

The Primary Gas and the Postulates of Quantum Mechanics-VII

V.A.Induchoodan Menon,
1, Director's Bungalow, Gujarat University
Campus, Ahmedabad-380009, Gujarat, India.
e-mail: induchoodanmenon@yahoo.co.in

Abstract

The author shows that that for each quantum mechanical property of a micro-system there is a corresponding thermodynamic one in the primary gas. He further shows that the basic postulates of quantum mechanics have equivalents in the primary gas approach based on statistical mechanics provided time is accorded directional symmetry. He shows that the interference pattern obtained in Young's double slit experiment could be explained in terms of the primary gas approach using the directional symmetry of time.

PACs numbers: 03.65-w, 3.65 Ta, 03.75 -b, 05.40 -a, 05.70 Ce

Key Words : Primary Gas, Stochastic Quantum Mechanics, Action-entropy equivalence, Quantization of space and time .

1 Introduction

It was earlier shown that a particle could be represented by a standing half wave called "staphon" which is formed by the confinement of a single circularly polarized luminal wave called "photino". The properties of a particle like mass, electric charge and spin were found to emerge from the confinement of the photino [1],[2][3],[4]. It was further shown that the states occupied by the staphon successively in time by its interactions with the vacuum fluctuations in the Higgs field could be taken to form a gas called the primary gas. The only difference between the primary gas and the real gas is that while in the real gas the microstates are occupied simultaneously, in the case of the primary gas the micro-states are occupied successively in time. But for this difference, the statistical mechanics of the primary gas is equivalent to that of the real gas [5]. It was observed that the primary gas picture of a particle and the wave picture of a particle are equivalent ones and it appears to be a direct result of a new symmetry called the Wick symmetry. In fact, it was proposed that quantum mechanics could be understood in terms of the statistical mechanics of the primary gas where time has not lost its directional symmetry [5].

In this paper we shall examine the compatibility of the basic postulates of quantum mechanics to the statistical mechanics of the primary gas. Besides, using the primary gas approach we shall try to explain the interference pattern obtained in the double slit experiment using an electron beam.

2 Primary Gas Equivalents of the Wave Representation of Particle

First of all we have to keep in mind that the primary gas picture is an energy momentum picture of the particle. But by a deft regrouping of the number of microstates nN with the inverse of temperature, we have been able to convert it into the space-time picture where time is treated as real. The plane wave representation of a particle is the corresponding space-time picture in imaginary time. If we go by the Wick symmetry, the plane wave picture of a particle should get converted into the primary gas picture if it undergoes Wick operation [5]. Let us start with the plane wave representing a particle given by

$$\phi(E') = B e^{-ih^{-1}(E' - p'x)} . \quad (1)$$

The use of primes in E' and p' suggests that they should not be confused with the average values which will be denoted by E and p . Likewise, the probability for the occupation of a broglino state could be written as

$$W(E') = g(E') e^{h^{-1}(E' - p'x)} . \quad (2)$$

It may be noted that $W(E')$ and $g(E')$ are also functions of p' . However, as only waves aligned in the direction of the linear motion have non-zero amplitude, E' would completely determine p' . If we now operate on (1) with the Wick operator, we obtain

$$\check{R} \phi(E') = \check{R} \{ B e^{2\pi i n N} e^{-ih^{-1}(E' - p'x)} \} . \quad (3)$$

Here we have introduced the factor $\exp(2\pi i n N)$ on the right hand side as its value is unity, since n and N can take only integral values. Denoting $\check{R} \phi(E')$ by $W(E')$, we have

$$W(E') = B e^{nN} e^{-h^{-1}(E' - p'x)} . \quad (4)$$

This shows that when operated with \check{R} , the plane wave gets converted into a probability density function for the occupation of micro-state energy in a primary gas provided $g(E') = B \exp(nN)$. Since E' and p' lie close to the average values, $g(E')$ may be taken as equal to $g(E)$ which in turn could be taken to be proportional to $\exp(nN)$. The probability function gets a sharp maximum in the close neighborhood of the average values on account of the fact that degeneracy $g(E)$ is proportional to $\exp(nN)$. Therefore, it is quite reasonable to take the plane wave state as equivalent to the primary gas state.

When we represent a particle in terms of a plane wave, we never specify the number of single waves constituting the wave train or the length of the wave train which constitutes the plane wave. It is left undefined in the usual treatment. This is because, in quantum mechanics, the eigen state is supposed to be the most basic state. But in the primary gas approach we are attributing an inner structure to the eigen state in order to strike an equivalence between the two approaches, and N emerges out of this. We do not know whether N is a universal constant or an arbitrary number which gets factored out in any observation. In fact, in the interaction between two particles, N could be taken as a constant. The justification for such an assumption is that the variation could be attributed to the value of n which represents the number of the primary gas states involved in the interactions. One need not take both N and n as variables [6].

We know that the plane wave state is the eigen state of particle in the coordinate representation. In quantum mechanics, eigen state is taken as the most basic state which cannot be analyzed any further. The Copenhagen interpretation (CI) makes it a basic element of the quantum reality. According to CI any observation on a micro-system can take us only up to the level of an eigen state. Besides, any physical system should be interpreted only in terms of the observable reality [7]. Such a notion did not permit any further analysis of the eigen state. But in terms of the primary gas approach, we observe that an eigen state could be taken as equivalent to a broglieon state. In our approach we do not take the broglieon state as the most basic state. We assume that the broglieon state is constituted by a group of broglino states occupied successively. This may appear unwarranted as the broglino is below the level of observation. But such a structure is proposed here as it simplifies the picture and we are able to lay down the equivalence of statistical mechanics of the primary gas to the quantum mechanics. In that sense, the proposed primary gas approach is a hidden variable theory. But this approach does not accept the view that there is an objective

reality to the micro-system which is observer independent. It goes by the approach based on Copenhagen interpretation that the micro-system exists in a state where all possibilities exist in an unmanifested manner and the system crystallizes into reality only in an observation.

We shall now look for the primary gas equivalents of other quantum mechanical properties. We know from the Wick symmetry that the negative action is equivalent to entropy [5].

$$\text{ie; } -A/h = S/K \quad (5)$$

This may be expressed in terms of the energy-momentum of the particle as

$$(Et - px)/h = E_o t_o = S/K \quad (5A)$$

But we know that $t_o = NT_{eo} = Nh/K\theta_o$, where θ_o is the temperature of the vacuum fluctuations background which interacts with the particle [5]. Therefore, we have

$$S = NE_o/K\theta_o \quad (5B)$$

while that of the uncertainty principle is the equation for fluctuations. Note that the rest energy of the particle E_o behaves like the heat content and therefore, we may assume that in the primary gas representation of the particle (ie; reversible time picture), the rest mass of the particle behaves like the heat content of a gas.

We shall now try to list out the reversible time equivalent of other quantum mechanical entities below.

<u>Imaginary time</u>	<u>Reversible time</u>
i) Wave Function	State function of the primary gas
ii) Negative Action	Entropy
iii) Total energy	Internal energy
iv) quantum of time	Inverse of temperature
v) particle velocity	Drift velocity
vi) Langrangean	Negative heat content
vii) Uncertainty principle.	Equation for fluctuations
viii) Zero point energy	Thermal energy of vacuum fluctuations

3 The Basis for the use of Boltzmann's Canonical Distribution

In the approach followed above, one question that may be raised is regarding the use of the Boltzmann's distribution to represent the primary gas state. The justification for this is quite straight forward. First of all we should remember that we are dealing with one path of progression at a time. The system in the process of occupying the broglino states successively, occupies only a particular broglino state at a time. Note that this state is occupied out of very large number of broglino states available for occupation. In fact there is no limitation to the broglino states to be occupied here. In that sense, the situation is equivalent to a large number of boxes available for occupation with a limited number of balls. This is the situation where Boltzmann's distribution holds good. If the number of boxes and the number of balls were of the same order, then we would have been required to apply the Fermi-Dirac distribution. Remember that the broglinos possess half spin.

The concept of the ensemble will have to be given a fresh look in the case of the primary gas. In the case of the canonical ensemble of a real gas, we deal with energy and volume along with their conjugate variables, temperature and pressure. However, in the case of the primary gas we take the translational momentum in the

place of volume and velocity in the place of pressure. We know [5] that the internal heat of the primary gas is given by $\int v p$

$$Q = Nq = NE - \int v p \quad (6)$$

Therefore, the entropy of the system would be given by

$$S = Q / \theta = N (E / \theta - \int v p / \theta) \quad (6A)$$

Earlier we saw that such a primary gas could be taken to be equivalent to a real gas [5]. One important difference between volume in the case of a real gas and momentum in the case of a primary gas is that volume cannot be transformed out by suitably selecting a frame of reference while momentum can be. This means that we could always deal with the micro-canonical ensemble by introducing suitable transformation and study the system more conveniently. Afterwards, we may transform it back by shifting the frame of reference suitably. This is made possible by the fact that the entropy of the system remains invariant in such a transformation. In short, we do not have to deal with the canonical ensemble to work out the thermodynamics of the system. Micro-canonical ensemble would do.

4 The Primary Gas and the Postulates of Quantum Mechanics

In the earlier papers we saw that a wave function representing a micro-system would become a probability density function on being operated by the Wick's operator \bar{R} . We also saw that such an operation does not alter the physical situation. Only the imaginary time picture gets replaced by the reversible time picture which is same as stating that the wave nature of the micro-system gets replaced by the primary gas picture. This would mean that the dynamics of the system which is determined by the wave nature of the micro-system will have to be replaced by laws of statistical mechanics. This in turn would mean that the basic postulates of quantum mechanics could be understood in the light of laws of statistical mechanics. We shall confine ourselves to the three basic postulates of quantum mechanics for study [8]. These three postulates capture the essence of the operator form of quantum mechanics. There are further postulates, but these three are the most important ones. They firmly establish the existence of the wave function and its status as a complete description of the state of a quantum particle. The replacement of the values of the observable quantities (classical mechanics) with their corresponding operators (quantum mechanics) provides a recipe for using the wave functions and operators to calculate the values of the observables. Let us take the first postulate of quantum mechanics to start with [8].

Postulate I: *The state of a quantum mechanical system is completely described by the wave function ψ_k .*

Here the subscript k serves as a short hand for the set of one or more quantum numbers on which the wave function will depend. Let us take the plane wave representation of the wave function. Note that a plane wave is the eigen function of a momentum state (taking energy as the fourth component of the momentum) in the coordinate representation. This means that the system may be occupying any of the plane wave states denoted by k. Note that if the wave ψ_k is represented as a vector in a configuration space (Hilbert space), then ψ_k will be orthogonal to ψ_m unless $k = m$. In this way, the state of a system could be represented as a vector in an n-dimensional configuration space. This assumes that the system can occupy all possible states simultaneously in a virtual way and for such a possibility to be acceptable, time has to be treated as imaginary. It should be kept in mind that the orthogonality of the wave functions becomes important only at the instant of observation as two eigen states cannot be realized simultaneously. The basic idea here is that the system may occupy a large number of eigen states simultaneously so long as the system has not

crystallized into reality. The orthogonality of the eigen functions ensures that only one state could crystallize into reality in an observation. The higher the magnitude of the vector ψ_k larger will be the probability of catching the system in that state.

In the reversible time approach the state function of the primary gas (brogieon) state which is a probability density function plays the same role as the plane wave in the imaginary time. However, since we are treating time as real the concept of simultaneous occupation of various primary gas states could not be considered. Instead, W_k would represent the probability for the occupation of the state in the forward time evolution. Note the difference. In the imaginary time approach all the possible states are assumed to be occupied in a virtual manner by the progression of the plane wave, Ψ_k while in the reversible (real) time approach the corresponding state function W_k stands only for the probability for occupying the states. The states themselves are not occupied. However, if the equivalence between the plane wave and the state function for the primary gas is to be brought out, we need to have a different interpretation of W_k . We may circumvent this difference by using the frequency interpretation of the probability. Let us take the case of throwing a coin. Here the probability for getting a head or tail is 1/2. What it means is that when we throw the coin repeatedly for long, the number of times one would get a head will be equal to that for tail. In this interpretation, we assume that the head and tail states are actually occupied by the coin and the probability becomes merely finding out the ratio of the number of times head is occupied to the total number of states occupied. In a similar manner, we may treat the state function of the primary gas for a particular energy state as the relative density of occupation of that state in a virtual manner. This interpretation of the state function of the primary gas makes it easier to understand its equivalence with the wave picture as plane wave represents the probability amplitude for occupying an energy-momentum state.

The concept of the orthogonality of the eigen state emerges from the fact that the probability for observing the system in the k^{th} state at an instant is given by $\Psi_k^* \Psi_k$. This makes $\Psi_k^* \Psi_m = 0$ if $k \neq m$. In the primary gas approach, we observed that W_k represents density of occupation of the k^{th} state in the forward time evolution while W_k^c represents corresponding density to vacate the k^{th} state in the reverse time evolution. Therefore, the probability of observing the system in the k^{th} state should be given by $W_k^c W_k$. For the same reason the probability $W_k^c W_m$ will be equal to zero where $k \neq m$ for obvious reasons. This means that the concept of the orthogonality of W_k with W_m would apply here also as what it means is that if the system is observed in the k^{th} state it cannot be observed in the m^{th} state if $k \neq m$. We shall later show that W_k will always be equal to W_k^c .

One important issue that arises out of this real time approach is that the wave equation which applies to the wave nature of the particle would no more be valid in the primary gas approach. Let us take the Dirac equation given by

$$(\gamma_\mu \partial/\partial x_\mu + mc/\hbar)\psi = 0 \quad , \quad (7)$$

where $\gamma_k = \begin{bmatrix} 0 & -i\sigma_k \\ i\sigma_k & 0 \end{bmatrix}$, $k = 1,2,3$. ; $\gamma_4 = \begin{bmatrix} 1 & 0 \\ 0 & -1 \end{bmatrix}$.

Here σ_k represent Pauli's spin matrices. When we operate (7) with \tilde{R} we obtain

$$(\gamma_\mu \partial/\partial x_\mu + mc/\hbar)W = 0 \quad , \quad (8)$$

Note that $x_\mu = nNv_\mu T_e$, where $v_\mu = (\mathbf{v},c)$ and $T_e = h/K\theta$. We observe that the wave equation given in (7) exhibits undulatory behavior while that given in (8) does not have such a property since W is just a probability function. Therefore, prima-facie it

may appear that these two equations represent different realities. But we should keep in mind that the undulatory behavior holds good only within one wave length. If we treat one wave length as a single unit, then we would not observe any undulatory behavior. Instead, we would observe that the system progresses in a uniform manner. We shall examine this issue in more detail in the next section.

We know that the Schrodinger's equation could be extracted from the Dirac equation in the non-relativistic region. if we ignore spin, then, we would obtain the familiar form of the Schrodinger equation which is given below [9]. We also know that the Schrodinger equation for a free particle when given a Wick operation would transform into the Diffusion equation [10]. We shall take complex conjugate of the Schrodinger equation and apply the Wick operator to obtain

$$\tilde{R} \left\{ \frac{\hbar^2}{2m} \nabla^2 \psi^* - i\hbar \frac{\partial \psi^*}{\partial t} \right\} = 0 \quad (9)$$

$$\text{ie;} \quad \frac{\partial W^c}{\partial t} = \frac{\hbar}{2m} \nabla^2 W^c . \quad (9A)$$

This is the heat equation or diffusion equation where $(\hbar/2m)$ represents the diffusivity. W^c which stands the probability density could represent the particle density which in turn could denote the energy density. In this connection we should recall that [5] the rest energy of a particle could be treated as its internal heat. This means that the Schrodinger equation and the diffusion equation are two ways looking at the same reality. This would mean that we could view a potential as one which introduces a gradient in the vacuum fluctuations field that directs the diffusion process. In this connection it is worthwhile to recall an alternate approach to quantum mechanics called stochastic quantum mechanics has been proposed by Nelson, Yasue et al [11][12][13][14]. This approach has met with partial success. But this approach has not been able to obtain profound insights like the action-entropy equivalence and the Wick symmetry. The main reason for this could be that the stochastic approach shied off from proposing a basic structure to the particle and was basing its bet on the concept of point particle. The striking similarity between the plane wave and the probability density function was never probed in depth. The approach seems have focused too much on the similarity between the Schrodinger equation and the diffusion equation. But it is quite obvious that the primary gas approach can be developed further using the methods of stochastic quantum mechanics for understanding the behavior of the micro-systems in greater depth.

In the light of the above discussion it is obvious that the Dirac equation in real time also represents some sort of a diffusion equation. But we are not familiar with its classical analogue.

Postulate II: *Observable quantities are represented by mathematical operators. These operators are chosen to be consistent with the position-momentum commutation relations.*

To clarify the picture, let us take the plane wave representation of the eigen state ψ_n given by

$$\psi_n = B e^{i\hbar^{-1} p_n x} \quad (10)$$

The momentum operator $\hat{p} = -i\hbar \partial / \partial x$ so that

$$-i\hbar \partial \psi_n / \partial x = p_n \psi_n \quad (10A)$$

In other words, the momentum operator is defined in such a way that ψ_n becomes the eigen function and p_n its eigen value. It is obvious that this satisfies the commutation relation

$$-(x\hat{p} - \hat{p}x) \psi_n = i\hbar \quad (10B)$$

Note that the system is supposed to occupy the momentum eigen value p_n in any observation, and the average over all the values of p_n would be the ensemble average.

When we go over to the primary gas picture after a Wick operation, then also we observe that p_n will be the momentum of a broglieon state. The corresponding probability density function for the primary gas would be [6] given by

$$W_n = B e^N e^{-h^{-1}(Et - px)} \quad (11)$$

The corresponding momentum operator would be $\hbar \partial/\partial x$ and we obtain the similar eigen value equation

$$\hbar \partial W_n / \partial x = p_n W_n \quad (12)$$

Here also the average value of momentum would be obtained by averaging the values of p_n . Note that the commutation relation applies here also given by

$$(x\bar{p} - \bar{p}x) W_n = -\hbar \quad (12A)$$

Note that here \bar{p} represents \hat{p} which has undergone a Wick operation. Remember that the uncertainty in the momentum and the spatial coordinates arises out of the wave nature of the particle. Since the broglino state which is the micro-state of the primary gas is a single wave, the uncertainty makes its appearance here also.

Postulate III : *The mean value of an observable is equal to the expectation value of its corresponding operator.*

For a specific wave function ψ_n , the expectation value of the operator \hat{A} is defined by the expression

$$\langle A \rangle = \frac{\int \psi_n^* \hat{A} \psi_n d\tau}{\int \psi_n^* \psi_n d\tau} \quad (13)$$

where τ denotes the generalized volume element. Although this expression is introduced rather arbitrarily, its origin could be traced to the probability calculus. To clarify the point, let us suppose ψ_n is the eigen function of the operator \hat{A} and a_n is the corresponding eigen value. Therefore, we have

$$\hat{A} \psi_n = a_n \psi_n \quad (14)$$

Multiplying both sides by ψ_n^* and integrating over all spatial elements yields

$$\int \psi_n^* \hat{A} \psi_n d\tau = a_n \int \psi_n^* \psi_n d\tau \quad (14A)$$

This is possible because a_n is a mere number. If ψ_n is normalized, we obtain

$$\langle A \rangle = a_n \quad (14B)$$

Since the wave function can be a complex function, the operator too may be a complex function as in the case of the momentum operator. However, if postulate III is to make sense, the eigen value of an operator representing an observable must be a real quantity because this is something that can be measured in an experiment. Operators whose eigen values are real are called hermitian operators. As a result of this property of the operators any two eigen functions are orthogonal. That is, taking the eigen functions as normalized, we have

$$\int \psi_n^* \psi_n d\tau = \delta_{mn} \quad (15)$$

For switching over to the primary gas approach we have to use the Wick operator on the eigen function (we shall take the momentum eigen function in the coordinate representation for this purpose). We observe that the momentum operator as well as the momentum eigen function become real on operating with \bar{R} . This will leave the eigen value unchanged as a real number. The corresponding expectation value of the operator in the primary gas approach (in reversible real time) is given by

$$\langle A \rangle = \frac{\int W_n^c \bar{A} W_n d\tau}{\int W_n^c W_n d\tau} \quad (16)$$

where \bar{A} is the operator \hat{A} which has undergone Wick operation.

Note that in the case of a real gas the average value for momentum will be given by the relation

$$\langle A \rangle = \frac{\int \bar{A} W_n d\tau}{\int W_n d\tau} \quad (16A)$$

But in the case of the reversible time it is obtained by (16). We have already explained the reason behind in an earlier paper [6].

5 More on Wick Symmetry

We saw that the Wick operation transforms the plane wave into the state function of the primary gas. In this operation, $2\pi iN$ gets converted to N . If we take the case where $N = 1$, then we have $2\pi i$ getting converted to unity. Let us examine what is happening here. We know that the primary gas approach is the energy-momentum representation of the particle. But by suitable regrouping of the exponential term, we have been able to convert the energy-momentum picture to the space-time picture. But the cost we have to pay is that the space has to be quantized with a length of $R_e = (h\nu/K\theta)$ and time with an interval $T_e = (h/K\theta)$ [5]. In the process what happens within the duration T_e gets pushed into the internal coordinates.

Let us now examine the issue from the wave picture angle. We know that as the wave proceeds, its phase varies from 0 to 2π . This represents a rotation through 2π in the complex space. We already saw that the micro-states of the primary gas, N increases taking only integral values. In this picture the non-integral values taken between two adjacent integral values does not get accounted. But it is this region between 0 and 2π which represents the wave. This means that the primary gas approach treats each single wave as the basic unit or quantum. In such iteration, the inner structure of the quantum which is a wave is completely ignored. To put it differently, the primary gas approach pushes the wave nature (which emerges from the treatment of time as imaginary) of the broglino to its inner structure while the quantum mechanics extends the imaginary time treatment to the entire system.

When we strike the equivalence between the plane wave and the state function for the primary gas, one important difference that becomes obvious is that in the wave picture the particle actually occupies the states though in a virtual or unreal manner whereas the state function represents only the probability of occupying a particular state and therefore there is no actual occupation of the state as such. But we can circumvent this problem by using the frequency interpretation of the probability. Let us take the case of throwing a coin. Here the probability for getting a head or tail is 1/2. What it means is that when we throw the coin repeatedly large number of times, the number of times one would get a head will be equal to that for tail. In this interpretation, we assume that the head and tail states are actually occupied by the coin and the probability becomes merely finding out the ratio of the number of times head is occupied to the total number of states occupied. In a similar manner, we may treat the state function of the primary gas as the relative density of occupation of a particular state. This interpretation of the state function of the primary gas makes it easier to understand its equivalence with the wave picture as a plane wave represents the probability amplitude for actual occupation of an energy-momentum state.

Another important point that emerges from the Wick symmetry is the relationship between the probability for the forward evolution and the reverse evolution in time. We know from the earlier discussion that the state function $W_k(x,t)$ represents the sum total of all probability for forward jumps in time to the k^{th} state at the space-time point (x,t) from the past states. Likewise, $W_k^c(x,t)$ represents the probability for the reverse jumps to the past from the k^{th} state at the space-time point (x,t) . We know that when time has not lost its directional symmetry, the probability for the forward jump should be equal to that for the reverse jump. In other words $W_k = W_k^c$. Let us see if such a relationship actually emerges from the wave picture. Let us start with the plane wave representing the particle given by

$$\psi_k = B_k e^{-(Et - px)/\hbar} \quad (17)$$

To make matters simple, we shall transform the plane wave to a frame of reference with which it is at rest and then operate it with the Wick operator to obtain [6]

$$W_k(o) = B_k e^{nN} e^{-nNE_o/K\theta_o} \quad (18)$$

Since the system is in equilibrium with the vacuum fluctuations, we may take $E_o = K\theta_o$. Therefore, (18) could be written as

$$W_k(o) = B_k e^{nN} e^{-nN} = B_k \quad (18A)$$

It can be easily shown that the corresponding expression for $W_k^c(o)$ would be given by

$$W_k^c(o) = B_k e^{-nN} e^{nN} = B_k \quad (18B)$$

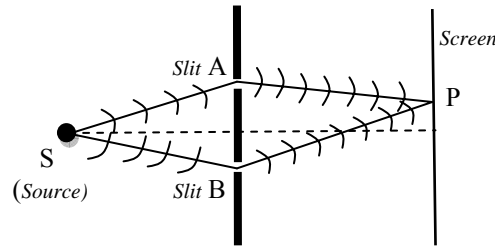
This confirms our assumption.

6 Explaining Interference pattern of the Double-slit Experiment

It may be felt that the interference pattern is a direct outcome of the wave nature which gets expressed only in the imaginary time. Therefore, it may seem impossible to explain this phenomenon in the primary gas picture which is the reversible time picture. Here we should keep in mind that even in the reversible time picture the internal structure of the broglino remains that of a wave. But this aspect does not come into play as each broglino is treated as the basic unit in a sequence, and two broglinos do not occupy the same spatial point at the same instant in time.

However, in an observation where the spatial location of the particle is measured with a maximum precision all the N broglino states constituting a primary gas state (broglieon) would be caught at one instant. In such a case, the phases of the broglino would come into play. Note that in the reversible time approach, the system is evolving on its own without getting disturbed by observation. Therefore, we had to deal with only one path of progression at a time and the case of two paths interfering with each other never arose. But in the act of observation, we are bringing together these broglino states belonging to various paths that exist at the same point in space-time. Therefore, the phase of these broglinos would play an important role resulting in the interference patterns. Here we have to keep in mind that if we want to keep the momentum to be as exact as possible in a measurement, then the primary gas state could stretch to a length of $N\lambda$. On the other hand if we want to keep the location of the particle to be as exact as possible, then, we have to consider the situation where all N broglinos occupy the same space-time point. In such a situation, the N states would form not a primary gas but more of a real gas as all the states are occupied at the same instant. But unlike a real gas, here the microstates would be occupied in a virtual manner.

Let us now examine the interference pattern obtained in the double slit experiment using an electron beam. We know the interpretation of this phenomenon



On the basis of the wave picture, electron from the source S goes through slits A and B and the secondary waves from the slits arrive at the screen and the interference between the two waves fronts creates the fringes at P .

Figure 1

based on the wave nature of the electron [15]. We shall briefly describe it here (see figure 1). The quantum mechanical interpretation is that the waves representing the particles spread around as a wave front from the source. The secondary waves emerging from slit A and slit B arrive at P on the screen where they undergo interference. If both waves reach P in phase the intensity will be maximum and if they reach with a phase difference of π , then, the intensity will be minimum. This explains the formation of the interference pattern on the screen. Note that this interference would be formed even if only one electron is emitted by the source at a time. This would mean that a single electron initially disembody into a wave front and passes through both slits simultaneously and arrives at P on the screen when suddenly it throws away its wave-disguise and appears as a particle. This interpretation may appear strange, but that is what quantum mechanics has to offer. The issue of the wave particle duality is still a topic which is not properly understood in quantum mechanics.

In the primary gas approach, the electron starting from the source jumps forward in time to slit A and from there it could jump forward to P along all possible paths and then jump back in time to reach A and back again to S . In a similar manner, we could imagine the same process taking place through slit B also. In fact, these forward and the reverse jumps in time creates a wave front emanating from S . This would also explain the secondary waves emanating from the two slits. In fact this interpretation is in tune with the Maxwell's equation which has solutions with waves moving forward in time and backward in time. We shall discuss this aspect in more

detail when we deal with the concept of the progressive time in depth. We now obtain the same result as obtained in the wave representation of the particle. The interference pattern is created due to the fact that the broglino has an internal structure of a wave and at P the broglinos emerging from slit A and slit B arrive simultaneously and is caught in an observation where their internal phases come into play and creates the interference pattern.

References

1. V.A.Induchoodan Menon , vixra:0909.0035(2009), (quant- ph)
2. V.A.Induchoodan Menon, vixra: 0911.0017(2009), (quant-ph)
3. V.A.InduchoodanMenon , Vixra:1001.0008(2009), (quant-ph)
4. V.A.Induchoodan Menon, vixra: 1004.0036(2010), (quant-ph)
5. V.A.Induchoodan Menon, vixra: 1004.0089 (2010), (quant-ph)
6. V.A.Induchoodan Menon, vixra: 1005.0043 (2010), (quant-ph)
7. D.Bohm, Cusality and Chance in Modern Physics, Routledge & Kegan Paul plc, London, p.91-94. (1984)
8. J. Baggot, The Meaning of Quantum Theory, Oxford University Press, London , p'42-8, (1992)
9. J.J.Sakura, Advanced Quantum Mechanics Addison-Wesley Publishing Co.Inc. (second Indian Reprint), p. 85-88, (1999)
10. J.C.Zambrini, Phy. Rev.A, vol.33, 1532-47 (1986)
11. E. Nelson, Phy. Rev. 150, 1079 (1966)
12. E.Nelson, Dynamical theories of Brownian Motion, Princeton University Press, Princeton, N.J., (1967)
13. E. Nelson, Quantum Fluctuations, Princeton University, Princeton, N.J., 1985.
14. K.Yasue, J. Math. Phys. **22**, 1010 (1981)
15. R.P.Feynman, Quantum Mechanics and Path Integrals, McGraw-Hill Inc.,N.York, p.2-17, (1965)