بسم الله الرحمن الرحيم

شبكة المعلومات الجامعية

جامعة عين شمس

التوثيق الالكتروني والميكروفيلم

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لم ترد بالاصل

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By

Essam Edfawy Mohamad
B. Sc in Mathematics (1983)
M. Sc. in Mathematics (1989)

Supervised By

Prof. Dr.
Afaf A. Sabry
Professor of Applied Mathematics
University College of Women
for Arts, Science and Education
Ain Shams University, Cairo

Prof. Dr.
Mahmoud EL-Sayed EL-Boghdady
Professor of Applied Mathematics
Faculty of Science
Assiut University

Faculty of Science
University of Assiut
EGYPT
1996

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The development in understanding the behaviour of particles and the rules they obey was so quick during our century that it is quite essential to give a short review of the development of thoughts and new concepts leading to the present status.

After Newton, the important development was the discovery by Maxwell of his famous laws of electromagnetism, which at the same time described the electromagnetic waves as described by electric and magnetic vectors.

Relativity is in fact started as a result of considering the invaiance of Maxwell's equations in different systems. Lorentz showed that the only linear transformations between x,t and x',t' that keeps the form of Maxwell's equations are the Lorentz transformation, and not the Galilean transformations which kept Newtons equation invariant.

Einstein then the real basis of Relativity on defining the mass as the energy, and then by the discovery of the general relativity.[1]

Quantum mechanics was based on the concept that the motion of particles can not be followed, which was based on the Heisenberg uncertainty principle. This fact implied another more important concept for a system of identical particles. A state of N identical particles can not be differentiated quantum mechanically from a state when they interchange their positions. It follows that N! of what we call classical states originating from the total number of interchanges of the particles constitute only one

quantum state. This concept had a far reaching consequence in statistical mechamics, which was devoloped before the discovery of quantum mechanics. Originally Boltzman formulated the historically important law of finding statistically the absolute entropy of a system of particles as the logarithm of the total number of available states of the system. Applying his definition to the mixing of two portions of an ideal gas of identical particles led to the well known Gibb's paradox. This paradox was remedied artificially by dividing the calculated number of classical states by N!. At that time it was not known the physical reason for this, as quantum mechanics was not yet discovered. After the discovery of quantum mechanics, it is now a common practice to define the statistical states, as quantum states available to the system.
The development of quantum mechanics was so quick. It started by introducing a state function $\psi(\vec{x},t)$ which satisfies the Schrödinger equation, in which the momentum operator is defined as a differential operator

$$p = \frac{\hbar}{i}\frac{\partial}{\partial q}. \qquad (1)$$

The function ψ is complex, and its physical meaning comes from the definition of the charge and current densities, as is well known. The Heisenberg first quantisation rules came next:

$$pq - qp = \frac{\hbar}{i}, \qquad (2)$$

that the momentum operator satisfies this rule instead of the definition (1). In fact the definition (1) is satisfied by the more general definitition (2).

Pauli made the important concept of defining the state ψ as a