Units of h?

$$h = \frac{[E]}{[\omega]} = \frac{M\frac{r^2}{T^2}}{\frac{1}{T}} =$$

r - length
M - mass
T - time

$$= \frac{Mr^2}{T} = [r]\left[M\frac{r}{T}\right] \text{ - angular momentum}$$

($[r]$ ~ r, $[M\frac{r}{T}]$ ~ p)

$\pm\frac{1}{2}\hbar$ - spin

Since $[h] = [r][p]$ we can be inventive.
We can associate length to the particles.

$$\lambda = \frac{h}{p} \sim \text{de Broglie wavelength}$$

If the particle does not move

$$\lambda = \frac{h}{mc} \text{ - Compton wavelength}$$

(Compton $\lambda \neq$ de Broglie λ)

$$mc^2 = E_{ph} = h\nu = \frac{hc}{\lambda} \Rightarrow \lambda = \frac{h}{mc}$$

wavelength of photon with same energy.

For atom of mass m:

$$\lambda \sim 2.1 \text{ pm } !$$

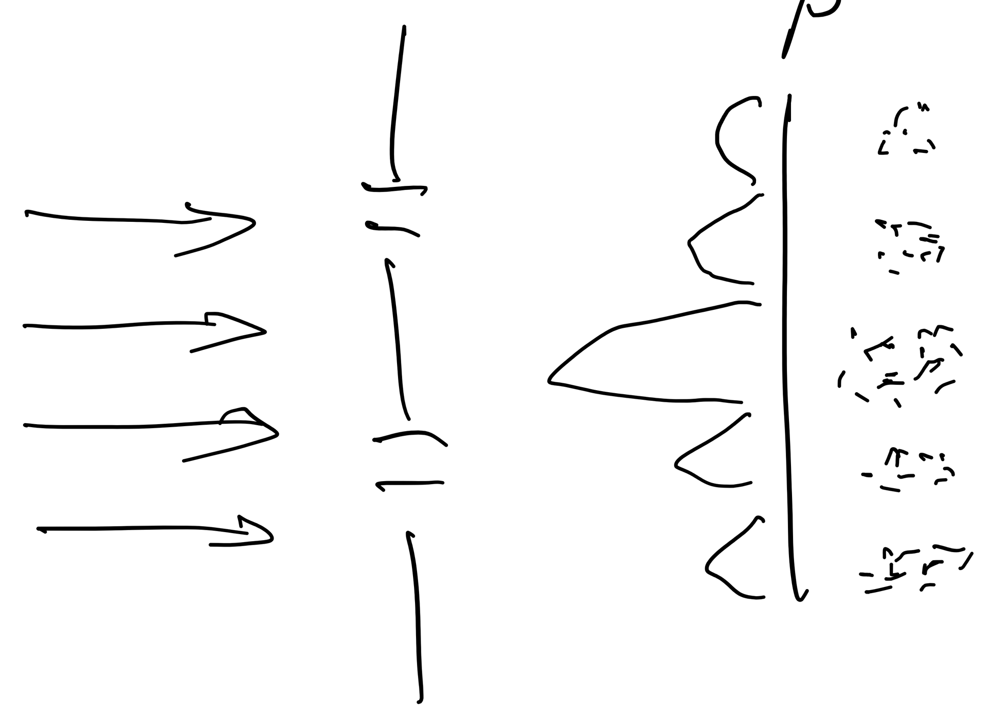
Louis de Broglie (1924)

photon: particle E, p $\leftrightarrow$ wave λ

If photons are dual (particle and wave) why particles in general can be seen as waves.

But wave of what?
Probability amplitudes
de Broglie said we will associate λ to particle

$$\lambda = \frac{h}{p} \quad \text{plane wave}$$



Two-slit experiment from photon to molecules 10 kDa (1 pm)

de Broglie allowed to introduce wave function.