Wave Function, Developed Gaussian Distribution

by Hamid – August 2008

Normal distribution law reduces in an indisputable manner the quantum behavior of nature to a mathematical formula and ***wave function*** represents the sub-quantum structure(s) of this behavior at all scales, from the smallest sub-atomic particles to the entire universe.

The new probability wave function can be derived from Gaussian Normal Distribution provided that a perfect ***definition of uncertainty*** to be available and the ***hidden variables*** as the pillars of this function to be recognized in bell curve.

In general terms, quantum mechanics does not assign definite values to observables. Instead, it makes predictions about probability distributions; that is to say, the probability of obtaining each of the possible results from measuring an observable. In other words, before measuring the characteristics of a natural phenomenon its characteristics do not have definite values. Instead, they are described by normal distribution function. The degree of uncertainty in measurement depends mostly on the accuracy of measuring device. Consequently, higher level of technology enables us to measure the characteristics more precisely. As a matter of fact, the order of measurement is important [Ref.1].

For a normal distribution 99.73% of random variables or observations fall within 3 standard deviation (σ) of the mean value (μ), that is, between μ-3σ and μ+3σ. The probability wave function should at least meet this requirement.

Taking into consideration that discreteness in quantum mechanics is an absolute principle, it would be more appropriate to rename the random variables to ***quantum variables*** which can only have some set of discrete values.

Standard uncertainty has been defined in one of my articles [Ref.2], as follows:

The standard uncertainty u_x of a measurement result *X* is equal to six standard deviation of *X*, i.e. $u_x = 6\sigma_x$.

If "**μ**" would be the mean value of the measurement result, then $\mathbf{X=\mu\pm3\sigma_x}$.

The concept above has been used for interpreting the *Diffraction Phenomenon* [Ref.3], *Double Slit Experiment* [Ref.4] and *Planck Length* [Ref.1]. Most likely the latter could have a key role in explanations concerning the ***quantum gravity***.

The hidden variables in normal distribution (bell curve) are μ-3σ, μ-2σ, μ-1σ, μ, μ+1σ, μ+2σ and μ+3σ. Each component of wave function, namely M3, M2, M1, Ci, P1, P2 and P3, is formed around one of these variables respectively [Refs.3&4].

The summary of above mentioned topics and the general configuration of wave function has been shown in Figure 1:

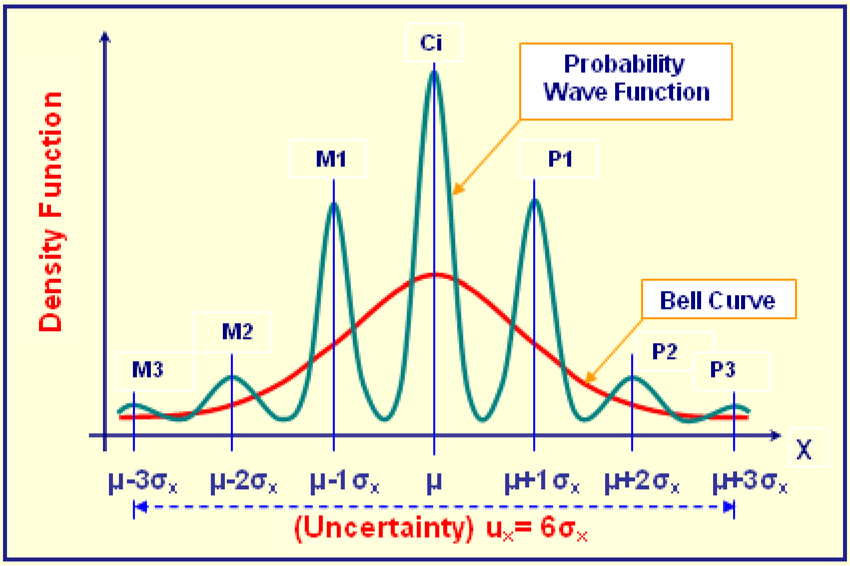

Figure 1

The distribution of all seven groups shall be jointly normal or approximately normal. They, totally, arrange the probability wave function or the ***love formula*** that we are going to generate:

Ψ = M3+ M2+ M1+ Ci+ P1+ P2+ P3

$$\int_{\mu-3\sigma}^{\mu+3\sigma} \psi.dx = 0.9973 = 99.73\%$$

Distribution function of each group can be deduced from probability density function of Normal Distribution with the following formula, in which "**μ**" is mean value (**mathematical expectation**) and "**σ**" (sigma) is standard deviation that determines the width of the "bell":

$$f(x) = \frac{1}{\sigma\sqrt{2\pi}} e^{-\frac{(x-\mu)^2}{2\sigma^2}}$$

The total area under this curve, from minus infinity to plus infinity, is one. That is to say it embraces 100% of random variables (**quantum variables**). Therefore the area under *f(x)* between any two values, say, from x=μ-3σ to x=μ+3σ, is the proportion of cases which lie between the two values:

$$\int_{-\infty}^{+\infty} f(x).dx = 1 = 100\%$$

$$\int_{\mu-3\sigma}^{\mu+3\sigma} f(x).dx = 0.9973 = 99.73\%$$

This regulation has been used for calculating the area under the probability density function of each particular group (component) in wave function [Ref.4]. Table1 indicates the results:

Table 1

	M3	M2	M1	Ci	P1	P2	P3	Total
Probability (Population)	0.49%	6.06%	24.17%	38.29%	24.17%	6.06%	0.49%	99.73%

The mean value or **mathematical expectation** of different groups is given in Table 2.

Table 2

	M3	M2	M1	Ci	P1	P2	P3	Bell Curve
Mean Value	μ-3σ	μ-2σ	μ-1σ	μ	μ+1σ	μ+2σ	μ+3σ	μ

Even though the probability of all seven groups implies that their distribution singly is not normal, but we can obtain distribution function of each group from the bell curve. For doing this, it is sufficient to change the standard deviation to σ'=1/6σ (u=6σ'=σ) and by a factor less than one, proportional to each case, to reduce the height of the "bell". This means that the total area under each one, from minus infinity to plus infinity, will be less than one. Therefore they are abnormal distributions individually.

The probability distribution functions of all seven groups can now be constructed, see Figure 2. To summarize the functions it is supposed that μ=0.

$$M3 = \frac{6 \times 0.00974}{\sigma\sqrt{2\pi}}\left[e^{\frac{-18(x+3\sigma)^2}{\sigma^2}}\right]_{-3\sigma}^{-2.5\sigma}, \quad M2 = \frac{6 \times 0.06076}{\sigma\sqrt{2\pi}}\left[e^{\frac{-18(x+2\sigma)^2}{\sigma^2}}\right]_{-2.5\sigma}^{-1.5\sigma}$$

$$M1 = \frac{6 \times 0.24238}{\sigma\sqrt{2\pi}}\left[e^{\frac{-18(x+\sigma)^2}{\sigma^2}}\right]_{-1.5\sigma}^{-0.5\sigma}, \quad Ci = \frac{6 \times 0.38396}{\sigma\sqrt{2\pi}}\left[e^{\frac{-18x^2}{\sigma^2}}\right]_{-0.5\sigma}^{+0.5\sigma}$$

$$P1 = \frac{6 \times 0.24238}{\sigma\sqrt{2\pi}}\left[e^{\frac{-18(x-\sigma)^2}{\sigma^2}}\right]_{+0.5\sigma}^{+1.5\sigma}, \quad P2 = \frac{6 \times 0.06076}{\sigma\sqrt{2\pi}}\left[e^{\frac{-18(x-2\sigma)^2}{\sigma^2}}\right]_{+1.5\sigma}^{+2.5\sigma}$$

$$P3 = \frac{6 \times 0.00974}{\sigma\sqrt{2\pi}}\left[e^{\frac{-18(x-3\sigma)^2}{\sigma^2}}\right]_{+2.5\sigma}^{+3\sigma}$$

Seven Components of Wave Function

New Wave Function Ψ=M3+M2+M1+Ci+P1+P2+P3

Figure 2

By the same rule it is possible to make sub-quantum structures of different groups or components.

If μ=0 and σ=1, the Gaussian Distribution is called ***standard normal distribution***, with the following formula:

$$f(x) = \frac{1}{\sqrt{2\pi}} e^{-\frac{x^2}{2}}$$

By applying the above-mentioned standard, hidden variables or mean values will change into integers -3, -2, -1, 0, +1, +2 and +3. In other words, for every specific value of "**μ**" and "**σ**" we have all required data for drawing the graph of wave function, by Excel for example. The curve of standard wave function looks like Figure 3, which can be regarded as *the* ***Universal Wave Function***.

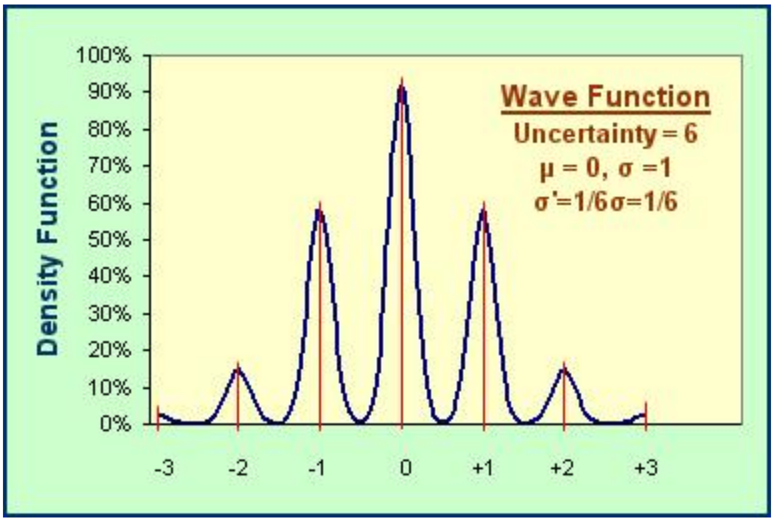

Figure 3

The wave function introduced here is applicable to the measurement results related to all natural phenomena. For a while imagine that the brain which controls our thought and behavior may be a type of quantum variable. Where is our place in wave function of the human mind?

References

1. Planck Length and Quantum Geometry, March 2007, toequest.com
2. Definition of Uncertainty, June 2008, toequest.com
3. How Can the Photons Tolerate Each Other?, October 2004, toequest.com
4. Double Slit Experiment and Quantum Mechanics, December 2005, toequest.com