On the True Origin of Quantum Nature in Atoms: A Missing Story

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Abstract. The overlooked narrative about the origin of quantum nature in atoms primarily stems from a close examination of two sequential events from the past. The first event was Einstein's attribution of quantum characteristics to light waves in his effort to elucidate the photoelectric effect, which ascribed both a corpuscular and wave nature to light. The second event involved de Broglie's proposal regarding the wave nature of material particles, such as electrons, suggesting that they too possessed both corpuscular and wave characteristics. This advancement led to the emergence of a new branch of mechanics, termed quantum mechanics, which posits that the energy associated with any particle cannot be continuously altered but can assume a specific or some finite value, thereby endowing energy with a quantum form. This quantum nature of matter was perceived to arise from its dual wave-particle nature. It was later revealed that this mechanics exhibits a probabilistic character, which has sparked considerable debate among physicists. Essentially, the prevailing question at that time revolved around how electrons are stabilized within atoms and how these atoms can emit light waves of specific frequencies. In addressing this question, physicists, despite their limited resources, conducted high-quality experiments during the initial three decades of the 20th century, yielding significant conclusions. However, they occasionally overlooked critical signals obtained from these experiments. Had they not done so, the current understanding of physics might have been markedly different. This paper seeks to reassess those signals that were intermittently disregarded and constructs a comprehensive narrative regarding the potential impact they could have had on the evolving mechanics of that era, as well as the alternative perspective of physics that might have emerged from them.

1 Introduction

Quantum mechanics has always been a subject of controversy because its principles are counterintuitive, challenging our common understanding of a concrete and predictable reality. Major controversies arise from the probabilistic nature of quantum results, the idea of a wave function that represents real "ontic" properties or our "epistemic" knowledge, the influence of measurement and observation in shaping reality, and the difficulty in interpreting the deep implications of the theory, including quantum entanglement, for which many claims

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are being made. In particular, after the presentation of Bell's inequality theorem in 1965, the possibility of entanglement in quantum mechanics, which had been rejected as a ‘spooky action at a distance’ by Albert Einstein, Boris Podolsky, and Nathan Rosen in 1935, came into discussion for the first time after a long hiatus [1-2]. Under this influence, John F. Clauser and his student, Stuart Friedman, performed an experiment in 1972 that demonstrated a violation of Bell's inequality theorem, which was to affect the foundations of physics and was considered to have confirmed the predictions of quantum mechanics with certainty from which a very promising picture is being presented to the world today [3]. But along with that, some ups and downs are also coming to the fore, in which some research papers making claims in this regard have been retracted, while some articles expressing concern about this have also been published in renowned journals [4]. What accounts for all of this is the dual nature of radiation and matter, also known as wave-particle duality. There are two main reasons for the introduction of the concept of wave-particle duality into physics, one is the light quantum proposed by Einstein while explaining the photoelectric effect, which suggested that light has a corpuscular nature along with a wave, and the other is the wave nature of matter particles proposed by de Broglie, from the feeling that nature loves symmetry. And all this happened through the attempts to explain the photoelectric effect and the atomic structure and the spectrum of specific frequencies emitted by it. In fact, the photoelectric effect is an instantaneous effect, that is, instead of focusing on the forces exerted by the electric and magnetic fields in the light wave on the electrons and discovering that atoms emit waves of a certain frequency, that is, the electrons in them oscillate at a certain frequency, the progress made over the last century from wave-particle duality has now reached the stage of photon entanglement. Indeed, it is a universal fact that light waves cannot assume a corpuscular form, and conversely, no material particle of a corpuscular nature can be represented as a wave. Consequently, this paper re-examines the errors made in addressing the photoelectric effect and the aspects that were neglected in the comprehension of atomic structure. In fact, physicists of that era, despite their limited physical resources, conducted remarkable experiments and reached significant conclusions; however, certain crucial elements appear to have been disregarded. Had these been considered at the time, the current state of physics, as articulated in this paper, would reflect a narrative that is now missing.

2 Regarding Einstein's suggestion of light quanta in the context of elucidating the photoelectric effect and addressing certain unresolved questions associated with it

In 1905, Einstein initially presented the idea of a light quantum, which was referred to as a photon, a term coined by Lewis in 1926 [5-6]. At that time, the photoelectric effect was still an enigma, particularly because no one could elucidate why the kinetic energy of the emitted electrons was contingent upon the frequency of the incident light. However, in 1900, while addressing blackbody radiation, Max Planck introduced the notion of energy quantization, asserting that the molecular oscillators within a blackbody do not emit or absorb energy in a continuous manner, but rather in discrete packets or bundles [7]. Specifically, when the oscillator vibrates at a frequency ν, it will either absorb or emit energy in multiples of h□, where h is subsequently referred to as Planck's constant. This marked the inaugural instance of energy being articulated in relation to frequency. Similarly, in the context of the photoelectric effect, the kinetic energy of the photoelectron was also dependent on the frequency of the light. Naturally, Einstein, employing Wien's law and the concept of entropy, demonstrated that radiation of frequency ν confined within a volume behaves like particles whose energy is equivalent to hf. Thus, Einstein posited that light possesses both wave and particle characteristics, a notion that was not embraced for the subsequent two decades, yet it provided a crucial advantage in elucidating the photoelectric effect. At that juncture, he stated that in the photoelectric effect, an electron would absorb all or a portion of the energy from a light quantum, with some of that energy being utilized to liberate the electron from the metal surface, while the remaining energy would be transformed into the kinetic energy of the electron. This implies that if the electron absorbs the entire energy of the light quantum, it will be emitted or released with maximum kinetic energy. One thing to note from this is that according to Einstein, an electron can also absorb partial energy of a light quantum, so the kinetic energy of some electrons emitted in the photoelectric effect is less than that of the maximum kinetic energy. Nevertheless, this contradicts the quantum mechanical interpretation of the atomic absorption spectrum; nonetheless, it has not faced any challenges thus far. Quantum mechanics posits that when an electron in an atom jumps from the E_2 energy level to the E_1 energy level, it emits a photon of energy $h\nu$, as described by the following equation.

$$E_2 - E_1 = h\nu \qquad (1)$$

An electron can only go back from the E_1 energy level to the E_2 energy level by absorbing a photon of frequency ν in light. It is not possible for it to achieve this by absorbing a photon of frequency higher than ν. However, according to Einstein, if an electron is able to absorb some of the energy of a photon, it can do so by taking the necessary energy from a higher-energy photon. However, this phenomenon has not been observed experimentally. Later, no one thought about why this happens in the photoelectric effect itself. Numerous questions remain unanswered in Einstein's explanations, yet they are rarely addressed, such as the fact that no one understands the type of energy associated with a photon. From a scientific perspective, it is fundamentally incorrect to regard energy as a divine power and to believe that it can do anything. Once more, there is a lack of explanation regarding how the electron absorbs that energy or the mechanism employed in that process. Additionally, no one can provide a rational justification for why that energy transforms into the kinetic energy of the electron, nor can they explain why it does not convert into mass in accordance with Einstein's mass-energy equivalence, and why the overall mass of the electron remains unchanged. As a result, it is also unclear what type of energy is transformed into mass. This clearly indicates that there is a lack of understanding regarding the processes involved, yet it is astonishing how physicists maintain such unwavering confidence in the existence of light quanta or photons. Even when the energy of a photon is converted into the kinetic energy of an electron, it remains ambiguous who will ascertain the direction in which that electron will travel, a point that Einstein also did not clarify. Scientifically, it cannot be asserted that the electron can move randomly, meaning in any direction. Such a statement lacks validity. At this juncture, it is pertinent to reference the X-ray scattering experiment conducted by Compton in 1923, which is recognized as the Compton Effect [8]. Through this experiment, he demonstrated that X-rays behave similarly to billiard balls, for which he applied the principles of energy conservation alongside momentum conservation. It was from this experiment that Einstein's concept of the light quantum gained significance. The same principles are now applicable to the photoelectric effect; that is, when an electron absorbs the complete energy of a light quantum, it should also acquire the corresponding momentum. Consequently, the electron must initially move in the same direction as the light quantum. This means that the electron must first penetrate deeper into the metal with maximum kinetic energy as described in Fig. 1(a), making it difficult to forecast its future behaviour. But here all the electrons are seen to be coming out of the metal surface in the opposite direction to the light quantum as described in Fig. 1(b), which means that someone is taking them out and no one knows about it yet. Nevertheless, such an unwavering belief in light quanta is indeed a very serious matter. Indeed, it is a universal truth that light is a wave, so it can never take on particle form, and everyone should have stuck to this idea, but everyone's mind was wavering. If high frequency light seems to be behaving like a particle in some cases, then it should have been found out why it is doing so, but instead of doing so, on the contrary, it seems that a great deal of effort has been made to make light take on particle form. Einstein had theoretically demonstrated that light displays a corpuscular nature at high frequencies, specifically within the Wien's limit, while it exhibits a wave nature at low frequencies, particularly within the Rayleigh-Jean's limit [5]. But the use of an X-ray diffractometer to gather information regarding the crystal structure of a compound relies on the assumption of the wave nature of X-rays [9-10]. That is, those X-rays exhibit corpuscular nature in one instance and wave nature in another, which means that Einstein's claim, is also meaningless. This indicates that in elucidating certain phenomena, the characteristics of electromagnetic radiation have been assessed according to the benefits of its wave or particle nature, which is an incorrect perspective.

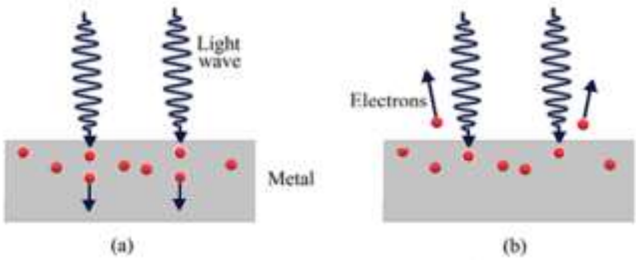

Fig. 1. Photoelectric effect, (a) the expected movement of the electrons according to the principle of momentum conservation, (b) the movement of the electrons observed in the actual experiment.

Certainly, the focal point of the light quanta theory was the photoelectric effect, and as previously mentioned, it is crucial to comprehend the precise mechanisms at play. One aspect that is evident from the preceding discussion is that in this phenomenon, someone is pulling these electrons out of the metal surface. Light is an electromagnetic wave, which means that electric field and the magnetic field within it can pull electrons out, but despite knowing this, no one has ever studied it, which would be an extremely rare example in scientific history. However, there has been a recent shift in thinking towards a more appropriate direction, highlighting several key elements for the first time [11]. Nonetheless, it is essential to revisit this topic to illuminate further significant aspects. Primarily, it prompts the inquiry of whether electrons possess a charge. Because, if the electric field within an electromagnetic wave applies a force on the electron, then, since forces are inherently mutual, the electric field of that electron must also exert a force on the electric charge associated with the electric field in that wave. However, there is no electric charge present with that wave, and thus the force must arise mutually. This implies that the electric field of the electron must exert a force on the electric field of that wave. If this holds true, then the electric field in that wave must likewise exert a force on the electric field of that electron. Consequently, this suggests that the electric charge does not contribute to the electric force, meaning it cannot be definitively stated that there is a charge on the electron. This indicates that the observed repulsion between two electrons stems from the interaction between the electric fields of those electrons, a concept that has not been previously considered. The oversight of many such factors may have caused classical mechanics to lag behind. Had these ideas been elucidated over time, perhaps the two branches of physics, classical and quantum, would not have emerged as separate entities. The universe cannot behave differently at varying levels.

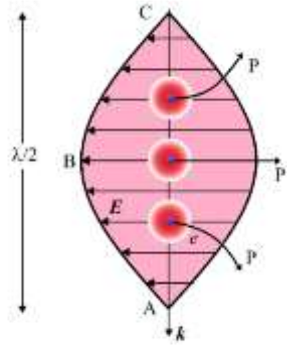

Fig. 2. Depiction of the interactions between the electric field of a light wave and the electric field of an electron in the photoelectric effect, along with the resulting movements in various regions of the wave's electric field.

In the photoelectric effect, it was necessary to verify how a light wave (electromagnetic wave) of a specific frequency and amplitude can interact and displace electrons on a metal surface in a sequential manner, which has not been considered much so far. Since the electron is initially stationary, it will be appropriate to consider only the electric field in that wave for investigation. Consider such a light wave with a wavelength of λ and amplitude of E_0 that strikes a metal surface, progressively interacting with the electric field of an electron located on that surface, as illustrated in Fig. 2. However, since the force arises from the interaction of two electric fields, it is necessary to consider the area of effective electric field in the light wave and also around the electron, so that the electric force between them can be understood from the interaction of the two fields. Therefore, in the figure, both fields are shown shaded. The arrows in the light wave only show the direction of the electric field in that region, and their length shows the average strength of the electric field at that location. However, such arrows have not been shown in the electric field of electrons, but are assumed there as well. How much and in what way the area of effective electric field of a light wave or an electron can be considered is still a matter of research. For now, the form shown in the figure seems sufficient to understand the subject. Initially, examining the electric field in the segment AB, which is asymmetric around the electron, will show that the electron must be pushed along a curved path, that is, down into the metal, so that no photoelectric effect occurs in this region. If the electric field at point B interacts with the electric field of the electron, the electron will be pushed parallel to that field line, that is, parallel to the metal surface, which will not cause any photoelectric effect in this area. However, if the electric field in section BC interacts with the electric field of the electron, it can push the electron away from the metal surface, which will cause a photoelectric effect in this area. In this case too, the electron follows a curved path, which shows that two forces must be present; one of these is the effective electric force, which must act in the opposite direction to the electric field of the wave and be proportional to the amplitude of that electric field as described in Fig.3. The second force that changes the direction of the electron must be perpendicular to the electron's velocity and inversely proportional to the wavelength, which is called the apparent force [11]. The combined work done by these two forces to remove the electron from the metal surface will be proportional to E_0/λ or νE_0 as frequency is inversely proportional to the wavelength. Some of this work will be spent in freeing the electron from the metal and the rest will exist in the form of kinetic energy, so the equation for the photoelectric effect can be given the following equation.

$$kE_0\nu = W_0 + K.E. \tag{2}$$

where k is a proportionality constant.

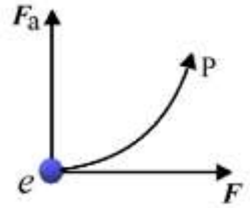

Fig. 3. Depiction of the potential movement of the electron in the photoelectric effect influenced by two forces: an apparent force, $\boldsymbol{F}_a$, and an effective electric force, $\boldsymbol{F}$.

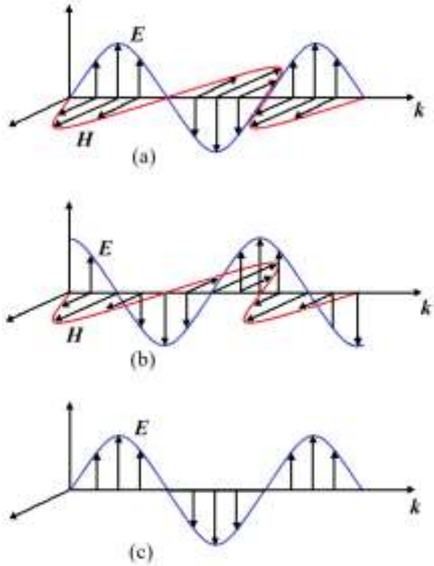

Fig. 4. Structure of electromagnetic wave according to (a) formal electrodynamics, (b) the nature of apparent force, and (c) in reality, electromagnetic waves in space will only have an electric field.

Equation (2) can be referred to as a purely empirical equation that illustrates this trend when viewed through the lens of classical theory. While deriving this equation, it was assumed that work is the product of force and distance. Therefore, the maximum force applied by that light wave should be eE_0, so naturally the maximum work done on the electron should be proportional to the amplitude of the electric field in that wave. Further, the direction of the kinetic energy gained by that electron should be parallel to that electric field. But due to the apparent force, the direction of that velocity changes and the rate of its change depends on how small the wavelength of that light wave is or how high the frequency is. Therefore, the work done to pull that electron out of the metal surface should be proportional to νE_0. Certainly, it has not yet been established the distance up to which that electric force influences the electron. It is possible that comprehensive understanding will only be achieved following the generalization of electric forces via field-field interactions, which could potentially be a complex issue. However, Einstein's equations do not include E_0, but one thing should be noted that it is the amplitude of the electric field in the light wave generated due to the oscillations of an electron in the atom. It is our belief that light waves are generated by the transition of electrons within atoms, a notion that is incorrect. If an atom emits light waves of a specific frequency, it follows that at least one electron within that atom must oscillate at the frequency of that wave. Further, the electric field of any electron is always constant and the same, consequently, the amplitude of the electric field in the light wave created by it may be constant and the same for every light wave, whatever may be its frequency. This means that kE_0 can be equal to the product h, and it is now very satisfying that Planck's constant is being linked to some physical thing, otherwise h would have had no basis until now. Further, when Einstein says that in the photoelectric effect, an electron absorbs one light quantum at a time, then of course only one light wave can interact with an electron at a time, which is probably giving a very important signal, otherwise Einstein's mere statement would have no meaning.

2.1 Relation between apparent force and magnetic force

Since the apparent force merely alters the direction of the electrons, it can indeed be classified as a magnetic force. The reasoning for this is that only one type of field should be produced in the space, as a field essentially represents a form of pressure within that space. If we designate that pressure as an electric field, then it precludes the existence of any other fields, whether magnetic or gravitational. However, this consideration has never been taken into account. If the existence of ether had been proven by the Michelson-Morley experiment, this idea would certainly have come up [12]. Even if the existence of ether had not been proven, there can only be one type of pressure and only its wave in space, which is already referred as the electric field, so the magnetic field cannot exist independently, and this is also evident from the above explanation. Furthermore, as the apparent force increases with frequency, if the frequency of any electromagnetic wave increases, the magnetic force exerted by it should also increase, which may be the main reason for the photoelectric effect. Moreover, where the electric field in the wave is high, the apparent force is zero, which means that the magnetic force must also be zero. This means that in any electromagnetic wave there should be a phase difference of 90 degrees between the electric field and the magnetic field, as shown in Fig. 4(b), but according to conventional electrodynamics, it is assumed that the phase difference between the two is zero, as shown in Fig. 4(a). Since the magnetic effect is the result of an asymmetric electric field, the electric field will exist only in the so-called electromagnetic wave, as shown in Fig. 4(c), which eliminates the question of the existence of magnetic monopoles, which is the subject of much effort and discussion. Furthermore, in photon entanglement experiments, the polarization of the photon is said to be measured, but in reality, only the polarization of the electric field is measured, so it is important to seriously consider what can be achieved from this. Considering the seriousness of this problem, it is necessary to experimentally verify whether the magnetic force increases with increasing the frequency of any electromagnetic wave and whether there is a 90-degree phase difference between the electric field and the magnetic field. This would prove that light has only a wave nature and would be the first refutation of de Broglie's dual nature hypothesis. This would have occurred much earlier had Einstein not introduced the concept of light quanta. However, it is futile to hold Einstein accountable for this. Physicists ought to have taken into account what their intuition suggests, unfortunately, the same thing is happening even now.

2.2 The possibility of the existence of apparent force (magnetic force) in terms of the interaction between electric fields

It is observed that the electric force emerges from the interaction of two electric fields, prompting the inquiry into the nature of the interaction between these fields that could account for the generation of the apparent force, which behaves like a magnetic force. Indeed, when two electrically charged particles, such as electrons, are stationary, there exists solely an electric force between them, which must arise from the electric fields of the two electrons that are purely radial, meaning divergent, or possess a non-zero curl. However, when these electrons are set into motion, an additional force, referred to as magnetic force, manifests between them when their electric fields acquire a tangential component, a parallel component, or a non-zero curl component. This clearly indicates that the electric force must arise from the interaction between the radial components of the two electric fields of the electrons, while the magnetic force must result from the interaction between their parallel or tangential components of the electric fields. This implies that if two independent electric fields are interacting with one another, then two forces can exist between them. If they have non-zero divergent components in their electric fields, they will experience an electric force. Conversely, if they have non-zero curl components in their electric fields, they will experience what is termed magnetic force. If both types of components are present in their electric fields, they will simultaneously experience both types of forces. In fact, its roots are very deep but it has never been considered otherwise the true nature of the magnetic field would have been realized. In the photoelectric effect, when an electron is accelerated by the electric field present in a light wave, it develops a tangential or parallel component in its electric field. Given that the electric field of light already possesses a parallel component, the interaction between these two must result in an apparent force, or magnetic force, which is always directed perpendicular to the electron's velocity, causing the electron to trace a curved trajectory. Furthermore, if the electric field of a light wave is capable of accelerating an electron, it becomes crucial to investigate how this occurs. The initial significant step in this investigation is to conduct experimental tests to determine whether the applied magnetic force intensifies with an increase in the frequency of the electromagnetic wave and whether there exists a 90-degree phase difference between its electric and magnetic fields [11]. This will clarify numerous misconceptions about magnetic fields and magnetic forces in physics.

2.3 Robert Millikan's experiment on photoelectric effect

Indeed, the quantum hypothesis regarding light, introduced by Einstein in 1905, faced scepticism from physicists for almost next two decades. Among these sceptics was Robert Millikan, who initially doubted Einstein's photon theory and undertook experiments aimed at refuting it, as he believed it contradicted the established wave theory of light. Between 1914 and 1916, he carried out a series of meticulous experiments intended to accurately determine the correlation between the frequency of incident light and the maximum kinetic energy of the emitted photoelectrons [13]. Despite his initial reservations, the experimental findings aligned perfectly with Einstein's predictions, thereby validating his photoelectric equation. Consequently, his experiments are regarded as pivotal in shaping the contemporary understanding of quantum mechanics, marking a shift in physics from a classical framework to a more comprehensive, quantum-oriented perspective of the subatomic realm. In fact, the fundamental question before Einstein's photoelectric equation was how, despite the wave nature of light, the energy of a photoelectron was affected by its frequency. However, everyone, including Millikan, stuck to the idea that increasing the intensity of light would result in a corresponding increase in energy, suggesting that the energy of the photoelectron should also increase. But Einstein had said that in the photoelectric effect, an electron absorbs the energy of one light quantum at a time and only if it is sufficient does it escape the metal surface. Again, electrons in a metal at room temperature are never stationary, meaning that electrons absorb light quanta even when they are in motion. If an electron absorbs a light quantum and its total energy is not sufficient to escape the metal surface, it can immediately absorb a second or even a third light quanta and escape the metal surface. There is no discussion anywhere about why this does not happen according to Einstein's hypothesis. In fact, the so-called apparent force or magnetic force in that light wave is what pulls the electron out and if it is not sufficient, then that electron keeps oscillating parallel to that metal surface according to the frequency of that wave. The question is whether in the photoelectric effect, one electron can interact with a single light wave at a time and whether the amplitude of the electric field in the light wave emitted by any atom is the same. Investigation is required in this direction.

3 Regarding various important but often overlooked aspects in the process of developing the atomic model

In 1923, French physicist Louis de Broglie proposed that matter, like light, exhibits wave-particle duality, underpinning an alternative view to Einstein's quantum theory of light. This theory had a significant impact on the evolution of the atomic model and the fundamental principles of physics as a whole. Consequently, the present condition of physics is increasingly leaning towards quantum mechanics; however, the intricacies of the quantum realm remain elusive not only to the general public but also to the majority of physicists. To ascertain if any errors have occurred, it is crucial to revisit the experiments and findings of physicists who endeavoured to decode the atomic structure and the radiation it either emits or absorbs. It is essential to consider any clues they might have missed during their investigations. Actually, the current quantum atomic model has been established through a sequence of scientific advancements made by physicists. In the early 1800s, John Dalton introduced the indivisible particle theory. Then, in 1904, J.J. Thomson proposed the plum pudding model, which included embedded electrons following his discovery of the electron. In 1911, Ernest Rutherford introduced an atomic model following his experiment involving the scattering of alpha particles through a thin sheet of gold foil. This experiment revealed a compact, positively charged nucleus encircled by lighter negatively charged particles referred to as electrons. Subsequently, in 1913, Niels Bohr improved this model by proposing that electrons reside in distinct energy levels surrounding the nucleus. The modern quantum mechanical model was established in 1926, after de Broglie's introduction of wave-particle duality. At this juncture, it would be appropriate to revisit the experiments and conclusions drawn from Rutherford's first proposal of the atomic model in 1911 and the subsequent journey, since there appears to have been little change until Thomson's discovery of the electron.

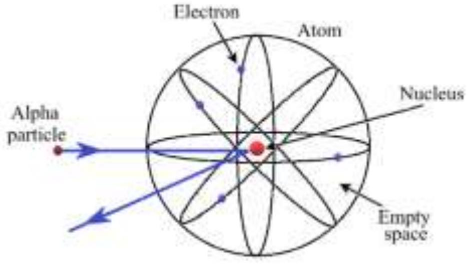

Fig. 5. Rutherford's atomic model illustrating a heavy positive nucleus situated at the centre of the atom, with electrons orbiting around the nucleus.

It is clearly evident that the experiments carried out by Rutherford in collaboration with his associates Geiger and Marsden, between 1906 and 1909, significantly contributed to the understanding of atomic structure [14]. They discovered that when alpha particles were directed at a thin sheet of gold foil, only one or two out of approximately eight thousand were deflected or bounced back. From this observation, Rutherford inferred that atoms possess a significant amount of empty space and that nearly all of their mass, as well as the total positive charge of the atom, is concentrated in the nucleus, the central part of the atom, where the alpha particles were deflected upon impact. Naturally, since atoms are electrically neutral, it was presumed that an equal number of negatively charged particles, known as electrons identified by J. J. Thomson, would be arranged around the nucleus within the atom.

Consequently, the immediate question that emerged was why the electrons did not spiral into the nucleus. At that time, there was a comprehensive understanding of planetary motion, leading to the assumption that electrons in atoms would also orbit in such a manner that their forces would be balanced, as illustrated in Fig. 5, thereby ensuring the stability of the atoms. However, if the electrons were to continue their orbital motion, they would emit energy, which would cause them to decelerate and ultimately fall into the nucleus.

In 1913, Niels Bohr introduced the idea of stationary orbits to address the issue while examining the hydrogen atom [15]. He proposed that the hydrogen atom possesses stationary orbits where the electron does not emit energy as it moves, with the orbital angular momentum of the electron being an integral multiple of $\underline{h}/2\pi$. However, this notion was met with scepticism because the electron generates its own electric field, and if it rotates in an orbit, this electric field would create ripples around the nucleus, which would propagate as electromagnetic waves. Consequently, the electron's speed would diminish, ultimately leading it to spiral into the nucleus. Thus, the creation of ripples during the electron's rotation in any orbit rendered Bohr's concept of stationary orbits unacceptable. Nevertheless, Bohr had a compelling argument that he had successfully predicted the spectra of the hydrogen atom based on this concept. Although Bohr himself did not support the existence of stable orbits until 1926, the prevailing belief, at least until that year and still today, was that electrons in atoms travel in orbits, which is fundamentally wrong. If all electrons in atoms were to move in orbits, or even if they were described as waves in accordance with quantum mechanical principles, it would be impossible for solid matter to be composed of such atoms. Indeed, Rutherford's findings indicated that electrons within atoms do not travel in orbits; however, at that time, he and others subsequently overlooked this fact. When deducing the size of the nucleus in relation to the atom, Rutherford remarked that if the atom were scaled to the size of a cathedral, the nucleus would merely be the size of a fly, highlighting the significant amount of empty space present within the atom [16]. Furthermore, during a lecture in 1936, he remarked, "It was almost as incredible as if you fired a 15-inch shell at a piece of tissue paper and it came back and hit you". This illustrates that despite the alpha particles colliding with the nucleus with considerable force, the nucleus remains stationary, as illustrated in Fig. 5. Nevertheless, he entirely disregarded the implications of this observation. This suggests that, on one hand, there exists a complete vacuum within the atom, indicating that the nucleus is suspended at the atom's centre, and even when alpha particles impact it, it does not shift. Therefore, it is perplexing why the question of what is keeping it in place did not occur to Rutherford. There must exist a certain force, which remains fixed in position and simultaneously stabilizes the nucleus. The foil was composed solely of electrons and nuclei, indicating that one or both of these components must be responsible for maintaining the nuclei's stability in relation to one another. If one considers nuclei, there is repulsion between them, so they will scatter, so the file could not survive. There is attraction between electrons and nuclei, and there is repulsion between electron-electron and also between nucleus-nucleus, so if the electrons are distributed properly in the space between the two nuclei and all the forces are balanced, then the foil can remain stable. However, if electrons continue to orbit around atomic nuclei, this scenario becomes unfeasible, marking the initial indication that the notion of electrons moving in orbits is flawed. Consequently, the idea that electrons travel in orbits had to be discarded, or at the very least, it should have remained a topic of discussion, which unfortunately did not occur. Even had this realization taken place, the issue would not have been resolved, as all the positive charge of the atom was concentrated within the nucleus, while the total negative charge was spread out in the form of electrons. Thus, the nucleus could have easily attracted the lighter electrons, incorporating them into itself. Therefore, there was a necessity for an additional force to maintain the electron’s distance from the nucleus, yet at that time, no one was aware of such a force. Consequently, the notion that electrons travel in orbits within atoms became widely accepted, which Bohr utilized while formulating the hydrogen atom model. In this context, he suggested that in addition to the concept of stationary orbits, when an electron transitions from an outer orbit to an inner orbit, the energy difference is transformed into an electromagnetic wave. The frequency of this wave is determined by dividing the energy difference by Planck's constant, h. Bohr's proposal was both astonishing and peculiar. Firstly, the idea of stationary orbits was not widely accepted, and secondly, during the emission of a hydrogen spectrum, the electrons did not need to oscillate at that frequency, a point even Einstein had indicated at the time, suggesting that Bohr would not dare to make such a claim. Nevertheless, by making this assumption, Bohr was able to articulate the emission and absorption spectra of the hydrogen atom. This occurred after Einstein introduced the corpuscular nature of light waves in 1905, marking the first significant upheaval in physics. When electrons in a hydrogen atom transition from an outer orbit or higher energy level to a lower energy level, or inner orbit, their energy difference is converted into electromagnetic waves, representing a second major upheaval in physics. Prior to this, physicists believed that if an atom emitted electromagnetic waves of a specific frequency, then something, namely electrons, must oscillate at that frequency. However, Bohr contended that this was not a necessity. However, Bohr's atomic model was capable of explaining the spectra observed in experiments, leaving him with no alternative, which led to widespread confusion. Nevertheless, this model matched experimental findings, leading to widespread belief in its validity. Naturally, scientists tend to assume that if a proposed model corresponds with experimental results, there must be some truth to it. The strength of this assumption is exemplified by a statement made by Feynman in 1965. He quoted that, "It doesn't matter how beautiful your theory is, it doesn't matter how smart you are. If it doesn't agree with experiment, it's wrong" [17]. Bohr's proposal represented a departure from the traditional assumptions of physics, emphasizing the notion that unusual phenomena must be occurring at the atomic level. Indeed, the concept that electrons travel in orbits within atoms was contested by an alternative idea, yet it did not receive significant attention. A helium atom contains two electrons, and its overall magnetic moment is zero, indicating that the electrons ought to be orbiting in the same path at equal speeds but in opposite directions. Consequently, as they complete one orbit, they should approach each other twice. However, due to the intense repulsion between them, at that moment, they should be distancing themselves from one another, meaning they cannot simultaneously orbit in opposite directions under any circumstances. Nevertheless, the notion that their net magnetic moment is zero, suggesting they should not be orbiting, should have been considered, yet it was overlooked. The orbital motion results in electrons possessing orbital magnetic moments. Nevertheless, there was a lack of agreement among scientists regarding how the net orbital magnetic moment of paired electrons could equal zero. In other words, physicists of that era were more focused on the implications of mathematical equations than on the actual physical processes occurring within atoms. Since Bohr's model could only measure the absorption and emission of light by atoms at specific optical wavelengths, leading physicists of the time tested and refined it for heavier atoms; they began to notice signs of even more strange phenomena, which made it clear that, in addition to orbital quantization, the orbital angular momentum component of the electron must also be quantized in a specific direction. Specifically, Bohr's model suggests that an electron in the lowest energy orbital is expected to have only two angular momentum values along any direction. These values would be oriented in opposite directions in space, with no intermediate values permitted, a phenomenon known as space quantization. This phenomenon was regarded as even more unusual than orbital quantization. Nevertheless, the German physicist Otto Stern found himself perplexed by the electron's orbital motion in 1916. He was also a critic of the Bohr model, particularly concerning space quantization, to the extent that he stated he would abandon physics if it were proven to be correct. To investigate the idea of space quantization, he designed an experiment with fellow German physicist Walther Gerlach, in which they vaporized silver in an oven and directed its beam through an inhomogeneous magnetic field, as illustrated in Fig. 6(a) [18]. A silver atom contains a total of 47 electrons, with the last one being unpaired, resulting in its net magnetic moment being perpendicular to the plane of the orbit in which the electron is moving, according to Bohr's assertion.

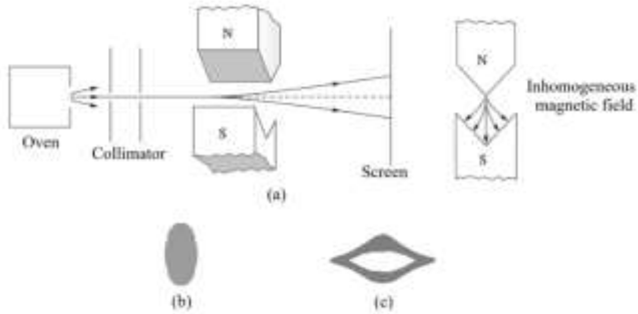

Fig. 6. Depiction of the Stern-Gerlach experiment, (a) the experimental configuration, (b) anticipated outcome of the silver beam exposure, (c) the experimental exposure obtained.

Given that the orbital angular momentum of that electron is oriented randomly, the direction of the magnetic moment should also be random, leading to the expectation that the beam of silver atoms would disperse in a vertical line, as depicted in the Fig. 6(b). However, if the angular momentum demonstrates space quantization, the beam should only separate into two distinct spots, as shown in the Fig. 6(c). They encountered numerous obstacles in acquiring precise experimental outcomes. Nevertheless, after conducting additional experiments, they discovered in 1922 that the beam was indeed divided into two, thereby validating Bohr's concept of spatial quantization of angular momentum. In 1925, Georg Uhlenbeck and Samuel Goudschmidt, while elucidating certain unclear aspects of the atomic spectrum, proposed that electrons within atoms possessed an additional form of motion, termed spin, alongside their orbital motion [19]. This indicated that electrons rotated around their own axes while simultaneously orbiting the nucleus. They further clarified that the findings of the Stern-Gerlach experiment were attributable to the spin of the electron rather than its orbital motion. To this day, no one can properly imagine what the space quantization of the spin of an electron in an atom would look like physically. Therefore, it is considered a mathematical concept, even if it results in the physical splitting of the silver beam. To elaborate, J. J. Thomson first identified the electron in 1897, and both Rutherford and Bohr posited that it orbited the nucleus within atoms. It was not until 1925 that the concept of spin motion was recognized, which later came to be regarded as an intrinsic characteristic of electrons. Initially, it was thought that the orbital motion of unpaired electrons contributed to the net non-zero magnetic moment, which was deemed the origin of the magnetic field in matter. However, following the discovery of electron spin motion, it became evident that this motion was the actual source of the magnetic field in matter. In reality, magnetic fields physically exist and necessitate the physical movement of charged particles for their generation. Regrettably, due to advancements in quantum mechanics, the spin motion of electrons was not acknowledged as a physical motion but rather as a quantum mechanical attribute. Indeed, the spin motion of unpaired electrons in a silver atom, particularly its magnetic moment, resulted in the splitting of a silver beam into two segments. In the same experiment, however, if an electron beam is utilized in place of a silver beam, it will be observed that it does not divide into two. This suggests that electrons do not exhibit spin motion when they are located outside the atom. If this statement is proven correct, the development of physics will suffer significant consequences for the rejection of this idea. Indeed, if electrons in an electron beam had spin motion, television technology relying on CRTs would not have worked, a fact that J. J. Thomson and his contemporaries would have recognized. Consequently, if electrons were to be in spin while in the atom, it was necessary to determine the fundamental cause; however, this was not pursued. It had been clear from the previous analysis that electrons should not be moving in orbits within atoms. Thus, the idea that they could remain stationary at a fixed distance from the nucleus due to spin motion should have been recognized and explored, but was nevertheless ignored. But this same concept was initially proposed in the 'spin atomic model', the difficulties of which are explained in the following sections.

4 Expected internal structure of a helium atom

The helium atom is the simplest and smallest atom containing two protons and two neutrons in its nucleus, along with two electrons, that are distributed around the nucleus. Since its electrical and magnetic properties are known, it is possible to speculate about its internal structure. If these two electrons were to orbit, as previously discussed, for their overall orbital magnetic moment to equal zero, according to the classical electrodynamics, they would need to orbit in the same path and at the same speed but in opposite directions as described in Fig. 6. However, due to the repulsion between them, this scenario is never feasible, thus negating the notion that electrons in helium atoms can orbit. Thus, classical mechanics clearly states that if the net orbital magnetic momentum of paired electrons is zero, they cannot be in orbital motion. It remains unclear why the observation that a helium atom possesses merely two electrons, which are said to form a pair, along with its net magnetic momentum being zero, implies that the electrons within it cannot be in orbital motion was overlooked. From this it should have been understood that if paired electrons cannot move in orbits, then unpaired electrons also cannot move in orbits. Therefore, it was necessary to consider how they could remain stationary at a certain distance from the nucleus even when they were not moving in orbit. In particular, it is the unpaired electrons in atoms that give matter its magnetic properties, and if those electrons were not in orbital motion, it was necessary to consider whether they had any other motion responsible for giving the electrons a magnetic moment, and if so, the question arose as to whether they had spin motion. But in 1925, Uhlenbeck and Goudsmit, while reinterpreting the Stern-Gerlach experiment, explained that electrons have spin motion, which was assumed to be an intrinsic property because of which they got inherent magnetic momentum called spin magnetic momentum. At a minimum, it should have been acknowledged that the electrons within helium atoms are also engaged in spin motion, resulting in a combined spin magnetic moment of zero. Consequently, these electrons must be in spin motion in opposite directions along the same axis, moving at the same speed, as illustrated in Fig. 8. In a real helium atom, these two electrons are expected to be stable along the same axis, positioned at equal distances from the nucleus, exhibiting opposite spin motion, as depicted in Fig. 9. Furthermore, when electrons are in a state of spin motion, they do not produce any electromagnetic radiation, which indicates that no electromagnetic energy is emitted, thereby keeping their spin motion unaffected, a situation that cannot be attained during orbital motion. Now here something new would have come forward that would have given a new turn to the development of the atomic model. Now reconsidering the forces acting between the nucleus and electrons of the helium atom, there exists a strong attractive force between the nucleus and the electron, contrasted with a relatively weak repulsive force between the electrons, since the distance between the electrons is twice that of the distance between an electron and the nucleus. Naturally, the net force cannot equal zero, resulting in a significant likelihood of the electron falling into the nucleus. However, it is important to note that due to the opposite spins of both electrons, a magnetic repulsion is generated between them, which intensifies as the speed of their spin motion increases. Therefore, if the net attractive force and the net repulsive force, which now includes both electric and magnetic components, are balanced at a specific distance and a particular spin speed of the electron from the nucleus, the system, namely the helium atom, will achieve stability. The cumulative net electric field and the cumulative net magnetic field of this system will equal zero, which is essential for a stable atom as described in Fig. 9. Nevertheless, it has been observed that electrons lack spin momentum when they are outside the atom. To comprehend why they gain spin motion only upon becoming part of atoms, it is important to first examine how the elementary particles in a helium atom can be assembled during formation.

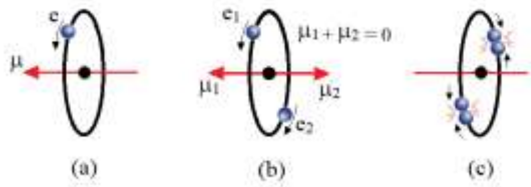

Fig. 7. An illustration demonstrating that the net orbital magnetic momentum of paired electrons is zero, necessitating that these electrons travel in the same orbit but in opposite directions at equal speeds.

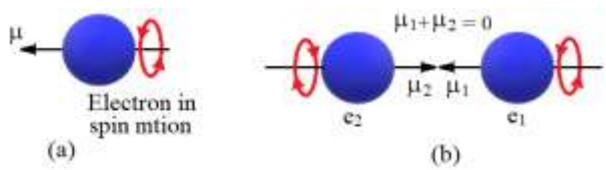

Fig. 8. An illustration that shows the net spin magnetic momentum of paired electrons is zero, which requires these electrons to spin on the same axis but in opposite directions at equal speeds.

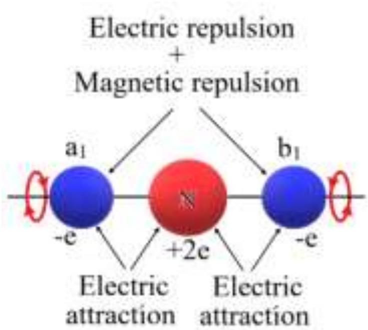

Fig. 9. The essential internal arrangement of a helium atom required to attain a net magnetic moment of the paired electrons is zero, while illustrating all possible forces involved.

4.1 Regarding the actual formation of a Helium atom

The aim of this section is to comprehend how electrons can accumulate around the nucleus of a helium atom, a scenario that has not been previously discussed. Typically, helium atoms are generated in the core of stars, or their nuclei are released from a radioactive atom, referred to as an alpha particle, which subsequently may convert into a helium atom. Given that its nucleus comprises two protons and two neutrons, it requires two electrons to maintain electrical neutrality, thus those electrons in proximity will be attracted towards it. If only one electron is situated very close to the nucleus, it will be drawn in and may fall directly into the nucleus, potentially resulting in the transformation of one proton into a neutron and the disintegration of the nucleus; however, detailed information regarding this phenomenon is currently lacking. Conversely, if two electrons are simultaneously attracted towards the nucleus, they will be drawn in opposite directions due to the repulsion that exists between electrons. As illustrated in Fig. 10(a), as the electron nears the nucleus, the attraction between the nucleus and the electron intensifies; concurrently, the repulsion between electrons also escalates. To reduce this electrical repulsion, both electrons will be triggered into opposite spin motions, which represents a crucial phase in the process of formation of atoms. Had this not occurred, atoms would not have formed. However, due to their spin motions, magnetic repulsion will now arise between the two electrons. As these electrons draw closer, the electrical repulsion between them will heighten, prompting an increase in their spin speed, which in turn will amplify the magnetic repulsion. Simultaneously, this spin motion will cause a reduction in the radial component of the electron's electric field while increasing the tangential component, leading to a decrease in the attraction between the electron and the nucleus, although the electrical repulsion between the electrons will also diminish.

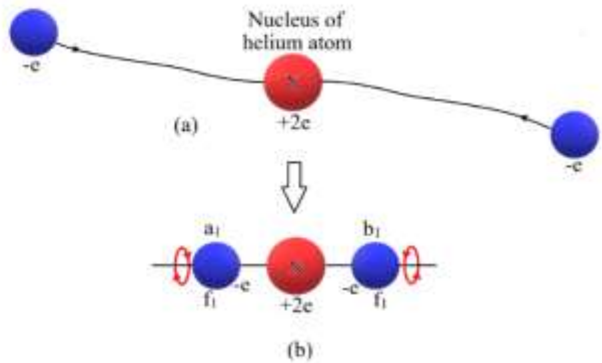

Fig. 10. Depiction of the formation of a helium atom. (a) Electrons are drawn towards the nucleus to achieve a net electric field of zero in the core of stars. (b) Electrons stabilize at equivalent positions from the nucleus, located on opposite sides.

A comprehensive mathematical analysis of this phenomenon remains to be conducted. If the attractive force between the electron and the nucleus surpasses the net repulsive force between the electrons, the electrons will again approach the nucleus, resulting in an increase in their spin speed and further magnetic repulsion. This process will eventually reach a point where the net attractive force between the electrons and the nucleus balances out the net repulsive force between the electrons, allowing the electrons to settle in their respective positions, as shown in Fig. 10(b), from which a helium atom will be formed. The locations at which the electrons achieve balance are known as the equilibrium points of the electron, situated at equal distances from the nucleus. In the ground state of the helium atom, both equilibrium points will be situated at a minimum yet equal distance from the nucleus. At this juncture, the electron will not require any orbital motion to maintain its position, and no energy will be released. Another thing that is given great importance in atomic physics is the spin up and spin down configuration of the electrons. In this situation, when an electron is viewed from outside the atom toward the nucleus, if it is rotating clockwise, it can be said to be in a "spin up" state in which the direction of its magnetic moment is toward the outside of the atom. And if it is rotating counterclockwise, it can be said to be in a "spin down" state in which the direction of its magnetic moment is toward the inside of the atom. In a helium atom, both electrons can be in either a spin down state or a spin up state. That is, when two electrons form a pair in an atom, both electrons will be in either a spin up state or a spin down state.

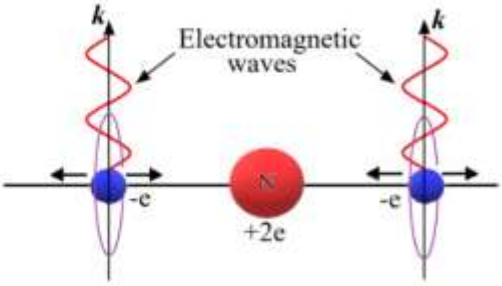

Fig. 11. A depiction of electromagnetic waves produced by the oscillations of paired electrons within a helium atom.

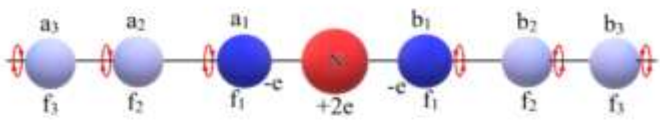

Fig. 12. In helium atom, electrons may be able to stabilize at various but equivalent positions from the nucleus, located on opposite sides, utilizing permitted different spin velocities.

4.2 Origin of Quantum nature and possible way of emission and absorption of spectra

In a helium atom, there are four forces to balance the two electrons: a total of two attractive forces acting between each electron and the nucleus, and two repulsive forces acting between the electrons, consisting of an electric repulsive force and a magnetic repulsive force. Due to some external interference, such as an increase in temperature or some other cause, when electrons are displaced from their balance points towards the nucleus, the electric repulsion force increases. To reduce it, the speed of spin rotation of these electrons increases, which increases the magnetic moments of both electrons, which in turn increases the magnetic repulsion between them. However, as the radial component of the electron's electric field diminishes, the attractive force also decreases alongside the electric repulsive force. Nevertheless, due to the increased magnetic repulsive force, these electrons will be driven back towards their balance or equilibrium positions. However, due to the mass of the electrons, they have gained momentum, meaning that the electrons will continue to move forward without stopping at the equilibrium points. As a result, the electric repulsion force between the electrons decreases, which in turn reduces their rotational speed, which in turn reduces the magnetic repulsion between them. As a result, the electrons are pulled back towards the equilibrium points, specifically the nucleus. Thus, both electrons oscillate radially around their respective balance points. To establish the equation for the effective force exerted on the electron, it is essential to first derive the equations for the four pertinent forces, a task that has yet to be accomplished and is expected to be quite challenging in light of a new comprehension of atomic structure. Nevertheless, this will represent a significant advancement in the understanding of atomic structure. This effective force will decide at what frequency the electrons can oscillate around that point which will be the natural frequency of oscillation of those electrons at that balance point. These oscillations will be simple harmonic oscillations. Again, as the electrons oscillate, they will both approach the nucleus at the same time and both move away at the same time, meaning their motions will be synchronized. When the electrons oscillate, since the electrons have their own electric field, they will produce ripples of the electric field, which will propagate in the form of an electromagnetic waves as shown in Fig. 11. These waves will propagate in a circular ring form around the balance point in a direction perpendicular to the axis on which the electron is oscillating. These waves produced by the two electrons will have a phase difference of 180 degrees. As the wave propagates, its amplitude should be inversely proportional to the square of the distance of the field point from the mean position of the oscillations of the electron. However, due to some particular environment, which requires further research, if such a wave propagates in one direction, i.e. in the form of a light ray, its amplitude should not decrease no matter how much distance it travels in space. If the helium atom is in its ground state, points a_1 and b_1 will represent the initial balance points of the electrons, with f_1 denoting their natural frequency of oscillation. Experiments have demonstrated that the helium atom can emit electromagnetic waves at multiple specific frequencies. Therefore, as shown in Fig. 12, the two electrons in this atom can balance at certain points at certain equal distances from the nucleus on either side, where the natural frequencies of the electron's oscillations are different.

4.3 Formation of higher atoms

Every atom of a higher order begins with a helium atom. Nevertheless, the spin atomic model posits that hydrogen must consistently exist in the form of H_2 molecules. This topic is elaborated upon in the section regarding the Formation of Molecules. Additionally, when a proton and a neutron are added to the nucleus of a helium atom, the nearby electron is drawn towards the nucleus to preserve the balance of electric charge. This results in a stronger binding between the first two electrons, preventing the third electron from approaching the nucleus directly, as it is obstructed by the effective electric field generated by the first two electrons. Consequently, the third electron will position itself at a distance where the attractive force from the nucleus and the repulsive force from the first two electrons are equal. Moreover, it will align on a plane that intersects the nucleus and is perpendicular to the axis of the first two electrons. Nevertheless, its distance from the nucleus will exceed that of the first two electrons. A significant occurrence in this scenario is that the tangential component of the effective electric field from the first two electrons will also induce a spin in the third electron. Clearly, the direction of its spin will be such that the direction of its tangential component of the electric field is opposite to the effective direction of the tangential component of the electric field from the first two electrons. Furthermore, the first two electrons can exhibit two potential combinations of spin momentum arrangements, which will also yield two possible combinations of spin momentum arrangements for the third electron, as illustrated in Fig. 13(a) and Fig. 13(b). Naturally, there are two possible combinations for lithium atoms that should each have a 50% chance of occurring in nature. This atom is known as lithium, where the radial component of the electric field associated with the third electron should achieve an overall balance; however, its tangential component cannot be balanced, resulting in an effective magnetic moment, which leads to instability. The third electron may stabilize at various positions along the y-axis, where it will exhibit different natural frequencies of oscillation. These stable positions may be determined by the permissible spin values of the electron, which is a crucial aspect of investigation. Nevertheless, the distance between the first two electrons is equal and less than the distance of the third electron from the nucleus, creating distinct energy levels. Physicists have already classified the energy level of the first two electrons as shell one, with subshell $1S^2$ where 1 indicates the energy level and S as the subshell. Regardless of the number of protons added further to the nucleus, the bond between the first two electrons becomes increasingly stronger with each additional proton, preventing a third electron from occupying the level of the first two electrons. Consequently, it is consistently observed that there are two electrons in the first level, that is, shell 1, in all higher atoms. Furthermore, these two electrons may oscillate at a higher frequency than the two electrons in the helium atom at ground state. The third electron is positioned slightly farther from the nucleus compared to the first two electrons; thus, it occupies the second level, referred to as shell 2.

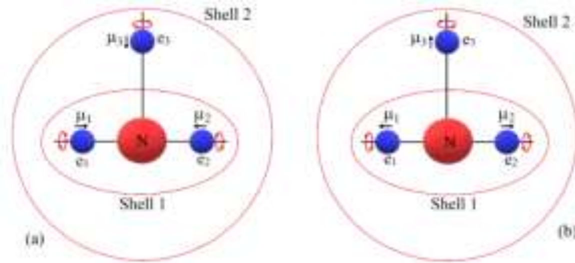

Fig. 13. The internal structure of a lithium atom, illustrating two potential combinations of spin orientations.

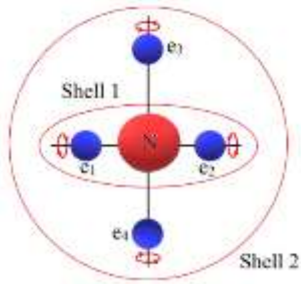

Fig. 14. The internal structure of a beryllium atom.

When an additional proton, possibly accompanied by a neutron, is incorporated into the nucleus of this atom, a fourth electron will be drawn towards this system. This electron will ultimately position itself on the opposite side of the third electron from the nucleus, aligned along the same axis but exhibiting opposite spin motion in relation to the third electron, as illustrated in Fig. 14. The third and fourth electrons, when balanced, should maintain equal distances and equal spin speeds, albeit in opposite directions. Consequently, the system achieves an overall balanced electric field, encompassing both radial and tangential components, resulting in a net magnetic moment of zero. This system, identified as a beryllium atom, is expected to be stable; however, this stability is not observed due to the increased surface area of the second shell, which permits the accommodation of additional electrons. Experimental findings indicate that the second shell comprises eight electrons, with two electrons residing in the subshell $2S^2$ and six electrons in the subshell $2P^6$. The two outermost electrons of a beryllium atom reside in the $2S^2$ subshell. As additional protons, and potentially neutrons, accumulate in its nucleus, more electrons are stabilized in the $2P^6$ subshell to maintain charge balance. Experimental findings indicate that the energy of the electrons in the $2P^6$ subshell exceeds that of the electrons in the $2S^2$ subshell. This implies that the distance of the electrons in the $2P^6$ subshell from the nucleus is greater than that of the electrons in the $2S^2$ subshell, making it crucial to comprehend the geometric reasons behind this phenomenon. Once six electrons occupy the $2P^6$ subshell, it reaches completion. The effective electric field generated by the two electrons in the $2S^2$ subshell and the six electrons in the $2P^6$ subshell prevents any additional electrons from entering the spherical surface they have formed. In this scenario, all electrons are paired, as illustrated in Fig. 13, resulting in a net magnetic moment of zero, which contributes to the stability of the system, referred to as a neon atom. The formation of electron pairs in the $2P^6$ subshell is specifically depicted in Fig. 15 for the neon atom. In short, more extensive research is needed to find the relative positions of all the electron pairs. In subsequent atoms, additional electrons are added to the next successive shell. But every larger atom starts with a helium atom.

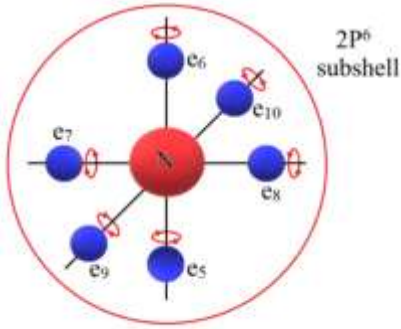

Fig. 15. The internal structure of a neon atom with showing only subshell $2P^6$.

4.4 Revisiting Stern-Gerlach experiment

Following the Stern-Gerlach experiment, research by Georg Uhlenbeck and Samuel Goudschmidt in 1925 found that the splitting of the silver beam in the Stern-Gerlach experiment was caused by the spin of the electrons, which was independent of their orbital motion. This finding indicated that electrons do not engage in orbital motion. This conclusion suggested that the stabilization of electrons within atoms may be due to their spin motion rather than their orbital movement. Consequently, it would have been understood how crucial the spin motion of electrons is in the formation of atoms and molecules. However, conversely, the spin motion of the electron was regarded as merely an intrinsic characteristic, leading to the assumption that the generated spin angular momentum and its associated spin magnetic momentum were solely quantum mechanical properties. This resulted in the neglect of its physical existence, which constituted a significant error. This further solidified the principles of quantum mechanics. Indeed, the electric current flowing through a coil generates a magnetic field that possesses a physical existence, in addition to the current within the coil itself. When a material produces a magnetic field, it is the spin motion of the unpaired electrons within the atoms of that material that is accountable. In other words, the physical reality of the spin motion of electrons cannot be disputed; to do so would be to reject reality. But instead, it is assumed that "spin up" and "spin down" are two possible internal angular momentum states of the electron, known as fundamental quantum properties, which are not literal physical rotations. They are simply labels for the two possible opposite directions of the electron's magnetic moment when measuring its spin. In fact, this is a pure compromise made to adhere to quantum mechanics under any circumstances, and there are many such compromises found in it, which are unacceptable, but the belief that no one can understand quantum mechanics continues to persist in accepting them. In fact, the reality is very different. From the discussion in the previous sections, it is clear that all the electrons in all atoms, including the silver one, will also be established using their spin. Only the last electron, as shown in Fig. 16(a), will be unpaired and it will be in the 5S subshell whose spin axis will pass through the nucleus. Again, when we look at that electron from outside the nucleus, it will be in either a clockwise or anticlockwise spin motion, one of which can be called “spin up” and the other “spin down”. Since this electron is in spin motion, it will look like a small magnet, and since it is stationary on the outside of the atom, it will look like a small magnet stuck there with its centre at the location of the electron. Therefore, when silver atoms are passed through an inhomogeneous magnetic field as shown in Fig. 5, the electrons whose S pole is on the outside of the atom will definitely be pulled towards the N pole of the inhomogeneous magnet i.e. up and the electrons whose N pole is on the outside of the atom will definitely be pushed away from the N pole of the inhomogeneous magnet i.e. down. From this it is clear that when silver atoms are passed through the inhomogeneous magnetic field as shown in Fig. 5, they will be divided into two parts either up or down. If the last electron in the silver atom were in orbital motion as shown in Fig. 16(b), the entire atom would be represented as a magnet with its centre at the nucleus and the direction of its magnetic moment would be random, and such atoms would spread out in vertical stripes as they passed through the inhomogeneous magnetic field, not be divided into two parts. While the whole picture is so clear, physics has moved far away from reality in the last 100 years. Indeed, this serves as the classical explanation for the beam splitting observed in the Stern-Gerlach experiment, which must hold true. In reality, there is no such thing as space quantization.

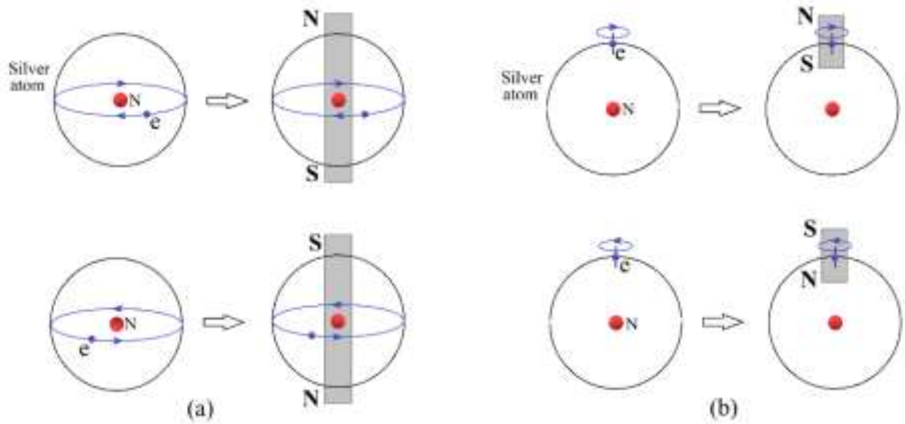

Fig. 16. (a) Magnetic behaviour of silver atom when the unpaired electron in spin motion, and (b) when unpaired electron in orbital motion.

4.5 What precisely occurs when a blackbody is subjected to heat

The purpose of studying blackbody radiation was to find out how much radiation of which frequency a body emits at different temperatures when it is in thermal equilibrium. The reason for choosing a blackbody for this was that it can both absorb and emit electromagnetic waves of all frequencies, so the entire spectrum of frequencies can be studied. Although an ideal blackbody does not exist, an experimental study of the radiation emitted by its equivalent body at different temperatures when it is in thermal equilibrium was carried out in the second half of the nineteenth century, from which the graph shown in Fig. 17(a) was drawn. Since this phenomenon is related to temperature, it was naturally tried to analyse it using thermodynamics, including statistical thermodynamics. In fact, to find the logical or philosophical reasons for this graph, an attempt was made to derive which theoretical equation the graph satisfies. In particular, Rayleigh and Jean were able to jointly derive a theoretical equation valid for the low frequency region of blackbody radiation, while on the other hand, Wien was able to derive an equation valid for the high frequency region [21-22]. From this, Max Planck realized that the interpolated equation of both equations could explain the entire blackbody radiation, and for this, he first wrote an interpolated empirical equation and then derived it theoretically through the new concept ‘quantum of energy’, the hypothesis of the Elements of Energy, which became the first brick in the foundation of quantum mechanics [7]. The only positive aspect in Planck's case was that the equations he derived were consistent with experimental data, however, the quantum of energy he proposed was depended on frequency and was confusing. He said that if a molecular oscillator in a body is oscillating at a frequency f, it will give or take energy in the multiple of $h\nu$ to others, that is, the energy will be given or taken in the form of a bundle or packet. From this, Planck was able to derive a theoretical equation that matched the experimental data, but the theoretical formulation he made for this does not explain what happens when the temperature of the body is increased. For example, in order for an electromagnetic wave of any frequency to be emitted, at least one of its electrons must oscillate at that frequency. Again, when the temperature of the body is increased, there is no clarity about how the electrons of higher natural frequencies in the atoms in it can oscillate. In fact, each electron in an atom is stationary and its natural frequency of oscillation will depend on the forces balancing it at the point where it is stationary. The closer the electron is to the nucleus, the stronger the forces balancing it so that, as shown in Fig. 17(b), the higher its frequency of oscillations will be and the further away it is, the lower its frequency of oscillations. Atoms can also have unpaired electrons and they will be in the outermost core whose natural frequency of oscillations will be consistently low. In a solid, all the atoms are very close to each other, so this affects the natural frequency of the electrons in them, so the electrons in the atoms of a solid have the potential to produce or absorb electromagnetic waves of all frequencies. When such a solid is heated, the outermost electrons in its atoms start to oscillate first, which have a low oscillation frequency, so infrared or red light is emitted from the material first. As the temperature of the material increases, the electrons in the inner core of the atoms also start to oscillate, so yellow and green light is also emitted along with the red light. As the temperature of the material increases, the electrons in the inner core of the atoms start to oscillate, so blue and purple colours are also emitted along with the above colours, so the body will appear white overall. In fact, all of these things should be included in a logical and philosophical explanation of blackbody radiation that will reconcile what is happening there and the equation derived from it.

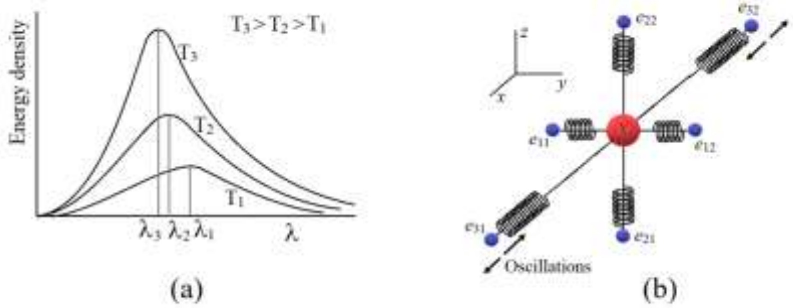

Fig. 17. (a) The change in energy density of radiation as a function of wavelength at various temperatures of a blackbody, (b) Illustration of the anticipated radial oscillations of several electrons within a typical atom.

4.6 The actual process involved in X-ray production

If an electron within the inner shell of an atom is to oscillate directly, merely increasing the temperature of the surrounding solid material may not suffice, as the stabilizing forces will be exceedingly strong. In such instances, it is only when a high-velocity electron from an external source penetrates the atom and imparts an impulse to the electron in the inner shell that oscillation at its natural frequency can occur. The effective electric field generated by the electrons within that atom will subsequently draw the external electron back out. Indeed, this very technique is employed to generate X-rays; however, the contemporary quantum mechanical interpretation diverges significantly from this explanation. It posits that the electron entering the atom from the outside replaces the electron in the atom's inner shell, resulting in the conversion of its energy into X-ray energy. Furthermore, the replaced electron exits the atom, regaining the same amount of energy that the entering electron lost. Consequently, there remains a lack of clarity regarding the source of this regained energy for the electron. Numerous questions remain unanswered within the framework of quantum mechanics, yet those that are particularly challenging are often disregarded.

4.7 Formation of molecules

In general, for an atom to maintain stability, both its net electric field and net magnetic field must equal zero. When two or more atoms have non-zero net electric and magnetic fields, they can attain stability by rejoining. As a result, a new joint system is created and stabilized, referred to as a molecule. Molecules consist of two or more unstable atoms that bond together to neutralize the total electric and magnetic fields, achieving stability. It is believed that the first light atom is hydrogen, which contains one electron and one proton in its nucleus. However, due to having only one electron, it is unable to maintain a specific distance from the nucleus through spin motion. As illustrated in Fig. 18, two protons and two electrons can align along the same axis, allowing both electrons to balance the attractive and repulsive forces by adjusting their spin velocities and the distance separating them. In this scenario, there will be repulsion between protons, repulsion between electrons, and attraction between protons and electrons.

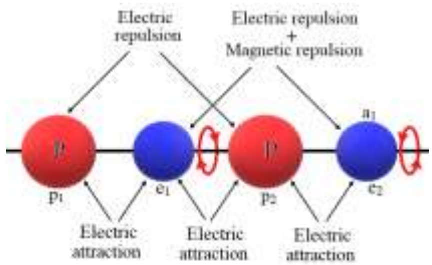

Fig. 18. Structure of hydrogen molecule (H_2).

Consequently, H_2 may exist in place of H. Its overall magnetic moment and total electric charge would be zero, rendering it quite stable. Furthermore, if the hydrogen atom possessed only a single electron, and if that electron could have remained stationary at a specific internal distance from the nucleus due to spin motion—an occurrence that is fundamentally impossible—then, given that it is unpaired, the net magnetic moment of this atom would not be zero, which is not observed. This indicates that H^2 would have emerged instead of H. Considering a water molecule as a straightforward example, it is composed of one oxygen atom and two hydrogen atoms. The oxygen atom contains four electrons in its 2P6 subshell and requires two additional electrons to fill this subshell, which it achieves by accepting two electrons from two hydrogen atoms. In this context, when hydrogen is involved in the creation of molecules, it appears to exist in the form of an atom. As the oxygen atom draws the two hydrogen atoms closer, it naturally pairs with the first oxygen electron (e7) adjacent to it, and subsequently, as the second hydrogen atom approaches, it pairs with the remaining unpaired electrons (e8). Consequently, the oxygen atom successfully completes its $2P^6$ subshell of electrons. The overall electric and magnetic fields of this molecule will be zero, resulting in a stable molecule as illustrated in Fig. 19. The oxygen atom acts as an acceptor by taking in two electrons from the two hydrogen atoms to finalize the 2P subshell, thereby designating the hydrogen atom as the donor.

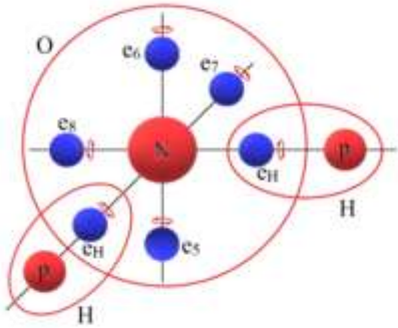

Fig. 19. Structure of water molecule (H_2O).

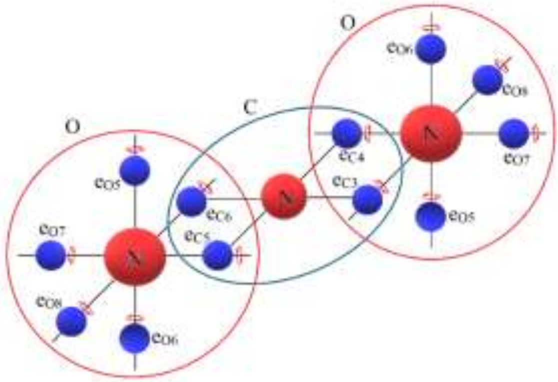

Fig. 20. Structure of carbon dioxide molecule (CO_2).

When discussing a more intricate molecule, one may refer to the carbon dioxide molecule as depicted in Fig. 20. A carbon atom contains two electrons in its 2S subshell (e_{C3}, e_{C4}) and an additional two electrons in 2P subshell (e_{C5}, e_{C6}). In contrast, oxygen possesses four electrons in its 2P subshell. First, the two electrons (e_{C5}, e_{C6}) of carbon from subshell 2P form pair with the two unpaired electrons (e_{O7}, e_{O8}) of the oxygen atom from subshell 2P to create two electron pairs. Moreover, the second oxygen atom also forms two pairs with the remaining two electrons (e_{C3}, e_{C4}) of the carbon atom in subshell 2S by breaking the pair formed in this subshell, because eight electrons are required to complete the second shell, which cannot be completed in this case. Consequently, the two oxygen atoms accept four electrons from the carbon atom, thereby completing their 2P subshell. In this context, the oxygen atoms act as electron acceptors while the carbon atom serves as electron donors. The overall electric and magnetic fields of this molecule are zero, indicating that it is a stable molecule. There exists a multitude of possibilities for the formation of various such molecules. This phenomenon is feasible solely because electrons do not travel in orbits within the atom; instead, they achieve stability by forming pairs within atoms. This novel and realistic perspective necessitated a re-evaluation of the chemical formula for each molecule.

From the preceding discussion, it is evident that electrons within atoms do not move in orbits. Therefore, it is incorrect to represent electrons as orbiting when illustrating atomic models, as this reinforces the false notion that electrons travel in atomic orbits. Again, it is a misconception that electrons are expressed in the form of waves in atoms. The spin motion of electrons constitutes a physical movement that is crucial for the formation of atoms and molecules. Hence, this atomic model may be referred to as the 'spin atomic model'. It is vital to emphasize that if electrons in atoms were to remain in orbital motion, their effective magnetic moment could never reach zero, and a solid with defined dimensions could not be established. Indeed, as technology advances and enables the capturing of images of electrons in atoms and molecules, it will undoubtedly clarify how electrons maintain stability and how they are distributed; however, it is impractical to wait for that moment. This consideration should be prioritized, especially when other occurrences suggest this. Nevertheless, within this model, the distribution of electrons across various dimensional levels remains incompletely understood.

5 de Broglie's hypothesis of matter waves

After Robert Millikan's experiments on the photoelectric effect, carried out from 1914 to 1916, which confirmed Einstein's 1905 theory regarding light quanta, along with the X-ray scattering experiment performed by Compton in 1923 that validated the particle-like behaviour of X-rays, it was logical to expect that if light exhibits particle traits while also acting as a wave, then all physical particles should likewise exhibit wave characteristics. This concept was first presented by de Broglie in 1924, emphasizing the dual characteristics of photons and electrons. de Broglie theoretically established that the wavelength of the wave linked to a moving particle, known as a matter wave, is related to the momentum of the particle, p, via the subsequent equation.

$$\lambda = h/p \tag{3}$$

where h is the Planck's constant.
Additionally, de Broglie presented numerous groundbreaking ideas alongside the concept of matter waves during that time, including the internal clock of the particle and the pilot wave that directs the particle's path, among other theories. Nevertheless, it was primarily the wavelength of the matter wave linked to moving material particles that became widely recognized.

5.1 Formatting the text

In 1927, Clinton Davison and Lester Germer at Bell Labs showcased the wave nature of electrons through diffraction from a nickel crystal in the Davison–Germer experiment [23-24]. This discovery validated the theoretical de Broglie hypothesis regarding matter–wave duality and provided significant evidence for quantum mechanics. Initially, Davison and Germer were investigating atomic structure by scattering low-speed electrons off a nickel crystal. However, an incident in the vacuum chamber led to excessive heat accumulation, which prevented the experiment from failing as the nickel recrystallized into a larger crystal. The recrystallized nickel functioned as a diffraction grating, and the electrons scattered from its surface exhibited fascinating peaks and troughs. While presenting his findings in England in 1926, Davison became acquainted with de Broglie's theory and recognized the importance of the data he had gathered, leading to early insights into electron diffraction. This confirmed the wave nature of electrons and the wave-particle duality of matter. Moreover, the experiment provided the first empirical evidence for de Broglie's wavelength for electrons and represented a significant advancement in the validation of quantum mechanics, altering the understanding of subatomic particles. Later, in 1961, Claus Johnson conducted a double-slit experiment with electrons, which demonstrated for the first time that an electron beam produces an interference pattern [25]. This discovery provided further strong validation of the wave-like properties of electrons and the principle of wave-particle duality. This finding offered a more robust confirmation of the wave-like characteristics of electrons and the principle of wave-particle duality, which had often been used to contest the wave nature of particles. It was once again astonishing that events were occurring at the atomic and subatomic levels, far beyond what is observable at the macroscopic scale, which helped to establish a solid belief in quantum mechanics.

5.2 Reanalysis of Davisson–Germer experiment and Claus Johnson experiment

Based on the preceding analysis of atomic structure, it is evident that electrons within atoms maintain stability at a specific distance from the nucleus through their spin motion. Consequently, when the atoms in the nickel crystal during the Davisson-Germer experiment arranged into planes, the stability of the electrons in the outer regions of each atom suggests the presence of a layer of electrons on those planes. These electrons are likely to be either reflected or repelled by these layers. Thus, similar to how x-rays can reflect off these planes and create diffraction patterns, electrons should also generate diffraction patterns. However, due to the incomplete understanding of atomic structure, this phenomenon could not be adequately addressed. Of course, further research would have been needed to establish the relationship between the kinetic energy of the electrons and the peaks obtained in the diffraction pattern. Claus Johnson's double slit experiment is worth mentioning as another experimental evidence of the wave nature of electrons, in which electrons are seen to produce diffraction patterns when passed through a double slit. Now in this case, when the electrons are accelerated through the gun, they are charged particles, and when they pass through the slit, they are waves, and when they hit the screen, they become particles again, all this is beyond imagination. In fact, since we do not know what exactly is happening there when the electrons pass through the slit, and if we assume them as waves at that time, everything fits together, that is why this whole thing seems so contrived. Further in this experiment, even when a single electron strikes the screen at a time, the anticipated diffraction pattern can still be achieved with an extended exposure time. This clearly shows that each electron is being expressed as a single point, meaning it is being expressed as a single particle. In this scenario, the atoms located at the outer edges of the slit are expected to create a layer of electrons, and the electrons emitted from the electron gun should be repelled by the electrons in that layer, ultimately resulting in a diffraction pattern upon impacting the screen. In this scenario, had we been able to classically analyse the trajectory of each electron emitted from the gun, identify which electron in the slit repelled it, determine the direction of that repulsion, and ascertain where it impacted the screen, we might have uncovered the genuine cause of the diffraction pattern's formation. However, due to the lack of knowledge regarding the stationary nature of electrons at varying distances from the atomic nucleus, it was presumed that the electrons were exhibiting wave-like behaviour responsible for the diffraction, which contradicts universal principles.

6 Consequences of de Broglie's hypothesis of matter waves

According to the hypothesis put forth by de Broglie, if a particle can be represented as a wave, then there must also exist an equation that characterizes the behaviour of particles in a wave-like manner. In response to this, Erwin Schrödinger developed an equation in 1925, which he subsequently published in 1926 [26], now referred to as the Schrödinger equation, presented in the following manner.

$$i\hbar\frac{\partial\psi}{\partial t} = -\frac{\hbar^2}{2m}\nabla^2\psi + V\psi \tag{4}$$

It employs a mathematical function, Ψ, known as the wavefunction of the particle influenced by the potential V. Just as many previous events were conducive to the establishment of quantum mechanics, Schrödinger's equation could also be successfully applied to the hydrogen atom, allowing its properties to be accurately predicted, and the validity of this equation could be assumed. Thus, the Schrödinger equation became a fundamental equation of quantum mechanics, providing a mathematical framework for understanding the behaviour of subatomic particles. Nonetheless, there was a lack of clarity in elucidating numerous concepts, necessitating compromises on certain aspects, which rendered quantum mechanics exceedingly complex, leading to objections from the physicists of that era.

6.1 Probabilistic nature of the quantum mechanics

The wavefunction obtained by solving Schrödinger's equation for a particle does not furnish all the essential information pertaining to that particle. As a result, quantum operators were originally created to retrieve information about the particle's observables, including energy and momentum, which can be ascertained by applying these operators to the function derived from the Schrödinger equation. At that juncture, another issue emerged: the wave function would evidently be distributed across space, raising the question of where the particle could be located within the space occupied by that wave function, specifically, what the probability of locating it is, referred to as probability density. To address this, Max Born proposed an idea in 1926 stating that the absolute square of the wavefunction's amplitude at a given point signifies the likelihood of finding the particle at that specific location, a concept known as the Born rule [27-28]. Consequently, the developing discipline of quantum mechanics seemed to exhibit a probabilistic nature rather than a deterministic one, a concept that both Einstein and Schrödinger found difficult to accept. In fact, this question should have been raised when Einstein explained the photoelectric effect. Bohr, while explaining the spectra of hydrogen atom, had mentioned that when an electron jumps from the energy level E_2 to the energy level E_1, the difference in energy will be converted into an electromagnetic wave whose frequency can be given by the equation $h\nu = E_2 - E_1$. This means that the energy of the total wave should be $h\nu$ which according to Einstein is the energy of one light quantum, that is, the total wave represents one light quantum. It is expected that when an electron absorbs a light quantum, the size of that electron and that light quantum should be almost the same. Generally, the size of an electron is expected to be near about 10^-15 meters, so the size of a light quantum is also expected to be the same. But the wave emitted due to the transition of an electron in an atom will have at least some number of troughs and crests. With considering the wavelength of a visible light wave, the total length of that wave will be nearly 10^10 times larger than the size of the expected light quanta. Then the question arises as to where the light quanta would be located in such a long wavelength, and naturally this issue would have come up with the probability of finding the light quanta in that wave, but no one seems to have raised this question. But on the contrary, it appears that Einstein himself raised questions about the probabilistic nature of quantum mechanics, which shows a contradiction in Einstein's nature. At that time, it was generally believed that light existed solely as a wave and could not assume a physical form. Nevertheless, instead of adhering to this notion, people were involved in efforts to demonstrate the dual nature of particles, competing amongst themselves and embracing increasingly strange theories to address the questions that emerged.

6.2 Energy quantization and particle's wave nature

When the Schrödinger equation was solved for a particle restriction under a certain potential, it showed that certain energy values are allowed for that, which was contrary to the expectations of classical physics. Therefore, it was assumed that the wave nature of the particle is responsible for the quantization of energy. In fact, at that time, the important question was what electrons were doing in atoms and how atoms were emitting electromagnetic waves of certain frequencies. The advantage of Schrodinger's equation was that when it was solved for the hydrogen atom, it could predict the spectra it was emitting. Also, it was assumed that the electron in it was expressed in wave form, so the probability of finding it in an atom was given by Max Born's probability law, which was called the orbitals of the electron, which are very difficult to understand physically. Therefore, the concept that electrons move in orbits in atoms was abandoned and the idea that they exist in wave form became common. This led to the understanding that the quantum nature of atoms is due to the wave nature of electrons, which was very different from reality. From this, it was clear that the path that had begun in a wrong direction was about to go even further astray.

6.3 Heisenberg's uncertainty principle

Another significant principle in quantum mechanics is Heisenberg's uncertainty principle, which was formulated in 1927 [29]. It asserts that it is impossible to simultaneously know both the precise position and the momentum of a subatomic particle with perfect accuracy. If Δx denotes the uncertainty in measuring the particle's position and Δp denotes the uncertainty in the concurrent measurement of the particle's momentum, then the product of these uncertainties is always greater than or equal to $h/4\pi$, where h signifies Planck's constant. This implies that if one attempts to measure the position of a particle with increased accuracy, the error in the measurement of momentum will also rise, and vice versa. It has also been proposed that a similar scenario would occur for energy and time. This principle, by challenging the notion of determinism, ignited controversy and initiated a fundamental revolution in the realm of physics, transitioning from the classical concept of a fully predictable, deterministic universe to a quantum perspective grounded in probability. At that time, notable figures such as Albert Einstein raised questions regarding the implications of this principle for objectivity, which resulted in vigorous debate concerning the interpretation of quantum theory, particularly whether uncertainty is an intrinsic feature of nature or merely a limitation of measurement. However, after extensive discussions surrounding the Copenhagen interpretation, this principle was accepted not as a limitation of experimental methods but as a fundamental feature of quantum mechanics arising from the wave-particle duality of matter. In principle, no material particle, including electrons, could ever be expressed as a wave, but there has been a lot of discussion throughout history about what limitations could be imposed by expressing it as a wave. This was an unproductive use of intellect and time that could never be redeemed in the future.

6.4 Bohr's complementarity principle and Heisenberg's notion of wavefunction collapse

An additional concern that arose in quantum mechanics was that a material particle can be depicted either as a particle or as a wave, but not as both at the same time. As a result, in 1927, Bohr proposed another principle known as the 'Complementarity principle' [30]. This principle asserts that certain pairs of properties of quantum systems, such as wave and particle behaviour, are mutually exclusive, indicating that they cannot be observed and measured simultaneously within a single experiment. The behaviour displayed is dependent on the experimental conditions. If, during the experimental observation, the object is perceived as a particle, it raises a question regarding the status of the corresponding waves. To resolve this, Heisenberg, in 1927, introduced the concept of 'Wavefunction collapse' [29]. This states that, if an experiment is designed to determine the position of an object, the result of that experiment will cause that object to appear in a particular position, causing the wave function of that particle to collapse, meaning that the amplitude of the wave function will be at a peak at that location and zero elsewhere. In reality, this was merely a compromise to address the issues arising from the assumption of the particle's dual nature. However, once it is accepted that a particle has wave properties, it becomes necessary to explore the consequences of this assumption. As a result, quantum mechanics appears to include a number of strange phenomena or rules that are impossible to justify logically. There is no definitive explanation for why the wave function collapses at a particular location; the prevailing assumption is simply that the particle is located there.

7 Quantum entanglement and its consequences

Erwin Schrödinger introduced the concept of "entanglement" in 1935, recognizing it as a fundamental feature of quantum mechanics [31]. Since then, the mathematical framework governing quantum systems has shown that multiple quantum particles can be described by a single wavefunction, thereby classifying them as being in a state of quantum entanglement. His paper served as a critique of the perspectives held by physicists such as Niels Bohr and Werner Heisenberg concerning quantum. When two quantum particles are entangled and allowed to exist in more than one potential state, they are in a superposition of all possible states at once. The act of observing one particle causes its superposition to collapse, as explained by Bohr, leading to its transition into a definite state. Simultaneously, its entangled counterpart also collapses instantaneously into its corresponding state due to the intrinsic interconnectedness of certain particle properties, as dictated by Heisenberg's Uncertainty Principle. This interdependence, which Einstein famously termed 'spooky action at a distance', is regarded as a crucial element of quantum mechanics. In a letter to Max Born in 1947, Einstein coined the phrase "spooky action at a distance" to convey his profound discontent with quantum mechanics, which he perceived as incomplete because it implied that measurements on one entangled particle could instantaneously affect another, irrespective of the distance separating them, a phenomenon he believed contravened the principles of local realism. The historical backdrop includes the 1935 paper by Einstein, Podolsky, and Rosen (EPR paradox), which sought to underscore the perceived absurdity of quantum entanglement to stimulate a discussion regarding the completeness of the theory [2]. However, this perspective was later empirically contested, and efforts were made to refute it on a broader scale.

7.1 Experiments carried out to validate the presence of quantum entanglement, efforts aimed at its practical applications, and the resulting pressure exerted on physicists

There was limited discussion regarding the EPR paradox following its introduction; however, in 1964, the subject was revisited due to Bell's inequality theorem [1]. The primary aim of this theorem was to show that a theory based on "local realism" cannot reproduce the predictions of quantum mechanics for entangled particles. This provides a concrete, testable prediction to distinguish between the two viewpoints. The theorem essentially offers a way to decide between Einstein's idea that quantum mechanics was incomplete and the reality of quantum phenomena like entanglement. The initial experiments carried out by Clauser and Friedman in 1972 provided strong evidence against local hidden-variable theories by showing a violation of Bell's inequalities. The results confirmed the predictions of quantum mechanics, demonstrating that entangled photons maintain a correlation even when spatially separated, an effect Albert Einstein called "spooky action at a distance" [3]. In fact, there are no light quanta or photons in any light wave, and Clauser and Friedman, in their experiment, to prove that photons are in entanglement, they detected the polarization of those photons, which was actually the polarization of the electric field in that wave. But everyone was very far from this truth. Therefore, by considering the polarization of the electric field in the light wave as the polarization of the photons, which was a big mistake, further experiments were started to prove that quantum entanglement is a reality, including those conducted by Aspect and others, offered additional corroboration for this effect [32-35]. The subsequent significant contribution was said to be achieved by Zeilinger's team in 1997 by successfully demonstrated the teleportation of a quantum state, transferring the polarization state of one photon to another by utilizing entangled photon pairs, marking a significant milestone in the field of quantum communication and further, in 1998 by demonstrating entanglement swapping, a process that allows particles from separate entangled pairs to become entangled, even if they have never interacted [36-37]. This progress was thought to be crucial for expanding the potential of quantum networks. After that this team subsequently achieved quantum teleportation, showcasing the transfer of quantum states through the use of photons as qubits [38]. The experimental procedure utilized entanglement swapping to facilitate this teleportation. In 2012, they successfully conducted an experiment on the quantum teleportation of a photon's quantum state over a distance of 143 km in free space, spanning from La Palma to Tenerife in the Canary Islands [39]. Current expectations regarding quantum teleportation emphasize its potential use in the development of a secure and robust quantum internet, as well as in the creation of advanced quantum computers. This technology is anticipated to facilitate features such as communication that is fundamentally un-hackable, improved sensing abilities, and the capacity to connect and exchange quantum information among distributed quantum processors. Given all these developments, it is natural for everyone to feel that 'spooky action at a distance' is a reality that has been experimentally proven beyond doubt through photon entanglement, so there seems to be great pressure on physicists to accept this. Therefore, it is now difficult to say when and how this matter will be resolved.

8 Review with necessary conclusions and requisite suggestions

Analysing the progression of physics from 1900 to the current day highlights a significant emphasis on quantum mechanics. Physicists have encountered considerable difficulties in maintaining their engagement with this discipline, as the intricacies of quantum mechanics are not broadly understood, and there are no feasible alternatives available. Many physicists do not convey dissatisfaction regarding their exclusion from this area due to a lack of comprehension, a subject that is rarely discussed. The source of the pressure associated with quantum mechanics stems from the fact that, despite the conflicts among prominent physicists during its initial development, each contention played a role in its reinforcement. Importantly, Einstein and Schrodinger, who were instrumental in the progress of quantum mechanics, perceived that there were inherent flaws within it; however, they were unable to identify the precise point of failure, which ultimately contributed to the further consolidation of this field. Einstein notably rejected the probabilistic nature of quantum mechanics. During the 1927 Solvay Conference, Niels Bohr and his supporters, including Werner Heisenberg, Wolfgang Pauli, Max Born, and Erwin Schrödinger, championed the new probabilistic interpretation of quantum mechanics. In contrast, Albert Einstein emerged as the primary opponent, arguing that the theory was inadequate and failed to capture a deeper, deterministic reality, particularly criticizing its inherent randomness. This situation propelled Einstein, who had previously dismissed quantum entanglement as 'spooky action at a distance', into the spotlight, and it is now being demonstrated that this concept has indeed materialized. Following Einstein, no prominent physicist remained who would assert that this was the point of error. The consensus is that the behaviour of particles at atomic and subatomic scales is so peculiar that it cannot be comprehended without the framework of quantum mechanics. However, if we perceive that the assertions of quantum mechanics conflict with our intrinsic beliefs, we must investigate where the error lies, rather than attempting to persuade our own minds against our fundamental convictions.

In this context, it appears that the initial error was the assumption that light possesses a particle nature, despite the established understanding of its wave nature, a notion that Einstein adopted while elucidating the photoelectric effect. At that time, had he and others considered how the electric and magnetic fields within light waves can apply a force on electrons, numerous insights would have emerged. For instance, increasing the frequency of any electromagnetic wave amplifies the magnetic force it exerts, which is responsible for the photoelectric effect. Additionally, there exists a 90-degree phase difference between the electric field and the magnetic field in any electromagnetic wave. Consequently, the true essence of the magnetic field would have been understood, and the reason for the absence of magnetic monopoles in the universe would have been discovered. Furthermore, this understanding would have highlighted that light does not possess a particle nature, potentially preventing de Broglie's concept of the dual nature of matter waves from being proposed. It is indeed surprising that this issue has not garnered attention until now.

Back when Rutherford realized from his gold foil experiment that even when an alpha particle hits the nucleus of an atom with great force, it does not leave its place. He or someone else should have thought about what was keeping it from moving, but no one did. The electrons present in that foil were the sole entities capable of stabilizing the nucleus, indicating that those electrons were unable to move in orbit, which served as the initial sign that the electrons could not move in orbit. Therefore, Rutherford should not have considered planetary motion for the atomic model and should have presented the world with the reality that there must be some invisible force acting to keep the electrons stable in atoms away from the nucleus, but that did not happen.

Once more, Bohr's atomic model ought to have been dismissed, as the continuous movement of electrons in orbits would result in energy emission, an inevitable process that would lead them to ultimately spiral into the nucleus. Furthermore, when an atom emits light waves of a specific frequency, which are electromagnetic waves, it implies that at least one electron must oscillate at that frequency and remain stationary at a particular location. Consequently, the premise that electrons cannot orbit within atoms should have been upheld; however, this did not occur. A contributing factor to this oversight was the necessity of an additional force to prevent electrons from collapsing into the nucleus, specifically the magnetic repulsive force between electrons, which was not yet understood.

When it was realized in 1927 that the electron has spin motion while in the atom, then the repulsive magnetic force between the paired electrons should also be realized so that it was realized how the electrons remain stable in the atom at a certain distance from the nucleus. If research had been conducted in this direction, the true nature of the atom could have been revealed, including where electrons are stabilizing in atoms, what their natural frequencies of oscillation are at those locations, and what frequencies of electromagnetic waves that atom can produce. On the contrary, after the de Broglie hypothesis of 1924, it was assumed that the electron in the atom is in the form of a wave, due to which quantum mechanics got a new turn. Just as no electromagnetic waves can ever be expressed as particles, the fact that no physical particle can ever be expressed as waves was denied when it was a universal truth. The truth that light is never expressed as a particle, but rather it is an electric field, will have to be faced at some point. It is a fact that light quanta or photons do not exist. Once more, electrons or any material particle cannot be represented as a wave. Consequently, the questions that emerge—such as the incorporation of uncertainty in simultaneous measurement, the inclusion of probability regarding the particle's location, the collapse of the wavefunction, and the potential for entanglement—have never been valid and will never be valid. To be clear, photon entanglement teleportation will never be possible. But a lot of human brains are working to solve these non-existent things. Physicists have been discussing quantum physics for the last 125 years, but the discovery of how and where electrons are stabilized in atoms using their spin motion and what their natural frequency of oscillations is at that place, that is, the discovery of the quantum nature of the atom, which is still aside.

To resolve all this, it is very important to pay attention to two things. The first thing is to prove experimentally whether the magnetic force applied by the electromagnetic wave increases when the frequency is increased and whether there is a 90 degrees phase difference between the electric field and the magnetic field in that wave as it propagates in space. From this, it will be confirmed that the wave nature of light is responsible for the photoelectric effect and the part of the theory of quantum mechanics that light has a particle nature will be eliminated so that the existence of light quanta or photons will also be eliminated. It will also answer why magnetic monopoles are not found in the universe. The second is to calculate theoretical values for the forces that balance electrons in atoms using their spins, so that we can predict where and how those electrons are stabilizing and what the natural frequencies of their oscillations will be. From this, it will be understood which atom can produce electromagnetic waves of which frequencies. From this, it will also be understood whether the speed of the electron's rotation is maintaining a specific value or not, and whether this is the exact reason responsible for the electron maintaining different distances from the nucleus, which will also reveal where the true origin of the quantum nature of atoms lies. It may be difficult to settle this other matter, but without this, the reality of atoms will not be understood. From this it will also be clear that the quantum nature of atoms is due to the spin motion of the electrons in them and not to their wave nature. This will also bring to an end the rest of the current quantum mechanics.

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