Heisenberg Uncertainty Principle

Introduced first in 1927 by the German physicist Werner Heisenberg, the uncertainty principle states that the more precisely the position of some particle is determined,

In quantum mechanics, the uncertainty principle (also known as Heisenberg's uncertainty principle) is any of a variety of mathematical inequalities[1] asserting a fundamental limit to the accuracy with which the values for certain pairs of physical quantities of a particle, such as position, *x*, and momentum, *p*,

that the position and the velocity of an object cannot both be measured exactly, at the same time,

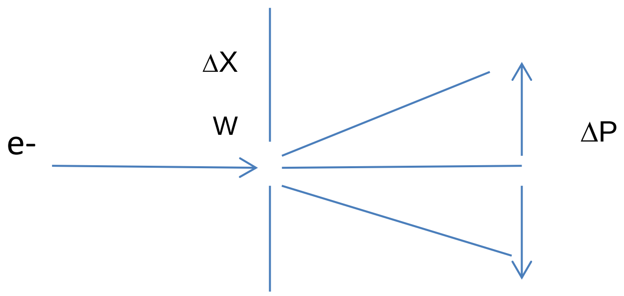
It is impossible to devise an experimental procedure for the measurement of X and P that would yield simultaneously absolutely precise values of X and P .

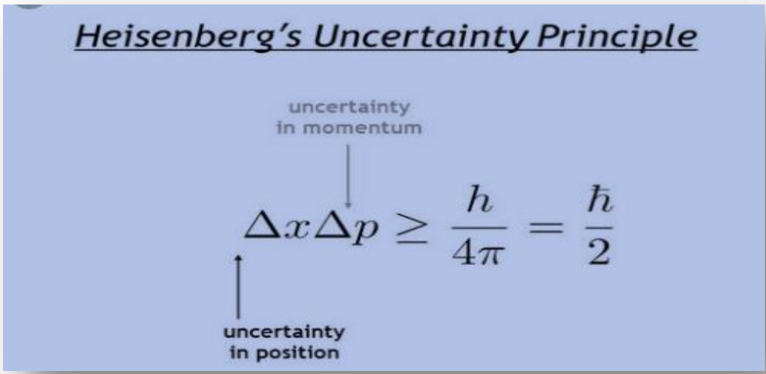
Particles that pass through the slit of which W have an uncertainty W in their X coordinate at the time of going through the slit calling this spread in X values ΔX.

When they were diffracted by the slit ,their direction of motion was changed so that part of their momentum was transferred to X direction .

A particle deflected upward by an angle Ө has an X component of momentum (p sin Ө)

A particle deflected down ward by an angle Ө has an X component of momentum (- p sin Ө).





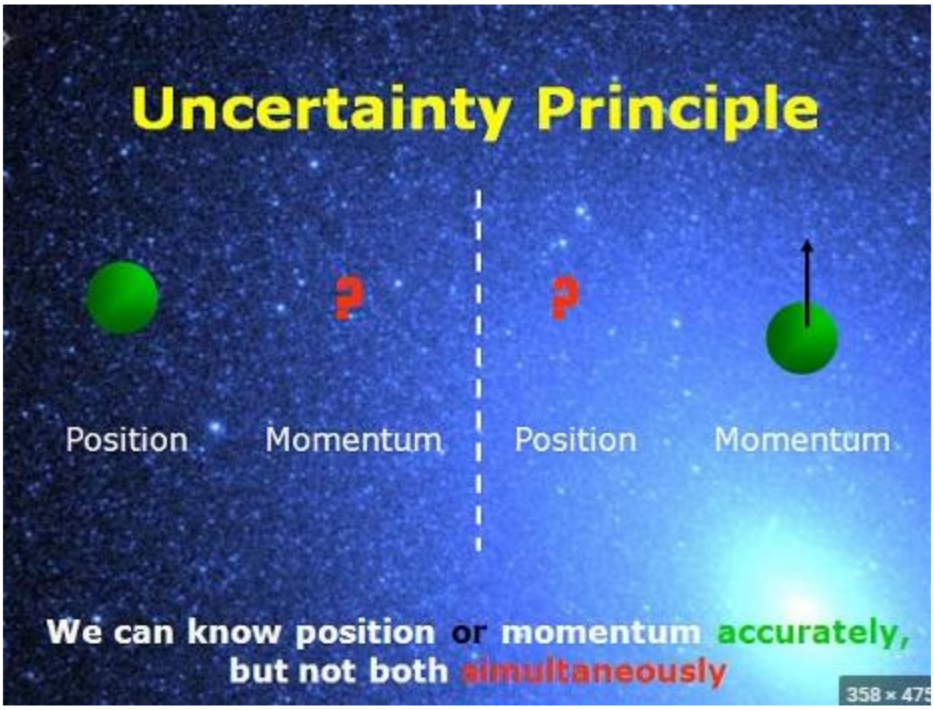
$\Delta X = W$

$\Delta p \, \Delta X = h$

$\Delta p \, \Delta X = \frac{h}{4\pi}$

$m \, \Delta v \, \Delta x = \frac{h}{4\pi}$

$\Delta E \, \Delta t = \frac{h}{4\pi}$



Ex1/ an electron in a molecule bond length 1.3Ao calculate the uncertainty of emitted wave length by the electron ?

$\Delta p \, \Delta X = h$

$\Delta p = h / \Delta X = 6.6 x 10^{-34}$ J.s / $1.3 x 10^{-10}$ m = $5 x 10^{-24}$ kg .m. s^{-1}

$P = h / \lambda$

$\lambda = h / p = 6.6 x 10^{-34}$ J. s / $5 x 10^{-24}$ kg. m. s^{-1}

EX2/ calculate the minimum uncertainty in its position of a projectile of mass 1 g is known to within 1 x 10^{-6} m. s^{-1} ?

$$m \, \Delta v \, \Delta x = \frac{h}{4\pi}$$

$$\Delta x = \frac{h}{4\pi \text{ m } \Delta v}$$

$$\frac{6.6x10^{-34} \, J.s}{4x3.14x \; 1x10^{-3} \; kgx \; 1x \; 10^{-6} \; m.s^{-1}} =$$

= 5x 10^{-26} m