Heisenberg's Uncertainty Principle
Derived From Standing Matter Wave Theory

by Michael Harney, June 10, 2005

The following is a derivation of Heisenberg's uncertainty principle based on the discrete nature of standing matter-waves. It will be shown that the uncertainty principle is simply due the quantization of matter based on the discrete nature of standing waves which can only have frequencies that are integer multiples of a fundamental harmonic frequency. This discrete nature leads to a lack of the existence of matter in the domain where [n] is not an integer because there are no standing waves present when n is fractional, and this has been misinterpreted as uncertainty in measurement.

First we assume standing matter waves which start with fundamental wavelength R equal to the Compton wavelength of the electron, [$R = 2.4 \times 10^{-12}$ meters]. Then all other standing waves have wavelengths as follows:

[1] $$\lambda = R/n$$

where [n] is the quantum number governing the number of nodes in the standing wave. Also, the energy in the standing wave is found from the solution to Schrodinger's equation for a two-dimensional wave trapped in an infinite-potential well:

[2] $$E = [(n_x)^2 + (n_y)^2]\pi^2 h^2/(8mR^2)$$

Where [E] is the energy in the wave, n_x and n_y are the quantum numbers governing the nodes in the two-dimensional wave, and m is the mass of the 'particle' or wave center represented by the fundamental wavelength (when [n_x and n_y]are equal to 1). The mass [m] for the fundamental wavelength can be found by setting the quantized energy of the fundamental wavelength using equation [2], setting [n=1] equal to the rest-energy of the 'particle' or wave-center that is represented by this fundamental wavelength:

[3a] $$2\pi^2 h^2/(8mR^2) = mc^2$$

Solving, we find [$m=7.2 \times 10^{-31}$ Kg], which is very close to the measured electron mass of [9.11×10^{-31} Kg].

If we now picture the standing wave of particular quantum numbers [n_x and n_y] we assign [n_{eff}] as the square root of the sum of the squares of the [n_x and n_y] so that [n_{eff}] represents the effective quantum number, or a composite of [n_x and n_y]. Then we know that when the standing wave changes its quantum numbers [n_x and n_y] by 1, it will effectively change [n_{eff}]by one and this is described as [Δn_{eff}], the change in effective quantum number either up or down by 1. Then equation [2] above produces an incremental change in energy, ΔE, for an incremental change in n_{eff} (which is Δn_{eff}) results in the following:

[3] $$\Delta E = (\Delta n_{eff})^2\ \pi^2 h^2/(8mR^2)$$

Time is what we perceive from the flow of matter, and therefore from the change in matter waves. As matter waves change incrementally in n_{eff} (Δn_{eff}), not only does their energy change, but so does their wavelength from the formula:

$$\lambda = R/n$$

The change in λ with respect to n, which we denote as $\Delta\ \lambda$ is found by differentiating the λ formula (1) above with respect to n_{eff} to produce:

[4] $$\Delta\lambda = 2R/(\Delta n_{eff})^2$$

As [λ] varies [$\Delta\lambda$] we find that the perception of time also varies based on

[5] $\Delta t = \Delta\lambda / c$

where [c] is the speed of light and the speed at which the matter wave propagates through the space-fabric. Now, based on an incremental change in effective quantum number (Δn_{eff}) which produces an incremental change in energy (ΔE) and an incremental change in wavelength ($\Delta\lambda$) which also produces an incremental time shift (Δt), we ask the question, what is the minimum product of change in energy (ΔE) and perceived change in time (or time shift of matter wave, Δt)? It is known as (ΔE)(Δt) which will be recognized as Heisenberg's uncertainty relationship. When we substitute the formulas (3), (4), and (5) above in for (ΔE)(Δt) we get:

$$(\Delta E)(\ t) = [(\Delta n_{eff})^2\ \pi^2 h^2/(8mR^2)][\ 2R\ /\ (c(\Delta n_{eff})^2)]$$

which reduces to

$$(\Delta E)(\Delta t) = \pi^2 h^2/[4mRc]$$

where [h=Planck's constant], [$m = 7.2 \times 10^{-31}$ Kg], $R = 2.4 \times 10^{-12}$ meters], and [$c = 3 \times 10^{8}$ meters/sec]. This then evaluates to,

$$(\Delta E)(\Delta t) = \pi^2 h^2/[4mRc] = 2.1 \times 10^{-33} \text{ J-sec} = \text{approx. } h$$

which is three-times the measured value of Planck's constant (less than order of magnitude).

This shows that an increase in energy which is due to an increasing [n] (equation [2], which also shows an increase in mass, equation [3a], causes a decrease in Δt (eqs. [4] and [5] combined), which makes (ΔE)Δt constant. Therefore, Heisenberg's uncertainty principle is derived from assuming a standing wave formula for all masses (with n=1 corresponding to l=R=electron matter-wavelength) and applying Schrodinger's equation to calculate the energies in the standing waves.

Heisenberg's uncertainty principle is not a probability function as previously interpreted, but a limit on how much energy and perceived time shift is changed when quantum number n is changed incrementally. It is incorrect to say that we cannot measure energy and time within certain limits (or momentum and distance within certain limits). It is more accurate to say that the standing wave function does not exist in between incremental changes of quantum numbers, and that there is no wave function valid for fractional quantum numbers. For example, going from [n= 300] to [n=301] is a valid change in the energy and time displacement of the standing wave function, but there is no measurement possible for [n=300.5] because the standing wave function is not valid in this respect. Therefore, measurement of the function does not and cannot occur. But there would be nothing to measure if we could go to this level - there is no way for the standing matter wave to exist at [n= 00.5]. Heisenberg's uncertainty principle is merely a limit on the nature of standing waves based on integer quantum numbers. We perceive this to be the limits of what we can measure, but it is only what can really exist.