** number of **wavelengths** must fit in the **circumference** of an orbit



Other wavelengths

Waves with **other wavelengths** interfere with themselves upon reflection and their amplitudes quickly **drop to zero**

For an electron moving in n th circular orbit of radius $\mathbf{r_n}$, the total distance is the circumference of the orbit, $2\pi r_n$.

Thus

$\mathbf{2\pi r_n = n\,\lambda}$, where n = 1, 2, 3...

de Broglie Hypothesis

According to de Broglie

$$\lambda = \frac{h}{mv_n}$$

Or

$$2\pi r_n = \frac{nh}{mv_n}$$

Angular momentum

Then $mv_n r_n = \frac{nh}{2\pi}$ is the angular momentum.

Thus de Broglie hypothesis provided an explanation for Bohr's second postulate for the quantisation of angular momentum of the orbiting electron

Limitations of Bohr model

The Bohr model is applicable to **hydrogenic atoms**. It cannot be extended even to mere two electron atoms such as helium.

It could NOT accurately calculate the spectral lines of **larger atoms**.

While the Bohr's model correctly predicts the frequencies of the light emitted by hydrogenic atoms, the model is unable to explain the **relative intensities** of the frequencies in the spectrum

It does not explain the **Zeeman Effect**, when the spectral line is split into several components in the presence of a magnetic field