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Is modern physics is rotting?

It is my firm belief that the last seven decades of the twentieth century will be characterised in history as the dark ages of theoretical physics.

Carver Mead 2001

1.1 Dogma

Physics is considered to be the purest of all natural sciences. Scientists practising physics are supposedly those "special" people who search for knowledge with an "open mind". New ideas and concepts are supposedly welcomed and objectively considered and tested. Since my own training is in physics and materials science, I also believed that this behaviour must reign supreme in science. I have applied these rules diligently while trying to build my own career.

It thus came as a traumatic shock to discover when already approaching retirement that the real bigots in the world are to be found within the physics community, and more specifically amongst our modern-day theoretical physicists, who have lost the plot many years ago when they became convinced that it is impossible to "visualise" what happens on the atomic scale. Werner Heisenberg (1901-1976) propagated this concept as a postulate to develop his matrix-model for quantum mechanics.

When Heisenberg developed his theory during 1925, using abstract number arrays (matrices) to model quantum-mechanical behaviour of atomic-electrons*, Heisenberg started from the premise that the only reality at the quantum level is what can be measured: With time this came to imply that there exists no causal reality behind the measured reality (see alternative arguments in section 36). This premise developed into the presently accep-

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* *When the term "electron" is used in this book it will refer to an experimentally-verifiable "entity" with a rest-mass m_e, which has a "point-centre" of mass that corresponds to a "point-centre" of charge equal to $-e$ (e is the unit of charge measured for electrons and protons). Theoretical physicists have argued that the latter characteristic mandates a "point-particle" with a "point-charge".*

ted paradigm according to which there are different potential-realities that actually "exist" simultaneously, of which only one can manifest when a measurement is made: In my opinion, by choosing this as his guiding principle, Heisenberg took physics back to the age of superstition.

The worst aspect is that it looks suspiciously as if Heisenberg, against all odds, persisted with this ridiculous viewpoint for personal-political reasons: i.e. in an attempt to ensure that his theory for electron "point-particles" based on matrices would not be replaced by another theory that was developed one year later by Erwin Schrödinger (1887-1961) which is based on a differential*, harmonic* wave-equation with a complex-amplitude*.

Schrödinger's wave equation implies that an electron is not a "point-particle" at all, but that it occupies a volume in three-dimensional space: The "essence" of an electron must thus simultaneously encompass all the points within this spatial-volume. Such a region is called a "field": When a field changes with time in a certain manner, it is a harmonic wave (see section 7.5). Schrödinger's theory allows the "visualisation" of an "electron" in terms of the intensity within three-dimensional space of a complex-harmonic wave-amplitude. From this perspective there is a causal-reality behind what is being measured: And this reality can be modelled in terms of the well-known mathematics which describes wave-behaviour and wave-interactions.

It could not have been pleasant for Heisenberg that an alternative approach was published which contradicted the prime assumption he had made barely one year earlier when he developed his matrix-theory. Instead of welcoming this new development objectively, he immediately reacted with animosity: In a letter to Wolfgang Pauli (1900-1958) Heisenberg wrote (translated from German): "*The more I think about the physical portion of Schrödinger's theory, the more repulsive I find it…….What Schrödinger writes about visualisability of his theory is probably not quite right, in other words it's bullshit*". The last word has also been translated as "crap".

Heisenberg's reaction is typical of what one finds amongst physicists. Although they claim that they welcome new ideas and that they evaluate such ideas with open minds, they rarely, if ever, do so when they are confronted with data or models which challenge what has already been published; especially by themselves.

It is this attitude which has increasingly led to the present epidemic sickness where those scientists in control of physics have evolved into a powerful, organised religious-institution (a "physics-church") with "sects" which are more dogmatic than any fundamentalist religious-sect can ever hope to be. In fact, the physicists are worse, since theists do not dishonestly

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* *It will become clear in this book what is meant by the terms "harmonic" and "differential": The meaning of the term "complex" with regard to wave-amplitudes will be explained and discussed in section 7.5.*

claim that they are “open-minded”: They clearly state that they accept what they believe solely on faith. In contrast, physicists claim that their insights are objectively based on experimental-facts and impeccable logic. As will be seen in this book, this is the biggest lie ever!

Many “highly acclaimed schools of physics” at “respectable institutions” have reached “cult-status”: The “other physicists in the world” know that in order to get any recognition and funding they have to “suck up” and follow like sheep! If not, they soon experience ridicule, censorship, blacklisting, and excommunication. Therefore, when alternative possibilities in physics are discovered which are not in line with what is dogmatically believed by the “mainstream practitioners” in control of the “physics-church”, physicists are more likely to ask: “*What does Philip Anderson say about it*”, than to analyse the new ideas objectively on scientific merit; and then give their own honest opinion. They will rather let a new paradigm-shift slip by than take the risk of being rejected by the mainstream practitioners of physics.

This attitude has been illustrated by an interlude I have had with Prof. David Pettifor of Oxford University during a conference in South Africa in 2007. He is a Fellow of the Royal Society of London (FRS). I told him that I have a manuscript on superconduction which had been rejected by “*The Proceedings of the Royal Society A”* on grounds that I find illogical and spurious; and asked him if he would be so kind to look at the remarks of the editor and give me his opinion. His response was: *“I am not going to break rank with the Royal Society”.*

1.2 Experimental philosophy

The Royal Society of London was founded during the 17th century in an attempt to eradicate the mentality which (earlier in that century) had led to Galileo Galilei (1564-1643) being excommunicated and put under house arrest. They touted the concept of “experimental philosophy”: i.e. when possible, the final arbiter must be experimental-verification.

Since then, the “golden rule” of physics should have been consistently as follows: **Any physics-theory or model should always be under constant review no matter how well or for how long it has withstood the test of time. This demands that any new data, model or theory must be evaluated objectively and not be rejected out of hand because the existing dogma seems to be working well enough. If no obvious or logical fault can be found with the new data, model or theory, the new physics must be accepted as a possible alternative for existing physics until incontrovertible experimental evidence or impeccable logic based on related experimental evidence, can render the final verdict.**

If it should be found that any newly-proposed physics is able to model any aspect, no matter how small, which the existing physics cannot, the latter physics must be wrong (maybe not completely, but wrong remains wrong);

and must thus be reconsidered, modified, or replaced - no matter who has postulated it and no matter if a Nobel Prize has been awarded for it: One small fact is enough to discredit accepted dogma no matter how well it seems to explain all other aspects (see also section 29)!

If "scientists" do not scrupulously adhere to this approach, paradigm-shifts in physics will be blocked, and physics will be splashing around in a quagmire: Exactly as it is doing at present! In my opinion, new knowledge is so important for the survival of humankind that any physicist who violates this golden rule should be charged in the World Court with crimes against humanity.

It is ironic that the "physics-church" wants the general public to believe that they actually follow this "golden rule", and that this is why physics is supposedly "self-correcting" while "other disciplines" are not. They have, however, established an even worse mentality than the one which had resulted in Galileo being put under house arrest by his peers; just because he dared to argue that the earth might not be the unique, stationary centre of our universe!

1.3 Galileo's inertia

Galileo pointed out that when one travels on a ship which calmly glides with constant speed through the water, material-objects on the ship will remain stationary relative to the ship as if the ship itself is stationary. The property of a material-object which allows it to remain stationary when actually moving without acceleration has become known as "inertia".

Thus Galileo correctly argued that although we may think that the earth is stationary, the earth might actually be moving around the sun as had been postulated by Nicolaus Copernicus (1473-1543). It is therefore unlikely that the earth is <u>the</u> unique, stationary centre of the universe: In principle, any object moving with a constant speed v can be considered to be stationary within a reference-frame moving along with it[*]. Not surprisingly, such a reference-frame has become known as an "inertial reference-frame".

Subsequently, after the advent of calculus[†], Sir Isaac Newton (1643-1727) quantified Galileo's inertia in his first law: He equated the inertia of a body with the body having <u>mass</u> and <u>momentum</u>, and in his second law he equated acceleration of such a body with the presence of a <u>force</u>. Thus, when a body with mass moves with a constant speed, it experiences no net force, and is stationary (at rest) within a reference-frame travelling with it. It is

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[*] *Obviously the earth is not travelling in a straight line and with constant speed around the sun. Furthermore it rotates around an axis through its centre of mass. These effects can, however, be accounted for in Galileo's arguments.*

[†] *Calculus is the mathematics which enabled physicists to calculate how bodies with mass move and interact. It has also been used to model waves and wave motion (see section 7.5). Galileo had to rely on geometrical constructions to verify his postulates.*

of utmost importance to note that Galileo's concept of inertia is the single most important foundation-stone on which all subsequent physics has been based. If it should be found that this concept does not apply, all physics, from Newton's laws to Schrödinger's wave equation, will have to be scrapped *en-toto* and redone.

Galileo's insight relies on such simple, and experimentally verifiable, logic that it is shocking that his detractors could not understand it. It is difficult to believe that they could all have been so incredibly stupid. There must have been intelligent people around at that time: It seems more logical to conclude that those with intelligence did not want to accept the fact, no matter how compelling it is. It was an inconvenient truth: It rattled their dogmatic reference frame and thus their feeling of security! Therefore it had to be declared a heresy!

It must be emphasised that Galileo's detractors were his peers: It is too simplistic to blame the "Catholic Church" for what happened to Galileo. At that time this Church, in addition to being a religious institution, acted as a "Scientific Academy" (similar to the American Association for the Advancement of Science, the Royal Society of London, etc. at present): After all, it had been largely the priests and monks who safeguarded scientific knowledge during the Dark Ages. Thus, the people responsible for Galileo's treatment were his scientific "peers" who advised the Catholic Church that Galileo "must be wrong", or who just kept quiet to safeguard their own careers!

1.4 Ptolemy's universe

Ptolemy (approximately 87-170) based his model of the universe on the postulate by Aristotle (approximately 394-332 BC) that the earth is the unique, stationary centre of our universe: By the time Galileo appeared on the scene, this belief had been in existence for nearly 2000 years.

The cracks in Ptolemy's model should have been clear to people with common sense long before that time: These cracks required that the orbits of the planets had to be "renormalized" in order to include "epicycles". The general belief was that this model had withstood "the test of time": It was the "jewel in the crown" of physics! I wonder if somebody had won an important physics-prize for "proving" that Ptolemy's model could be "renormalized to include epicycles".

Not knowing about the "golden rule", Galileo's peers would not have seen any reason to even consider another model, no matter how simple, experimentally correct, and incontestable Galileo's arguments were. Ptolemy's model described all the information they wanted to believe is relevant. It even gave a perspective of where "heaven" is. "Our universe" supposedly ended on a "celestial-sphere" which "rotates around the earth" on which the stars are situated: "Heaven, God (∞BC-∞AD) and the Angel's" being on or outside this sphere. In fact, they had to be there in order to supply the forces required to rotate this sphere. How else can anything move?

Galileo's peers could thus argue that "*the existing model fits the facts so well that we do not need another model*". Can we blame them? Yes we can and we must. It is in the public interest to forcefully state that the latter argument should be, and must be anathema to any person who practises science. It is thus imperative to make absolutely certain that such reasoning is never again used to judge new physics.

1.5 An important question

The relevant question to ask is thus the following: Is such reasoning still possible at present? Unfortunately the answer is a resounding yes! In fact, it is not just possible, but the whole system which is, at present, being used to evaluate new physics has been optimized to exactly generate and nurture the same mentality which had led to Galileo's woes.

In comparison, Galileo was blessed: At that time even the Catholic Church gave him permission to teach the "Sun-Centred Universe" as a "hypothesis". At present he would have been blocked by the "physics-church" from even publishing a "hypothesis" in "any respectable physics-journal" which contradicts what the "Physics-Vatican" wants to believe. My experiences over the past ten years compel me to believe that even the Royal Society of London would have blocked his ideas (see section 37): Is it a case of "*Britannia waves the rules?"*

1.6 Superconduction

My own eyes only popped wide open during 2000-2001, after I serendipitously discovered a macro electron-wave, formed by millions of electrons in a good vacuum between a cathode* and an anode*. This phase transfers negative electric-charge from the cathode to the anode without the presence of an electric-field within it: This is so since at thermodynamic-equilibrium (see section 7.2), which manifests when a steady state current is flowing, it can be proved by impeccable logic, based on the impeccable physics of electronic interfaces, that in this case the electric-field <u>must</u> be cancelled by an opposite polarisation-field†.

The cancellation of an applied electric-field is <u>the</u> defining characteristic of superconduction, since this is exactly what Heike Kamerlingh-Onnes (1853-1927) measured in 1911: My experimental result thus proves without any doubt whatsoever that I have discovered a superconducting phase that forms at room and higher temperatures (see sections 11, 12 and 13). How it forms and how it transfers charge are matters that were not known at the

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**A cathode is a negatively-charged body (also called an electrode) and an anode is an electrode which is positively-charged.*

†Polarisation is discussed in section 7-4.

time of discovery: Since then the mechanism revealed itself: This is explained in this book.

To repeat: It was, and still is, a simple matter to prove by using impeccable, well-established, undergraduate physics, that the electric-field within this phase is, in fact must be cancelled by an opposite electric-field. And even though this must be so, it is found experimentally that electric-charge keeps on being transferred through this phase; thus causing an equilibrium electric-current to flow around an electric-circuit containing this phase as an element.

In fact, it is the very first experiment in the history of science that proves unequivocally that charge can be transferred through a phase while the applied electric-field must be completely cancelled within the phase. For all other superconductors discovered to date there has been, and still is no incontrovertible proof that the electric-field is exactly zero within these materials while a current is flowing through them. In fact, many experts argue that the current must be caused by a magnetically induced electric-field: As will be seen in this book, the latter mechanism is impossible nonsense!

The search for superconduction at room temperature has been the Holy Grail of physics since 1911. But was my discovery received with acclaim? No it was not, and still is not: This is so since the formation of this phase cannot be modelled in terms of the accepted physics-theories which are presently in vogue to explain superconduction. Thus, I must be wrong; just like Galileo must have been wrong when he postulated a principle which is in violation of Ptolemy's model.

1.7 Censorship

What causes this mentality to still manifest nearly 400 years after Galileo? One of the major contributing factors has been the argument that any "new physics" can only be considered relevant after it has been "peer-reviewed" and vetted by the "ruling physics-sect" in charge of that field of physics, and then published in a "respectable physics journal". When then, during subsequent years, other scientists in the same field find no fault, this physics becomes sacrosanct! It sounds like a reasonable approach, but it turned out not to be the case since the human inclination to be dishonest and corrupt has not been taken into account.

Peer reviewers are exactly those scientists who had been allowed to publish in "respectable journals" after "peer review" and are thus persons who have not had at any time "rattled" the foundations of main-stream-dogma. With rare exceptions they will thus defend the mainstream-dogma of the "physics-church" with religious servitude. And this is exactly what is happening at present.

Herein lays the rub! Religious dogma has also been "peer reviewed" and vetted by the highest authorities on religion for thousands of years. Richard Dawkins should thus be rejected as a crackpot until he has had his book (*The God Delusion*) “peer reviewed” by the accepted authorities on religion and then published in a “respectable journal on religion”.

Obviously, such a process, whether adjudicating religious writings, or physics, or any other field, is incestuous and can be abused: And the human inclination has always been such that any system which can be abused ends up being abused: Scientists are not exceptions when it comes to dishonest, and even criminal behaviour. In fact, modern-day scientists in control of physics have become the unchallenged masters in manipulating what they think “should be allowed to be known and believed”. It seems that they think that all “other” people are morons, who must be protected from what the physiccists (in control) think is “wrong-physics”. We are in dire need of a Martin Luther to shake up the “physics-church”.

I believe that if one cannot explain physics in simple terms to a lay person, one should not be practising physics. At present we have reached the situation where our theoretical physicists cannot explain their models even to experimental physicists without invoking obscure mathematics which nobody can really understand! They confuse everybody, including themselves, with mathematical theorems based on concepts like “spontaneous symmetry breaking”; “time reversal”; etc. which, most probably, have nothing to do with real, actual physics whatsoever. And those who ask questions are ostracised as “crackpots”.

It is already late in the day when a well-known theoretical physicist (Lawrence Krauss) can plead in the New Scientist (dated 31st August 2008) that the editors of scientific journals should be our “gatekeepers”. Even though Krauss states in his article that this is supposedly not censorship; this is exactly what he is advocating! And this is exactly what is happening at present.

The incontrovertible fact is that there exists absolutely no mechanism to ensure that an editor or a “peer reviewer” does not reject new paradigm-shifts in physics just because the latter challenge what he/she and the other “sect-members” in control of the relevant field want to believe that the “actual” physics is, and what they want to keep it to be; even though they themselves have no understanding of what it is really all about.

The reaction is even more hostile when the proposed new physics negates some, or all of the research that the peer reviewer has done in his own lifetime. Remember Heisenberg’s reaction to Schrödinger’s equation?! Fortunately Heisenberg was not in a position to block Schrödinger from publishing his ideas. If it were to be presented now for the first time, 80 years after Heisenberg’s model, Schrödinger’s input would most probably be rejected by the editors of our “peer-reviewed” journals.

That this would have been so, is supported by the fact that John Gribbin in his popular book entitled “*In Search of Schrödinger’s Cat”*, wrote that Schrödinger’s equation was a “step backward”. It will be seen in this book that although this equation is most probably not the ultimate wave-equation for matter-waves, it should have been hailed as the greatest breakthrough of the 20th century. But, unfortunately, the required development of this breakthrough to its logical conclusion has been blocked by physics-politics which succeeded to steer the "physics-church" into the quagmire of never-never land (see section 1.9 below).

The present rapid increase in such scientific political games has been facilitated by the rule that a "peer reviewer" must be "anonymous". Why this must be so is difficult to understand and utterly illogical to defend. Either you know your physics and are proud to add your name to your opinion, or you should not judge other people's work at all. It is thus not surprising that censorship and outright corruption have become the norm!

It has become customary to "address" the latter problem by using two peer reviewers and even (so-called) "double-blind" reviewing: But a bit of intelligent thinking should convince anybody with common sense that such measures are inadequate: They are not even as effective as a pregnant girl rubbing her tummy with "vanishing cream".

In all cases where I have been a referee and have recommended publication because the physics-logic was sound, even though the manuscript challenged mainstream ideas, the other referee and editor overruled me - except once when I succeeded (after again putting up a fight) to get the editor of *Physical Review Letters* to allow publication. But the latter case is the exception which proves the rule! Even so, the manuscript was only published after the editor and the other referee forced the authors to attempt an explanation in terms of mainstream-dogma!

A young Albert Einstein (1879-1955) would have had no chance whatsoever to have gained any recognition at the present time! How can any sect allow an unknown patent-clerk to publish radical new ideas at variance with mainstream-dogma? The "gatekeepers" must protect the public from such heresies! No wonder the Nazi-gatekeepers disdainfully called Einstein's contributions "Jewish physics". It seems that at present the same mentality is in control of physics!

When I happened to point out in a scientific discussion-forum on the internet that a well-accepted hypothesis in physics might be wrong, I was admonished as follows: "*If hundreds of thousands of professors and their graduate students did not find anything wrong over many years, then you don't either!*" One can well imagine a religious expert admonishing Richard Dawkins that "*If millions of priests and their followers did not find that there might be "no God" (over 6000 years) then you don't either!*" The time and number of experts involved in the latter case are far more convincing.

1.8 Goebbels' ghost

I have been forced to conclude that present-day physics is being built (like Ptolemy's model) on premises which are accepted to be true because they have been repeated so often that it is firmly believed that they must be true. Joseph Goebbels (1897-1945), Adolf Hitler's (1889-1945) propaganda-minister knew the effectiveness of this approach: He knew that when a lie was regularly repeated, it eventually became accepted as truth. Thus, for obvious reasons, I will call the wrong beliefs which have become embedded into physics, "goebbelisms".

It will be shown in this book that there are goebbelisms in physics which have become so entrenched that they are in undergraduate text books. According to impeccable logic there is even a goebbelism by Einstein: He derived from his special theory of relativity that an observer will see that a moving rod shrinks in length along the direction within which it is moving: He did not realise that this derivation violates the very postulates on which his special theory of relativity is based (see section 7.3.4).

This supposed "Lorentz-Fitzgerald length-contraction" has been postulated by Hendrik Antoon Lorentz (1853-1928) and George Francis Fitzgerald (1851-1901) in order to explain why it is not possible to measure the speed of the earth relative to the ether. At that time it was believed that light-waves move within a stationary medium (the ether) which fills the whole universe. Einstein postulated that such a medium does not exist and then blissfully went ahead to derive a result from his equations which should only occur if such a medium does exist.

Or can it still manifest even when light is not moving within ether? It will be shown in section 7.3.4 that see the front and rear ends of a moving rod are also separated in time, and can thus not be used to define a simultaneous length for the rod. It will also be argued that if Einstein did not make this "little blunder", the physics-origin of the de Broglie wavelength for a moving electron would have been crystal clear years ago (see section 34.7).

To discuss all the goebbelisms within physics will require another book, or an encyclopaedia of books dedicated solely to such a task. I will not attempt to write such a book, since I will most probably miss many goebbelisms owing to my own training: I have also been indoctrinated by concepts which are wrong, but accepted as holy dogma by the "physics-church".

Therefore, only those goebbelisms will be touched upon which are of relevance to the intended scope and contents of the present book: i.e. to relate my journey during the past 10 years which has led me inexorably to the shocking realisation that today's leading physicists and the institutions that they control are more bigoted than any fundamentalist religious person, or organization, or lay-person can ever hope to be.

Amongst the many goebbelisms, which will be encountered in this book, there are three which relate to superconduction and therefore form a thread throughout this book: Therefore they will already be mentioned and summarised at this point: To do so, physics-concepts will be used which might be unknown to readers who are non-specialists: Concepts like electric-field, electric-resistivity, charge-carriers, the phase-angle of a wave, etc. These concepts will be explained in more detail as we progress through this book.

In fact, they have to be spelled out in more detail since, as will be seen in this book, our present day theoretical physicists also do not understand them. Thus, the descriptions of these three goebbelisms serve as opening salvos: A setting of the stage for what will follow in more detail.

(i) *The validity of Ohm's law:*

When Onnes discovered superconduction in 1911, he observed that the voltage measured across any two separated contacts to the material decreases to an immeasurable small value when an equilibrium superconducting-current initiates and flows through the material: He eventually concluded, without being able to prove it experimentally and without any impeccable logic from related experimental data, that the voltage is actually identically zero across the two contacts.

This mandates that in his experiment there cannot be a conservative*, static electric-field that is driving the current within the material; even though the material forms an element within a circuit for which there must be such an electric-field at every point within the circuit; also within this material when it is not a superconductor.

This experimental fact is so important that it needs repeating: To date it could never be directly proved by experiment, or impeccable logic that an applied, static, conservative electric-field is, or must be, cancelled to be exactly zero while a current is flowing through a superconductor. In the first instance this is so since it is impossible to construct a voltmeter which can measure zero-voltage. Secondly there has been no related physics known from which it could be proved by direct logical deduction that an applied, static, conservative electric-field within a superconductor must be zero. The only corroborating evidence comes from experiments using a circular electric-field which, however, switches off on its own when the time-dependent magnetic-field, which is causing it, becomes constant; even when the material is not a superconductor.

The latter has been the situation until the experiment mentioned in section 1.6 (and described in more detail in sections 11, 12 and 13) for the first time ever proved unequivocally that it can actually happen that an equilibrium-current flows while an applied conservative electric-field must be completely cancelled by an opposite polarisation-field. In the latter experiment it must be so since the incontestable laws of thermodynamics (see sec-

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**What is meant by a "conservative" field will be explained in detail in section 7.3.*

tion 7.2) and electrostatics (see sections 7.4, 9 and 12) demand that it must be so. It is impossible to be otherwise.

For nearly 100 years it has been accepted in the scientific literature that it is sufficient to understand the relationship between the cancellation of an applied conservative electric-field within a superconductor, and the equilibrium-current flowing at the same time through a superconductor, by simply concluding that the superconductor has "zero electric-resistance". In fact, Onnes initiated this misconception by representing his results in terms of a graph of electric-resistance as a function of temperature; instead of using what he actually measured: Namely the voltage across two contacts.

He should have realised that the concept of "zero electric-resistance" has never been defined anywhere in the scientific literature before he did his experiment; and this is still the case at present. This simple fact has also not been appreciated by the *hundreds of thousands of professors and their graduate students* since 1911. Why? Because they erroneously believed that the concept of "zero resistance" is predestined by "Ohm's law".

It is a great pity that Ohm's empirical relationship between an applied voltage V across a resistor and the current I flowing through a resistor, has been called Ohm's "law". It is not a law of nature but an empirical relationship which was experimentally established to manifest within a conductor when the charge-carriers suffer so many consecutive acceleration-scattering events that one can approximate their movement by an average, constant drift velocity: If Ohm's law does apply for zero resistivity, one must explain how a constant equilibrium-current can flow with a constant drift velocity without requiring multiple acceleration-scattering events.

The important point which has been totally missed by "*hundreds of thousands of professors and their graduate students",* for nearly 100 years, is that when such multiple acceleration-scattering events do not occur, Ohm's law, as it had been experimentally derived, does not apply at all since a constant equilibrium-current with a constant drift-speed is then not possible. Zero electric-resistance can thus not be proved by invoking Ohm's relationship which demands non-zero resistivity in order to be physically valid. Since there had been no previous proof that a constant, equilibrium-current can flow with zero resistivity, it is really the discovery of superconduction which for the first time ever experimentally proved that this is possible. But it did not explain why it is possible.

The incontrovertible fact is that one must first understand the mechanism that is responsible for superconduction before one can understand why an equilibrium-current can flow without requiring multiple acceleration-scattering events to ensure that the current is an equilibrium-current with a constant speed: Only then will one be in a position to define what "zero resistance" physically means! Thus, the mere invocation of the concept of "zero resistance" does not explain superconduction, since it is the really mechanism that causes superconduction which should first be known in order to explain and define what "zero resistance" really is.

It is because of the latter fact that the presently-accepted models on superconduction are all completely irrelevant and just plain wrong! They all concentrate on only explaining the absence of scattering of charge-carriers, and then claim that this absence of scattering is sufficient to cause a zero electric-field within a superconductor. This they do without realizing that the absence of scattering, although required, cannot ensure an equilibrium-current that flows at every position along its flow with an average constant drift-speed.

There is no physics-law which mandates that the absence of scattering within a conductor on its own will prevent charge-carriers from being accelerated by an applied electric-field. According to Newton's second law, when acceleration of charge-carriers occurs, there must be a potential difference between any two points within the material along the direction in which the charge-carriers are being accelerated; even when the charge-carriers experience no scattering whatsoever. In the latter case the speed of the charge-carriers is not everywhere the same as it must be for an equilibrium-current with a constant drift speed. Thus, to postulate a mechanism which allows charge-carriers to flow through a material without scattering is not sufficient to explain why and how an equilibrium-current is possible through a superconductor without a voltage being present.

The incontestable fact is that, at present, there is not a single model within the accepted scientific literature which is capable of explaining the fundamental, defining-characteristics of superconduction: Namely, why and how an applied, conservative electric-field is cancelled within such a material as soon as it becomes superconducting; and why an equilibrium-current with a constant drift speed then still keeps on flowing through the material as if the charge-carriers are still being accelerated and scattered all the time.

Are physicists really so stupid that they cannot understand the latter simple incontrovertible logical fact? I believe that they just do not want to concede; since once they do, they will be compelled to admit that the presently-accepted models on superconduction are all wrong: i.e. that there are at least six physicists who received Nobel Prizes for wrong physics. Furthermore, they will next be compelled to admit that there are large sections of quantum physics, based on the same concepts, which are completely wrong: i.e. at least another fifteen physicists who received Nobel Prizes for wrong physics.

They do not want to accept that it is not a scandal when well-accepted physics is proved to be wrong: In fact, when this happens, it usually advances physics. It is, however, a scandal when the information which could prove that accepted physics might be wrong is being suppressed and censored; as is happening at present.

Why is this happening? Just imagine the "*hundreds of thousands of professors*" who taught and did research on superconduction: They are suddenly confronted with the incontestable fact that what they are teaching, and the paradigm within which they have been doing research, have been wrong for more than 50 years. This is just too horrible for them to contemplate: They thus rather feign a "sudden" inability to understand when the simplest empirical relationship in physics ever, namely Ohm's law, applies and when it does not apply.

In addition, those physicists who have not been directly involved in the field of superconduction, stay out of the fray by claiming that they are not "experts" in the field: Can it really be true that the majority of physicists alive today are not expert enough to understand the limitations of Ohm's law? Impossible!

Arthur Schopenhauer (1788-1860) said: "*All truth passes through three stages. First, it is ridiculed. Second, it is violently opposed. Third, it is accepted as being self-evident."* This is exactly what I have been experiencing during the last ten years when I tried to explain the limitations of Ohm's law to physicists. I have not yet reached the third stage; but expect that it must be reached in the future, since the limitations on the applicability of Ohm's law are really self-evident.

I expect, however, that once that stage has been reached, it will be used to humiliate me. It will be concluded that I did not contribute anything new because what I have said is "*self-evident*". At least I agree that it should be *"self-evident"*: But so far I have not found many physicists who are willing to even try and understand this *"self-evident"* fact! If they had been, they would have realised long ago that all the models for superconduction (except the one in section 23 of this book) are flawed.

It seems that physicists with open minds started to die out when Einstein and Schrödinger passed on. Two of the most tragic subsequent losses were John S. Bell (1929-1990) and Bernd Matthias (1918-1980) both of whom sadly passed away at relatively young ages.

(ii) *Model for the Aharanov-Bohm effect*

Another prime example of a goebbelism, which will be visited and revisited in this book, is a model originally proposed by Yakir Aharanov and David Bohm (1917-1992): They predicted that a magnetic-field through a long solenoid will shift a (double-slit) electron diffraction pattern sideways (see sections 7.5 and 35 for an explanation of double-slit diffraction). Such a shift was subsequently experimentally demonstrated, and has thus become known as the "Aharanov-Bohm effect".

In their predictive publication, Aharanov and Bohm surmised that an electron's charge can experience the presence of a magnetic-field even when this charge does not move directly through the magnetic field: This can supposedly happen owing to "gauge invariance"*. It will be argued, and proved by example in this book that in all the experiments which had been done to verify the Aharanov-Bohm effect, the centre-of-charge of the relevant electron always moved smack-bang through the magnetic-field! (See, for example, section 35.6).

Aharanov's and Bohm's derivation invokes a "quantum phase-angle" S which supposedly forms part of an electron's harmonic wave-amplitude and supposedly carries "information about the electron's past history" (see section 35.2). It will be shown in this book that such a phase-angle can never form part of any harmonic wave-amplitude, even when such a wave has a complex-amplitude; as is the case for an electron-wave (see section 7.5.11). Furthermore, their model is based on suppositions which violate the inviolate rules of elementary vector-calculus, as well as the elementary physics which models the formation of magnetic-fields.

An amazing claim is it not? Is experimental verification then not sufficient? Unfortunately not always: Especially not when the model violates the fundamental principles of mathematics. Common sense is also required. It is possible to be experimentally vindicated even when your model violates physics and mathematics.

It should be pointed out that there are other physicists who have objectted to the derivation by Aharanov and Bohm. Unfortunately their arguments did not go to the heart of the matter. The fact is that the Aharanov-Bohm derivation is wrong because it is based on physically-impossible postulates: i.e. it is based on the assumptions that quantum physics must be modelled in terms of "probability-amplitudes" (see section 1.9.3 below) and that these amplitudes have quantum phase-angles S which change continuously (and even non-linearly) with the position of an electron. As will be seen in this book, all quantum physics which relies on these concepts must be fatally flawed; no matter if it seems to model what is observed. Any correspondence with reality is fortuitous (see section 30).

The assumption that such a phase-angle S always changes "continuously"† with the "position" of an electron is used to apply the operators of calculus to the phase-angle as if it is a scalar field in space which, in contrast to the laws of mathematics, can have a gradient that is a non-conservative vector field (see section 7.3 for further information on fields). The operators of calculus will be discussed in increasing detail as we progress through this book. As will be seen in section 7.5, a continuous phase-angle can only form for a harmonic wave when it is a coherent‡, running wave, and this phase-

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* *When reading this book further, the concept of "gauge invariance" will become clear.*

† *Continuous space is discussed in more detail in section 1.9.2.*

‡ *The meaning and implications of the terms "coherent" and "wave front" will become clear further on in this book (see also section 7.5).*

angle then only changes linearly with position along the directions into which the wave-fronts are moving (see section 7.5.14). For all other harmonic waves the corresponding phase-angle has discontinuous changes with position. Thus, any derivation which relies on applying calculus to a phase-angle which supposedly can be a continuous, non-linear function of position under all circumstances (exactly what Aharanov and Bohm have done) is not based on the physics of harmonic waves.

(iii) Cooper pairs

A goebbelism which is found in every text book on superconduction is the following: "*For superconduction to occur the electrons must form pairs*".

According to a model which had been proposed by Leon Cooper, such pairs are formed within metals when the electrons are able to interact suitably with atomic vibrations within the metal. This goebbelism gained support from measurements on superconducting metals which led to the deduction that the charge-carriers responsible for superconduction are doubly-charged: i.e. each charge-carrier supposedly has a charge $q = -2e$, where e is the unit of charge on a single electron. It will be argued in this book, that the theoretical analyses which were, and are being used to interpret the results measured for these experiments, are wrong.

One of these experimental results is derived from measurements to determine the minimum magnetic-flux which can be trapped through a superconducting ring around which an electric-current is flowing (see section 25). Unfortunately, the mathematics, which is used to arrive at the deduction that the charge-carriers are doubly-charged, is based on the Aharanov-Bohm approach; and it is therefore wrong. When doing the correct derivation, it is found that the factor 2 does not relate to a double-charge at all (see section 25.7): In fact, if the charge-carriers were to have been really doubly-charged, the interpretation according to the Aharanov-Bohm model would have led to the experimental conclusion that the charge on each charge-carrier must be $q = -4e$.

Another experimental measurement, which is used to support doubly-charged charge-carriers, has been to measure, what is called, the AC Josephson-effect (see section 28.5): This is done by irradiating a so-called SIS-sandwich, consisting of two superconducting layers on both sides of an insulating layer with electromagnetic waves while a current is flowing through it. Voltage-steps followed by current-steps appear that are called Shapiro steps): The voltage difference between these steps supposedly prove that the charge-carriers are doubly-charged.

But this interpretation rests on the assumption by Josephson that a DC-voltage across the I-layer, between the two SC-layers, is sufficient on its own to cause a classical AC-current within the SIS-sandwich, which then passes charge-carriers to and fro through this I-layer. But the latter behaviour has never been convincingly demonstrated experimentally. The reason for this is that it a physical impossibility to place a DC-voltage across the I-layer while superconduction is occurring through the SIS-structure (see section 28.5).

1.9 The demise of common sense

1.9.1 Copenhagen: The city of fairy tales

The greatest source of many goebbelisms, which have led and still leads to wrong physics (like the model of the Aharanov-Bohm effect), is the "Copenhagen-interpretation" of quantum physics; which has been formulated by Heisenberg, Max Born (1882-1970) and Niels Bohr (1885-1962). As will be shown in this book (by quoting existing experimental data and by applying impeccable logic) these gentlemen led the "physics-church" through the looking glass into Alice's Wonderland. They did not realise that their interpretation is in violation of the most important foundation-stone on which all physics is based; namely Galileo's inertia.

Since the Copenhagen-interpretation will raise its head regularly in this book, it is worthwhile, already at this introductory stage, to summarise its most important postulates and how this interpretation of quantum physics, to the detriment of the future of physics, came to be accepted after it was forced down the throats of the leading physics-establishment during a "blitzkrieg" in 1927 at a now famous conference which was held in Brussels, Belgium (The 5th Solvay conference on *Electrons and Photons*): And how Einstein lost the battle but, as will be seen in this book, fortunately not yet the subsequent war.

1.9.2 Heisenberg's uncertainty-folly:

In order to oppose the interpretation that the intensities of Schrödinger's waves might represent physically real entities within three-dimensional space, Heisenberg used "thought-experiments" to postulate, what has become known as, "uncertainty relationships" between suitable pairs (so-called "canonically-conjugate"* pairs) of physical parameters which model a "particle" in terms of Newton's and Einstein's classical mechanics.

The two best known "uncertainty relationships" are the relationship for position x and its so-called "canonically-conjugate" momentum p; and the relationship for time t and energy E: In modern text books Heisenberg's "uncertainty relationship" for position and momentum is given in a tighter format than the formula originally derived by Heisenberg. This is so since this relationship can be calculated directly from Schrödinger's equation; according to which it can be written as:

**In general terms this means that the one parameter can be derived from the other by means of calculus (see below).*

$$\Delta p \Delta x = g\hbar \qquad \text{where} \qquad g \geq ½ \tag{1.1}$$

The value of g is determined by the intensity distribution of the Schrödinger wave within three-dimensional space: It can never be less than ½. The Greek symbol Δ (delta) is used to denote “an interval” or “a part off”, and $\hbar$ is known as Planck’s reduced constant. It is the original constant h postulated by Max Planck (1858-1947) in 1900 divided by 2π; where π is the number “pi” obtained when dividing the circumference of a circle with its diameter (see section 32.4): According to Planck’s postulate, a light-wave with angular frequency ω cannot have less energy than an amount ΔE which is given by:

$$\Delta E = h\nu = \hbar\omega \tag{1.2}$$

Why the angular frequency $\omega = 2\pi\nu$ has been introduced instead of sticking to the actual frequency ν, as had originally been used by Planck, will become clear in section 7.5 when discussing the important concept of a phase-angle for a harmonic wave.

As will be seen, many highly acclaimed modern theoretical physicists do not understand what a phase-angle for a harmonic wave really means: Like Aharonov and Bohm they choose phase-angles to fit the physics without realising that the phase-angle of a harmonic wave is determined by the boundary conditions under which the wave finds itself. The phase angle cannot be chosen to fit experimental results while ignoring the actual boundary conditions which prevail. When doing this the theoretical physicist is practising Voodoo!

The problem was, and still is, that Heisenberg not just interpreted that, but stubbornly insisted that, the entities Δx and Δp in Eq. 1.1, are “uncertainties” in the actual position and actual momentum of an electron “point-particle”. There is a large amount of literature on Heisenberg’s relationship for position and momentum: Many arguments and viewpoints exist, and, when reading the literature, it seems that even Heisenberg had backtracked on certain occasions - but unfortunately not for long enough to become realistic. At present the officially accepted version, as presented in text books, is that this relationship for position and momentum is a law of nature which is valid around the “most probable” point-position where a “point-particle” will be found when making consecutive, impeccable measurements on identical “particles”.

A compelling argument why the latter relationship cannot relate to the point-position of a particle, is the fact that the speed of such an hypothetical particle (when it is at a point-position x) is mathematically derived by using calculus: i.e. in order to determine the speed v of such a particle at a point-position x at a time t, this point-position x is differentiated* by using a time differential-operator*. In fact, the particle does not even have to be a point-particle since a body with mass, no matter how large, has a centre-of-mass which defines its position at a single point x.

To understand what is meant by "differentiating a point-position" we must first define what is actually meant by a "point": A point has no size: What does the concept of a point-position in space mean in terms of points which have no size? It requires space to be "continuous". What the latter means is that it is impossible to construct a small volume which can become small enough so that it only surrounds a single point. Choosing, for example, a spherical volume, then no matter how small the radius becomes, the sphere will always surround an infinite number of points. Only when the volume of the sphere actually becomes zero can one argue that it "surrounds" a single point: But this is of course an oxymoron situation since then there is not a sphere anymore which can surround a point. Nonetheless, one can argue that when space is continuous and the volume of the sphere approaches zero, it will "in the limit" define a single "point position". Clever Newton!

When deriving the speed v of a particle at such a point-position x, the calculus-method is as follows: A small non-zero distance-interval Δx, through which the centre-of-mass of the particle will move during a further time-interval Δt, is chosen at time t at the point position x where the particle is located at that very instant in time. One then calculates the average speed v_a during this time-interval by dividing the distance-interval with the time-interval: i.e.

$$v_a = \frac{\Delta x}{\Delta t} \qquad (1.3)$$

Obviously, the smaller one can make Δx and Δt, the better the accuracy will be with which the speed (at the position-point x) will be known.

This is where the beauty of calculus comes in: Just as a point-position is defined "in the limit", the mathematics of calculus allows one to also derive the speed v "in the limit". "In the limit" obviously means that the speed is obtained by allowing Δx and Δt to go to zero; just as the volume of a sphere goes to zero to define a point-position. This means that one ends up with the actual speed v at the actual point-position x at the actual instant in time t: It is similar to reading the speedometer on your car which in essence differenttiates distance with time in order to determine the speed at any position and instant in time. In calculus, this procedure is represented by a time differrential-operator which operates at the point x to generate the speed v at exactly the same point-position. This operator is written as:

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* *What is meant by differentiation and differential-operators will be explained and discussed in increasing detail as we proceed through this book.*

$$\frac{d}{dt} \tag{1.4}$$

When operating on x, one writes that:

$$v = \frac{d}{dt}x = \frac{dx}{dt} \tag{1.5}$$

Note that this expression looks like Eq. 1.3 but with the Δ's replaced by d's. This is to emphasise that when using this differential-operator, Δx, Δt and thus Δv all end up being zero "in the limit".

If there is no uncertainty in the position of a particle at a point-position x, one must conclude from this derivation that there must also be no uncertainty in the speed v at the point-position x: To repeat: This mathematical process mandates that when the position of the centre-of-mass of the particle manifests with 100% certainty at a point-position x, the speed v must also manifest simultaneously with 100% certainty at exactly the same point-position. Since the momentum p of a particle is its speed v multiplied by its mass m (see section 7.3.2), this means that the point-position x of a particle and its canonically-conjugate momentum p must manifest simultaneously at exactly the same point-position without any uncertainties involved when any one of them is a certainty.

Thus, if Heisenberg's interpretation is correct, it mandates that the momentum of a particle cannot be derived from its position by using the mathematics of calculus. There must then exist an alternative way to derive and calculate the momentum of a "point-particle". Heisenberg did not give any indication how this must be done. In fact, even his matrix-theory implicitly relies on the validity of using calculus to derive the momentum from the corresponding point-position; and should thus be commensurate with **no** uncertainties in both the position and momentum when the point-position is certain: The "canonically-conjugate relationship" between momentum and position is actually defined by the fact that this momentum is derived from its canonically-conjugate position by time-differentiation.

But maybe space in our universe is not continuous: A possibility is that space in our universe consists of discrete, separately definable position-points with "nothing" between them; whatever "nothing" might mean in this context: Some modern day quantum physicists argue that according to "quantum field theory" this is the case: That there exists a so-called "Planck-length" which supposedly separates the points in space to be discrete entities. Such a discrete point can thus be surrounded by a mathematical sphere which does not surround other points, so that one can argue that there actually is an uncertainty in the position inherent in space. When now using calculus, "in the limit" cannot be invoked to define a point-position with 100% accuracy but only within the accuracy defined by the Planck-length: It is argued that such a collection of points forms a so-called "quantum-foam".

There is no experimental proof whatsoever that “quantum-foam” actually exists. I believe that it does not exist because this concept leads to infinities in the theory of quantum field physics that have to be removed by dubious mathematical tricks which have been baptised as “renormalisation”. Basically it means that one does not get the result one wants, and therefore proceeds to “cook” the mathematics to get what one wants. A full discussion of quantum field theory will take us way beyond the original intent of this book and will thus not be pursued here. It will, however, be mentioned when required to do so (see, for example, section 38.2). Suffice to note that even if quantum-foam does exist, the Planck-length is so much smaller than the Heisenberg “uncertainties”, that it can be neglected as if space is continuous when deriving the speed of a particle at a point-position.

One could, however, argue that although both calculus and common sense demand that the position and conjugate momentum must simultaneously manifest at exactly the same point-position with 100% accuracy, it is impossible to measure these parameters accurately enough so that there will not be uncertainties in the position x and momentum p. Although Heisenberg did use arguments based on measurements (see sections 1.9.9 and 36.4), the interpretation that he proposed, and which unfortunately became accepted, is not based on the ability of an apparatus to measure with 100% accuracy: The latter is always impossible.

What he maintained, and what is still maintained in text books on quantum mechanics, is that even if you could measure the point-position x of the electron with 100% accuracy (so that the uncertainty-interval Δx becomes zero), one will and must find an uncertainty interval Δp in the value of the momentum which is infinitely large; and *vice versa*. These uncertainties are thus built into the physics-fabric of nature. They have nothing to do with the ability or non-ability to measure with 100% accuracy. They will be there even if one could measure with absolute accuracy: Which we all know is impossible even for large objects like beach balls. In fact, it is probably more difficult to measure the position of the centre-of-mass of a large object with high accuracy than this position for a smaller object.

Since Schrödinger’s wave-equation models an electron as a continuous, harmonic wave-field, this field like any other harmonic wave-field ever known must have an intensity-distribution within position space as well as a dual intensity-distribution within so-called “reciprocal space”. <u>All</u> harmonic waves <u>always</u> exist within both position-space and reciprocal-space. This is an incontrovertible experimental and theoretical fact which no physicist can dispute!

For a Schrödinger wave, there is, however, an assumed relationship between its reciprocal-space and the “momentum-space” of an “electron-particle”: This relationship is supposedly defined by de Broglie’s relationship between momentum and inverse wavelength (see section 1.9.4 below). It is for this reason that Heisenberg's "uncertainties" in position and momentum, and the relationship between them, can be derived from a Schrödinger wave.

The latter fact is, howoever, compelling evidence that these "uncertainties" must be exclusively wave-related and thus have nothing to do with actual "uncertainties" in the actual position and actual momentum of a "particle". For some inexplicable reason, the Göttingen-Copenhagen alliance did not want to consider such a physically-consistent explanation.

1.9.3 Born the gambler:
Göttingen University, where Heisenberg, Born and Pascual Jordan (1902-1980) were busy developing Heisenberg's matrix-mechanics further, was under threat of losing its leading position in the field of quantum mechanics to Schrödinger's wave mechanics.

Born justified Heisenberg's "uncertainty" interpretation for position and momentum as a "particle-relationship" by postulating that the intensity of an electron's Schrödinger-wave is a "probability-distribution" of where an electron point-particle will be found if its position could be measured with 100% accuracy: Thus, although Δx and Δp can be calculated from a Schrödinger-wave, they supposedly do not relate to actual wave-sizes within space and reciprocal space, as is the case for all other harmonic waves ever studied before, but rather to "uncertainties" around the most probable position and the most probable momentum of an electron.

It has thus become accepted holy-dogma that if it were possible to measure the position of an electron with 100% accuracy, the Schrödinger wave-intensity (with "uncertainty" Δx in position-space) which "represents" the electron before the measurement is made, must "instantaneously collapse" in position-space to become one of the points lying within the wave-intensity to, in this manner, reveal the exact position of the particle. Before the position-measurement is made, the electron can supposedly be anywhere within the intensity distribution of the wave: All positions at which the wave-intensity is not zero are possible. Only a measurement can supposedly assign an actual point-position to the electron.

But once the position has been measured, the uncertainty Δx in position has become much smaller; in principle zero. Therefore Eq. 1.1 then demands that the wave-intensity in momentum-space must simultaneously-"instantaneously" inflate so that it becomes extremely large in size; in principle infinite: For this reason one supposedly loses most, if not all, information on the momentum of the particle. Similarly, if it were possible to measure the momentum with 100% accuracy, the wave-intensity in momentum-space must "collapse instantaneously" into a point, thus giving a value for the momentum of the electron: This, in turn, mandates that the wave-intensity within position-space must now "simultaneously-instantaneously inflate" to become extremely large in size. One then supposedly loses all information on the position of the particle.

In order to determine the value of Δx, one must (according to Born's interpretation) measure the point-position of an electron with 100% accuracy for a large number of electrons, each represented by an identical Schrödinger-wave (a so-called ensemble of electron-waves). One will then obtain a statistical spread in the positions which are being measured; and this will mimic the intensity-distribution of such a Schrödinger-wave. From this distribution one can then calculate the most probable position $\langle x \rangle$ and the "uncertainty" Δx around this most probable position by using well-known statistical formulas for the average value and the so-called standard-deviation from the average value. If it were possible to do many measurements of the momentum with 100% accuracy on such an identical ensemble of electron waves, one can in the same way derive $\langle p \rangle$ and Δp. The product of Δx and Δp determined in this manner should then define Heisenberg's "uncertainty" relationship.

Probability-distributions play an important role in our lives: For example, the actuarial tables which are used to determine the viability of insurance-policies are based on such distributions of the age and demographics of human-populations. It is uncanny that there is a probability-distribution which occurs so frequently that it is called the "normal distribution". It is also amazing that this distribution has exactly the same shape as a so-called Gaussian-wave, and that for a Schrödinger-wave with a Gaussian intensity-distribution the product of Δp and Δx is exactly equal to $\frac{1}{2}\hbar$. For all other wave-shapes this product is larger (therefore the $\geq$ symbol has been used in Eq. 1.1). The equivalent normal distribution is shown in Fig. 1-1 for a statistical-variable x.

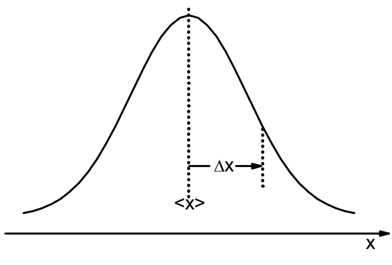

Figure 1.1: *The normal-distribution for a statistical parameter x.*

If this symmetric probability-distribution is valid when measuring x, one will, of course, find that the measurements will more often give values where the intensity of the distribution is the highest: i.e. they will give the "centrum" or "average value" $\langle x \rangle$ as shown in Fig. 1-1: Furthermore, most of the rest of the measurements will have values around <x>. According to Born, the most probable position where an electron will be found (called the "expectation-value") is thus the "average value" <x>; and Heisenberg's "uncertainty" in position around this "expectation-value" is given by the standard-deviation Δx around the average value <x>.

It is astonishing that Born's interpretation could have been considered seriously as real physics by anybody! Both Einstein and Schrödinger opposed it until their deaths: Einstein famously said: "God does not play dice!" Incredibly, there are experiments which seem to be in accord with Born's interpretation: In these cases many measurements on an ensemble of identical waves, can generate a "pixel-picture" of the wave-intensity.

It will, however, be shown in this book (see section 33), that the latter statistical-behaviour is caused by resonance-interactions between a suitable measuring-apparatus (having a high density of pixel-type measuring-sites) and an ensemble of electron-waves, and not because a Schrödinger-wave's intensity is an actual probability-distribution of the position of a particle within three-dimensional space. The different outcomes are defined by what the measuring apparatus can measure, and not by the wave-intensity on its own. The statistical behaviour in such a case is thus "normal" statistical behaviour, as found in any casino, which manifests when the measuring apparatus allows different possible outcomes.

It should be obvious that when measuring position, the size and geometry of the measuring apparatus must play a role: For example, one can measure the positions of an ensemble of identical electron-waves by recording the spots where each electron strikes a very large screen. Alternatively, one can build a measuring apparatus of the same material but which now consists of an extremely small screen. According to Born's interpretation, the measuring apparatus plays no role; only the identical intensity of each wave constituting the ensemble.

This would thus demand that the ensemble of electrons being measured with the small screen must form the same statistical distribution of points in space as is measured on the large screen: This, in turn, demands that most of the waves will collapse at points within space around the small screen: i.e. at points where the measuring apparatus cannot measure. It is obviously absurd to conclude that the large screen and the small screen will give identical results when measuring the positions of an ensemble of identical impinging electron-waves.

Furthermore, if the average value or centrum <x> is the "most probable" position to find an electron, then all Schrödinger-waves must have a symmetric, single maximum-intensity; as in the case of the normal distribution: Only around such a maximum-intensity can the intervals Δx and Δp be interpreted as "uncertainties" in the actual position and actual momentum of a "particle": i.e. only for such a wave can Heisenberg's interpretation of his uncertainty relationship be commensurate with Born's interpretation that the intensity of a matter-wave defines a probability-distribution.

The fact is, however, that the calculated value <x> for most Schrödinger-waves cannot be consistently interpreted as the "most probable position" of a particle. The majority of Schrödinger waves do not have a unique highest intensity which can correspond to the "most probable" position being given by the average value <x>: Many waves have identical maximum intensities at different positions: Even when the calculated value of <x> corresponds to one of these intensities, why would this intensity peak represent a "more probable" position than the other equally-intense peaks? All such peaks must represent equal probabilities!

Even worse, there are many Schrödinger-waves for which the calculated value <x> is found where the wave's intensity is actually identically zero (see section 8.6.2). It is really a strange "probability-distribution" where the "most likely position" to find an electron is at a point where the probability of finding the electron is exactly zero and nothing else but zero! It is absurd to even calculate an "uncertainty in position" around a position at which the electron can never be found!

Consider, for example, the situation where there are two birthday parties within a restaurant: One for a 70th birthday attended by people with ages around 70, and one for a 10th birthday party attended by the same number of people with ages around 10. One can generate a probability distribution for encountering a person with a certain age when entering the restaurant. This distribution will have two peaks around 10 and 70: For the sake of argument, suppose that the two peaks are identical so that one obtains the probability distribution shown in Fig. 1-2:

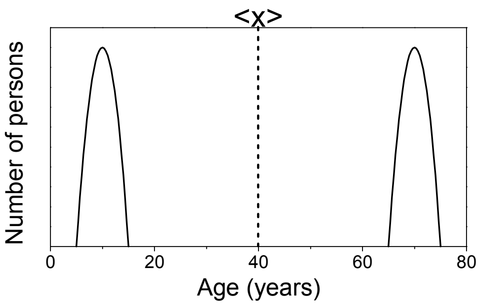

Figure 1-2: *Probability distribution of people attending two birthday parties in a restaurant. The average age of the people is <x>=40 years, but this is not the expected age for a person in the restaurant. This illustrates the impossibility of Max Born's probability-interpretation which he proposed for the intensity-distribution of a Schrödinger wave.*

One can then calculate an average value <x> for the ages of the people in the restaurant and find that it is 40 years: However, it is obviously nonsense to argue that when entering the restaurant, the first person one will encounter has a high probability to be 40 years old; and that the ages of the people in the restaurant will form an "uncertainty-interval" around this age.

What can be said is that when entering the restaurant one has a 50-50 chance of meeting a person with an age around 10 years or a person with an age around 70 years. The concepts of a "most probable age", and an "uncertainty in age" around this "most probable age", are in this case meaningless! An analysis of the solutions of the Schrödinger equation shows that this is also the case for the intensity of the majority of Schrödinger waves: This proves without any doubt that Max Born's probability-interpretation for the intensity-distribution of a Schrödinger wave must be wrong. He received the Nobel Prize in 1954 for this probability interpretation.

Clearly, there must be another interpretation for the intensity of a Schrödinger wave: There is another logical interpretation which is so obvious that it is acutely embarrassing that "*hundreds of thousands of professors and their students*" (including me during most of my career) could for more than 80 years not see this. It will be shown in section 8.6.3, by using a simple derivation based on solid state physics, and invoking Einstein's well known mass-energy relationship, that the core-intensity of an electron-wave <u>must</u> be its distributed mass; while its intensity-tails, which decay exponentially "towards infinity" most probably relate to the curvature of space around this core-mass (see also section 34). Einstein's well-known energy-mass relationship is given by:

$$E = mc^2 \qquad (1.6)$$

It is thus compelling to conclude that the centrum of an electron-wave's intensity <x> corresponds to the centre-of-mass of the wave-entity: It is well-known that the centre-of-mass of a body can be within a region where the body has no mass: i.e. where the "intensity of mass" is zero: For example, the centre-of-mass of a hollow ball is at the geometric centre of the ball where there is no material present. Thus, it is not surprising that <x> can be at a position where the intensity of the wave is zero!

1.9.4 de Broglie waves

Schrödinger <u>guessed</u> his differential wave-equation by basing it on a postulate which had been made in 1924 by Louis de Broglie (1892-1987): De Broglie proposed that an electron-particle moving with constant momentum p must have a coherent, harmonic wave "associated" with it; and that the momentum p of such a <u>moving</u> electron-particle is inversely related to the wavelength λ of such a wave through Planck's constant. In terms of Planck's reduced constant ($\hbar$) de Broglie's relationship is:

$$p = \frac{h}{\lambda} = \frac{2\pi\hbar}{\lambda} = \hbar k \tag{1.7}$$

Where we choose, for reasons which will become apparent, to set:

$$k = \frac{2\pi}{\lambda} \tag{1.8}$$

The parameter k is called the "wave-number" of the wave*. Note that k is inversely proportional to the wavelength: It has a reciprocal relationship with length. The wave number thus defines the wave's presence within reciprocal space. For this reason Schrödinger ended up defining his wave equation within a momentum-space instead of reciprocal space; as is the case for all other harmonic waves ever discovered.

De Broglie's postulate has been vindicated by demonstrating that electrons, which move with momentum p, diffract when they are reflected by atoms that are periodically arranged on a crystal-lattice; and that the wavelength responsible for this action indeed corresponds to λ as postulated by Eq. 1.7.

Diffraction of a wave is the ability of a wave to bend around an obstacle. The longer its wave-length λ is, the larger the objects become around which it can bend. Therefore one can hear sound waves around a corner. Such bending (or diffraction) is the ultimate proof that the transfer of energy from one point to another occurs by wave-movement. When energy is transferred by "particles" from one point to another, such bending cannot be possible.

Thomas Young (1773-1829) used a diffraction experiment to prove in 1801 that light bends when it is sent through two narrow slits; and that therefore light must consist of waves. Since this contradicted Newton's concept of "light particles", Young also had to endure derision, but fortunately not for so long and as intense as I have had to endure over the past ten years. The rot was there but not yet as complete as it is at present.

Young's simple "double-slit" diffraction experiment has since the advent of de Broglie waves during the 20th century become so controversial that Richard Feynman (1918-1988) called it the only mystery in physics. Diffraction will be treated in more detail in section 7.5.9 and the veil over the supposed mystery of double slit diffraction will be lifted in section 35. It will be seen that there is no mystery involved whatsoever! The simple fact is that light and matter only consist of harmonic waves. Newton's laws remain valid, but his "particles with mass" are each nothing else but a wave-intensity which has a centre-of-mass.

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* *In three dimensions it is known as the wave vector.*

It should be emphasised that the only experimental proof which exists to corroborate de Broglie's hypothesis, is that of moving electrons interacting with a stationary diffraction-apparatus. In contrast, a stationary electron has zero momentum: So the obvious question to ask is the following: What is the situation when an electron is not moving relative to another object?

An electron not moving, or even moving very slowly, must, according to de Broglie's hypothesis, have an infinitely long wavelength: Since such a wave can bend around any object, even of infinite size, it will not be able to "see" other objects in order to interact with them. Furthermore, as will be seen in section 7.5, such a "wave" can only manifest within infinite space; and can thus not exist within our non-infinite universe at all. Thus, for zero (and small) momentum, de Broglie's hypothesis fails. Why this is so, and must be so, will be explained in section 34.7.

1.9.5 "Uncertainty" versus wave-size?

As already mentioned above, it is an incontrovertible well-established fact in physics that all harmonic waves (see section 7.5) have dual-personalities since such a wave simultaneously manifests within position-space as well as within reciprocal space: The latter space is defined by inverse lengths. As also already pointed out, for a harmonic-wave the latter space is called the wave's k-space, where k is inversely proportional to the wave-length λ of the wave (see Eq. 1.8).

To quote from Feynman's lectures (volume III): "*Here we encounter a strange thing about waves; a very simple thing which has nothing to do with quantum mechanics strictly. It is something that anybody who works with waves, even if he knows no quantum mechanics, knows: namely, we cannot define a unique wavelength for a short wave train. Such a wave train does not have a definite wavelength; there is an indefiniteness in the wave number that is related to the finite length of the (wave) train, ……..*"

As will be seen in this book, a "coherent" wave is defined by the fact that it has a definite wave number k , and thus a definite wavelength (see section 7.5): To be a coherent wave, identical wave-fronts of the wave must move consecutively through space. Feynman's argument thus implies that a wave of limited length can never be a coherent wave. This is not correct! What Feynman failed to mention is that a short wave train with a definite wave number is possible, provided that such a wave is generated by a so-called "coherent" wave-source (see section 7.5).

Furthermore, he should have mentioned that a light-wave with a definite frequency is always an exception: For example, even a moving light-wave which has the minimum energy it can have (a quantum of energy equal to $\hbar\omega$) always has a definite wave number k; no matter what its size is. This is a consequence of the fact that, according to Einstein's special theory of relativity, a light-wave moving through vacuum has the same speed c relative to any observer; no matter at which speed the observer is moving. Einstein's special theory of relativity will be discussed in section 7.3.

What is thus strange for a de Broglie wave of a "free-electron", which obviously moves with different momentums p, and thus different speeds, relative to different observers (who themselves are moving relative to each other), is that it does, just like a light-wave, have a definite value for its wave number k relative to any one of these observers; even though k has different values relative to observers who are moving relative to one another. This implies that according to Feynman's reasoning above, a de Broglie wave must always be infinitely long relative to any observer, which is not physically possible within our universe. It must thus be generated by a coherent source.

De Broglie's postulate does not specify such a source. Thus, a contradiction arises: How is it possible for a de Broglie wave to have a definite wave-number k without being infinitely-long or without being generated by a coherent source? We will return to this aspect in section 34.7, where a possible coherent source for a de Broglie wave will be revealed.

The incontrovertible fact is that when not being generated by a coherent source, a harmonic wave (excluding a moving light-wave in vacuum with a definite frequency) has "average sizes" within both its position- and reciprocal spaces given by Δx and Δk; so that one finds along any direction x that:

$$\Delta x \Delta k = g \tag{1.9}$$

Just as in the case of Eq. 1.1, the value of the factor g is determined by the shape of such a wave, and cannot be smaller than ½: But Eq. 1.9 has nothing whatsoever to do with the position and/or momentum of a "point-particle"!

Heisenberg's so-called "uncertainties" Δx and Δp for an electron could be, and most probably are, nothing more and nothing less than the physically-real, average-sizes of the intensity-distribution of an actual harmonic wave in position-space and its dual intensity-distribution within its k-space; which, owing to de Broglie's relationship, has been incorrectly interpreted as a momentum-space for a "particle".

But Heisenberg and his colleagues in Göttingen and Copenhagen did not consider such a logical and self-consistent interpretation which is squarely based on the known properties of harmonic waves: If they had done so, it would have meant that they would have been compelled to admit that Schrödinger's approach supersedes their own approach. Maybe this was just too horrible for them to contemplate? They stuck to their guns by maintaining that the parameters Δx and $\Delta p = \hbar \Delta k$ are "uncertainties" in the actual point-position of an electron particle and the actual momentum of such a particle.

They maintained this stance in the face of the incontrovertible fact that the supposed "uncertainty-relationship" for position and momentum "of a single-electron" can be directly calculated from any single-electron Schrödinger-wave; even one which does not have a maximum intensity at the supposed “most probable, expectation value” <x>: What they should have noticed is that Heisenberg’s so-called “uncertainty-relationship” for momentum and position for a single-electron wave can be written as:

$$\Delta p \Delta x = [\hbar(\Delta k)]\Delta x = g\hbar \qquad (1.10)$$

Clearly Planck’s reduced constant cancels out; and is thus superfluous in this relationship. It only forms part of Schrödinger’s differential wave-equation because Schrödinger incorporated de Broglie’s relationship when he formulated this equation.

This raises a question: Was it really necessary for Schrödinger to have incorporated de Broglie’s postulate when he formulated his differential equation? In the case of the harmonic, differential wave-equations for light-waves derived by James Clark Maxwell (1832-1879), these parameters are not there; even though Planck’s constant plays a similar role for photons* as it does for electrons. In the latter case Planck’s constant only becomes incurporated when the source-term (see section 7.5) requires it to be there. Maybe Schrödinger should not have incorporated the de Broglie relationship in the format that he did (see section 34).

It will be shown in section 34.7 that de Broglie’s wavelength for an electron moving with a momentum p seems to rather follow from Einstein’s special theory of relativity. It will also be shown in section 8.6.3 that for any “bound electron” (like an electron around the nucleus of an atom) the momentum terms generated by a solution of Schrödinger’s wave equation, have nothing to do with the actual momentum of an electron whatsoever. In fact, as will be seen in section 7.5.12, even for a so-called “running Schrödinger-wave”, the “momentum” modelling this wave has nothing in common with the actual momentum of an electron moving through three-dimensional space which, owing to this movement, generates a de Broglie wavelength.

1.9.6 Bohr and quantum jumps

Although Heisenberg was Born’s assistant at Göttingen University, Bohr also had a great input into Heisenberg’s research. In fact, Heisenberg spent 1925-1926 at Bohr’s institute in Copenhagen. Thus, it was also in Bohr’s interest that the limelight should not be stolen from the Copenhagen-Göttingen effort by Schrödinger in Zurich.

Just after Schrödinger had published his differential wave-equation, Bohr and Heisenberg invited him to Copenhagen where he was put under interrogation. It is known that during that time Schrödinger fell ill and took to

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**A photon is supposedly a “light-particle”. How this concept came about is discussed in section 32.5.*

bed, probably after collapsing of exhaustion: Heisenberg reported that Bohr did not let up with his relentless barrage of questions and arguments, even sitting at Schrödinger's bedside talking for hours. Was he "shouting Schrödinger down", as Carver Mead suggested in an interview with the *American Spectator*? There is good reason to suspect that this is exactly what happened!

The main argument thrown at Schrödinger was that his waves cannot explain "quantum jumps": These changes supposedly "only" happen when "an electron-particle" jumps instantaneously from one energy-level to another: And since the latter behaviour is discontinuous, a wave can supposedly not model it: A wave supposedly only changes continuously with time. Bohr and Heisenberg succeeded in disparaging Schrödinger so much, that he is quoted to have said: "*If I had known that we would not get rid of these damn quantum jumps, I would have had nothing to do with this business*".

It is ironic that barely a year later Schrödinger proved that Heisenberg's matrix mechanics and his differential wave equation are completely equivalent: The one model can be transformed mathematically into the other. Thus if matrix mechanics can model quantum jumps, so obviously should wave mechanics. But that this should be so was not pursued until now in this book.

It is doubly ironic to note that in terms of Born's subsequent interpretation of the wave-intensity of a Schrödinger-wave, it became necessary to postulate that this intensity must "collapse or inflate instantaneously": These are discontinuous changes if ever I have come across any! So why could such an instantaneous-change in the shape and size of the actual physical intensity of an electron-wave not be a "quantum jump" without requiring an "electron-particle"? This possibility was obviously not considered or discussed in Copenhagen during 1926; and never afterwards either.

It will be postulated in this book that it is experimentally compelling to accept that such an instantaneous collapse or inflation of the intensity of an electron-wave (in fact, any matter-wave and also light-wave) <u>is</u> what is actually occurring during a "quantum jump". It will be seen that this discontinuous behaviour of a wave is already inherent in the mathematics of Schrödinger's differential wave equation.

A problem involved with such "instantaneous-morphing" of a wave-intensity is that the speed of collapse or inflation of the intensity can be, and in most cases, must be faster than the speed of light. It can thus be argued that according to Einstein's special theory of relativity such "wave-movement" is not possible within three-dimensional space.

But does Einstein's special theory of relativity limit the speed with which a wave can change its shape and size when the boundary conditions change? The shape and size of a wave are always determined by the boundary conditions under which the wave finds itself. Thus, if a sudden change in boundary conditions requires that the wave must change its shape and size instanttaneously or near-instantaneously, one expects that the wave must comply: When a wave has to morph it cannot diddle around to wait for Einstein! It's gotta move!

It will thus be postulated here that such a collapse or inflation of a wave does not violate Einstein's special theory of relativity at all. In fact, by postulating that such collapses and inflations are occurring, the conundrums and paradoxes, which have been bedevilling the interpretation of quantum physics over the past 80 years, can be explained in terms of realistic, causal physics which can be visualised!

1.9.7 Bohr becomes "complementary"

In an attempt to reach a compromise which encompasses the viewpoints of Heisenberg, Born as well as Schrödinger, Bohr postulated his "principle of complementarity": He stated that it had been experimentally proved that the same "electron-entity" sometimes acts like a particle and under other circumstances it acts like a wave. After de Broglie's hypothesis, the concept of "wave-particle duality" became an entrenched concept: According to Bohr this "paradoxical" duality is fundamental, and thus inbuilt into nature. We cannot explain why it is so, and therefore we must accept this as a fundamental physics-fact: It is so because it is so! We cannot tell God what He can do or cannot do!

According to Bohr's "principle of complementarity" one can either meet Dr. Jekyll or Mr. Hyde; but not both simultaneously. It will be argued in this book that this postulate is seductively misleading: It just postpones the understanding of physics; which is a criminal thing for a physicist to do. All that Bohr achieved was to compromise the future of physics and to cause increasing confusion to become rampant during the 20th century!

Based on this principle of complementarity it was further argued by Bohr that all wave-field descriptions of nature must be "quantized" at all times to include the dual existence of the wave-particle nature. This has led to so-called "second quantization", quantum electrodynamics and the other quantum field theories. It will be argued in this book that although a change in boundary conditions might require a field to become "quantized" into smaller wave-entities, the application of "second quantization" has been done by ignoring the physical boundary conditions under which such quantization will actually occur: This has led to the use of field-functions with adjustable "quantum phase-angles" S which are not possible for harmonic waves. And this, in turn, has led to the violation of fundamental mathematical principles on which vector-calculus is based: And this is exactly why the model proposed by Aharanov and Bohm is, like the principle of complementarity, just plain wrong.

In this book it will be argued that an electron is always a harmonic wave, as mandated by an appropriate, harmonic, differential wave-equation with complex amplitudes: The size and intensity distribution of such a wave is, as in the case of all harmonic waves, always completely determined by the physical boundary-conditions under which it finds itself. If you ignore boundary-conditions, as became the custom over the past 80 years, you are not doing physics! Nobody has realised that even a "free solitary" electron-wave is subject to boundary conditions.

The latter fact is astonishing; since the existence of such boundary conditions follows logically from Einstein's general theory of relativity; according to which mass curves space and curved-space causes mass. Curved-space means the existence of boundary conditions around a body with mass, and therefore a solitary electron-wave in "free-space" must be subject to boundary conditions. One cannot simply put $V(x) = 0$ for such an electron as if it experiences no boundary conditions at all (see section 34).

1.9.8 The Blitzkrieg!

At the 1927 Solvay-conference Heisenberg and Born stated that: "*We regard quantum mechanics as a complete theory for which the fundamental physical and mathematical hypotheses are no longer susceptible to modification*": This sounds like an attempt to close down any further discussion on the interpretation of quantum mechanics. Young Heisenberg was applying for professorships and would most probably not have been willing to concede at that time (neither did he ever afterwards) that his matrix-theory and his concomitant interpretation of quantum mechanics based on this theory might be flawed. Einstein, however, was not willing to buy this.

1.9.9 Einstein storms windmills

Einstein formulated many "thought experiments" to try and prove that position and momentum (as well as energy and time) must, at least in principle, manifest simultaneously without any uncertainties involved: Unfortunately, following Heisenberg's original arguments, he concentrated on finding ways to prove that it is in principle possible to "measure" the position and the momentum (or energy and time) of a "quantum-particle" simultaneously with 100% accuracy.

As already mentioned above, this is a totally different problem: The fact is that even when one tries to do such a measurement for a moving golf-ball it is, even in principle, impossible: The ball has size, so one cannot directly observe the position of its centre-of-mass and the momentum of this centre-of-mass. Furthermore, as will be argued in section 36, all measurements affect what is being measured to a larger or lesser extent; whether it is done on the quantum scale or not.

When, for example, observing a moving golf-ball by looking at it, light is reflected from the ball into your eye. If your eye was not there, the change in surroundings will be different. If, in addition, the observer is blind and can only follow the golf-ball by throwing other golf-balls at it, each hit will change the path of the original golf-ball and the measurement will have a larger effect on what is being measured than when using light.

It was essentially the latter idea which had led Heisenberg towards his "uncertainty" relationship for position and momentum: In a thought experiment (see section 36.4 for a discussion), he pointed out that light also has momentum, and that when trying to pinpoint the position of an electron by using light, one will disturb the electron so that it will not have the same momentum afterwards: Since we can then not simultaneously also know what the momentum of the electron is when we measure its position, and since, according to Heisenberg, measured reality is supposedly the only reality possible, the simultaneous manifestation of these two parameters must be a meaningless physics-concept.

Although it is undoubtedly correct that there will be a large uncertainty in the measured momentum of the electron under these conditions, this argument has nothing to do with actual, inbuilt uncertainties in the position and momentum of an electron-particle. Therefore, by trying to construct arguments which would prove that it is in principle possible to measure the position and momentum simultaneously with 100% accuracy, Einstein was storming windmills like Don Quixote.

Einstein presented a thought experiment at the 1930 Solvay conference relating to Heisenberg's so-called "uncertainty-relationship" for energy and time which can similar to the relationship for position and momentum be written as:

$$\Delta E \Delta t = g\hbar \tag{1.11}$$

Einstein considered a situation which allows a photon to escape from a box which contains radiation by opening a shutter at a definite instant in time. Since it is known that electromagnetic radiation trapped within a cavity has mass, Einstein argued that one can weigh the box before and after the photon has escaped (see also discussion of cavity radiation in section 32). One then knows the energy of the photon at the exact time that the shutter was opened. And there is thus no uncertainties involved whatsoever.

Bohr came back the following day and argued that the weighing process itself will, owing to Heisenberg's "uncertainty" relationship for position and momentum, cause an uncertainty when weighing the box and there will thus still be an uncertainty in the energy. This was probably the final blow which caused those in control of the "physics-church" to accept the Copenhagen-interpretation. If Bohr could make a genius like Einstein look foolish, Bohr must be right!

But in retrospect, if, as argued in section 1.9.5 above, the "uncertainty" relationship for position and momentum is not dealing with actual uncertainties, then Bohr has been wrong all along and Einstein right; provided that a "photon-gas" can exist within a closed box and that such a gas can be detected by weighing of the box. Reasons will be given in section 32.8, why radiation cannot be weighed when it consists of a "gas of moving photons": But only when it forms standing waves (waves are discussed in section 7.5).

More important is the fact that experimental evidence indicates that Eq. 1.11 has another meaning in physics than a supposed inability for the energy to have an exact value at an exact instant of time. From the widths of spectral lines emitted by atoms, one can deduce with a high degree of certainty that an electron-wave with energy E is allowed by Eq. 1.11 to change its energy by an amount ΔE provided it is not for longer than a time-interval Δt: After this time has elapsed the original energy E must be restored.

But this does not mean that there is an "uncertainty" in energy and time; since after the energy has changed by ΔE the resultant energy $E \pm \Delta E$ maintains this definite value at every instant of time within the time-interval Δt allowed by Eq. 1.11. All that this expression implies is that the energy of a matter-wave "resonates" with time. It will be argued in section 33 that such resonances are responsible for the absorption and emission of light by a matter-wave.

The latter behaviour of a matter-wave, which will be called a "quantum fluctuation", also plays other important roles in physics. In this book it provides the mechanism for so-called "tunnelling" (see section 9.3); for superconduction (see section 23); and also for some of the "force interactions" between matter-waves (see also section 38.2).

1.9.10 Heisenberg's mystic path

As an aside: How would one determine whether the position and momentum of a moving golf ball manifests simultaneously? There is only one way: One has to calculate the trajectory of the ball by assuming that the position and momentum of its centre-of-mass act simultaneously, and then check at various points along the trajectory whether the ball is there at that instant in time. If, in addition, one can only do the latter by having other golf-balls colliding with the original golf-ball, one can in principle launch an ensemble of golf-balls in an identical way and then check with other golf-balls at various points along the identical trajectories of the ensemble. One will then find a correspondence which confirms that both position and momentum <u>must</u> manifest simultaneously with 100% accuracy at every instant in time.

When doing this for electrons, one finds similarly that the position and momentum <u>must</u> also manifest simultaneously with 100% accuracy while an electron moves through space; and therefore it follows a well-defined trajectory. In fact, this correspondence is used every day when designing electron-microscopes and electron-accelerators.

Heisenberg tried to wipe the latter argument under the carpet by stating: "*I believe that the classical "path" can be pregnantly formulated as follows: The "path" comes into existence only when we observe it*". I do not know what "pregnancy" has to do with it, but one can well ask: What is really the difference between an observation and a measurement (see discussion in section 36)? In principle it is the same thing! And if you can "see" a path which can only be followed when both the position and the momentum simultaneously manifests with 100% accuracy, does this not violate the Copenhagen viewpoint according to which these two parameters can never be measured simultaneously (and thus also not "seen") in this manner? It obviously does!

In my opinion Heisenberg, with this statement, led physics further into the realms of the paranormal from where it has not yet found its "path" back to reality.

By stating that position and momentum cannot manifest simultaneously, Heisenberg not just violated calculus, but also the most important foundation-stone on which all physics is based: Namely Galileo's inertia. How can an electron be stationary at a point-position (say chosen to be zero within its own inertial reference-frame) if its position and momentum do not simultaneously manifest as both being exactly zero at the same point-position at which its centre-of-mass is?

A further fact is that inertia defines the laws of gravity: It is thus unbelievable that by accepting the probability-interpretation of quantum mechanics, physicists for nearly a century violated the concept of inertia; and then puzzled over why they could not incorporate gravity into their framework of quantum physics. It should have been self-evident that this would not be possible!

1.9.11 Follow the fork

After Bohr "proved" Einstein's argument wrong at the 1930 Solvay conference, a fork in the road was reached, and the physics-church decided to "take it". Two approaches emerged when applying quantum mechanics: I have baptised them, owing to my own personal prejudices, as "calculations" and "hallucinations".

(i) *Calculations*: In many cases the interpretation-problems were simply ignored while Schrödinger's equation was used to very successfully model experimental data: Especially in the fields of solid state physics and chemistry. Sometimes this is referred to as the "cookbook"-approach; or "shut-up and calculate" method. Nonetheless, this has caused a revolution in technology during the 20th century, which led us inexorably to our present digital compu-

ter age with all its benefits and drawbacks. Has this approach led us to a better understanding of physics? Yes and no. Yes; since there had been aspects in physics which could not be modelled until Schrödinger's wave equation came along. No; since the success of this approach has lulled us into a false belief that we do have a fundamental understanding of the actual physics involved.
(ii) *Hallucinations*: The other route rested on the assumption that the following two postulates are fundamental: Firstly, that the wave-intensity of an electron is a probability distribution of the position of a particle; and secondly that Bohr's principle of complementarity is a law of nature. From this viewpoint quantum mechanics developed into "quantum field theory". This required that all wave-fields must be "quantized": This approach led to quantum electrodynamics, and subsequently to all the other quantum field theories used to model, for example, nuclear interactions; particle physics, and also superconduction. All these theories require the "vacuum" to have energy so that it can produce "virtual particles" which are supposedly responsible for the "fundamental forces", which are in turn responsible for the interactions between the "fundamental particles" (see section 38.2).

It is claimed in the Bible that Samson destroyed the temple of the Philistines, by pulling down the two pillars which supported it. In this book it will be argued that one does not need a Samson to pull down the two pillars on which quantum field theory is based, because these pillars have never been there in the first place. In my opinion the "temple of quantum field theory" is "firmly" hanging in the air.

It will be argued in this book that both matter and light consist solely of waves and can be satisfactorily modelled solely in terms of suitable, differential wave-equations solved subject to appropriate boundary conditions (see section 7.5). The fact that the energy of a wave cannot be less than a certain quantum-amount does not mean that the wave is a particle or must represent the probability of finding a particle; and it does not mandate that all wave-fields must be quantized to satisfy "wave-particle duality" and "complementarity". Waves, each having only an allowed amount of energy, are only formed when the boundary conditions under which the wave-field finds itself requires this to happen. In many cases the wave-field is a continuous, single entity without any separate quanta in energy being present as separate entities (see for example sections 8.7 and 33.7).

1.9.12 Einstein throws a spanner

Einstein was not going to concede easily: He knew something was wrong but just could not put his finger on it. He finally did so in 1935: It is well-known that the really interesting physics is not just described by a Schrödinger-wave for a single, solitary electron, but also by a Schrödinger-wave for a "collection of particles": Schrödinger's so-called "many-body" wave-equation.

It is found that there is a “non-classical” interaction between such “particles” which cannot be modelled in terms of Newton’s laws. Einstein called this a “spooky action at a distance” and Schrödinger called it “entanglement”.

In 1935 Einstein and two of his students Boris Podolsky (1896-1966) and Nathan Rosen (1909-1995) published a paper entitled “*Can Quantum-Mechanical Description of Physical Reality Be Considered Complete?*” They argued that under suitable conditions two “particles” can “collide” and in the process become entangled to form a “bi-particle” Schrödinger wave: But, owing to the conservation of momentum these “particles” should, after the “collision”, move away from each other while conserving momentum (see section 7.3.11 for a discussion of collisions and conservation of momentum).

Since they are now described by a “probability”-wave, an observer does not know their positions until a measurement is made which will, according to the Copenhagen interpretation, force the wave into Born’s “statistical collapse”. When making a measurement on one “particle”, so that its position becomes known, one also knows simultaneously the position of the other “particle” from the conservation of momentum.

But in principle the measurement can be made after the two “particles” have moved for such a long time that they are light years apart. This would mean that when one of the particles is forced by a measurement to “statistically” manifest at a random point in space, the other particle must simultaneously-instantaneously know where this random point is, so that it can manifest at the correct position in order **not** to violate the conservation of momentum.

Einstein, Podolsky and Rosen pointed out that it is well-known from Einstein’s special theory of relativity that “two particles” cannot “communicate” faster than the speed of light. Therefore, unless this “instantaneous interaction” between “two particles” can be explained, the theory of quantum mechanics cannot be complete. This thought experiment became known as the EPR-paradox: EPR obviously referring to Einstein, Podolsky and Rosen.

1.9.13 A Bell tolls

Only after Einstein’s death could experiments be designed to test whether “entangled particles” can actually communicate faster than the speed of light. This became possible after the Irish physicist, John S. Bell, postulated a now famous inequality-condition which must manifest when the communication is instantaneous.

Against all expectations it was found experimentally that two “particles” that became “entangled” can communicate faster than the speed of light: when a measurement is made on one of them. The resultant conclusion, which is accepted as correct by those in control of the “physics-church” at present, is that Einstein has “again” been proved wrong and the Copenhagen-interpretation has been vindicated.

The latter conclusion is wrong: The fact that such instantaneous communication is possible, apparently between ‘two particles’, still does not negate Einstein’s argument that the interpretation of the theory of quantum mechanics is not complete. It does indicate that there must be “a mechanism” which requires a physical explanation. After all, it is an incontrovertible physics-fact that when one jiggles an electron on one side of a room, another electron only jiggles in sympathy on the other side of the room after a time-lag determined by the speed of light. So what would enable two electron-“particles” to communicate faster after they have entangled?

1.9.14 Space without time

There is a way, probably the only way, in which communication can occur instantaneously: It rests on the postulate that an entangled wave does not consist of separate “particles”, as interpreted by the Copenhagen-group; but that it is a single <u>holistic</u> wave. One can then argue that “within” the “three-dimensional essence” of this holistic wave, the wave is in instantaneous contact with itself within the volume its essence occupies within three-dimensional space; even when this “holistic-essence” forms a fragmented entity within three-dimensional space (see section 32.14)!

As will be seen in section 7.5.12, a harmonic Schrödinger wave requires an extra space-dimension in addition to the three space-dimensions which we as human beings can directly experience. Thus, although fragmented within our three-dimensional space, it can be argued that an electron-wave still forms a connection along an extra space-dimension.

When making a measurement, one changes the boundary conditions: As already pointed out above, when the boundary conditions change, the wave must morph: Thus when a measurement “reveals” the position of one of the “particles” which entangled to form the EPR-wave, it actually forces the holistic wave to instantaneously morph into two separate disentangled single-electron waves which are correlated with one another at that instant in time.

Nobody has noticed to date that the absence of time within the intensity distribution of an electron-wave within three-dimensional space follows directly from Schrödinger’s differential wave-equation (see section 7.5.12). This implies that the wave must be in instantaneous contact with itself within its three-dimensional intensity distribution. In a way this does seem to vindicate the Copenhagen-group that quantum mechanics is a complete theory; but not for the reasons given by them, since, as will be seen, the EPR-behaviour proves without a doubt that the Copenhagen-interpretation is not tenable! There is no wave-particle duality and, as already pointed out above, Bohr’s principle of complementarity is misleading.

1.9.15 Alternative interpretation

If the Copenhagen-interpretation is wrong, what is really happening? One of the objects of this book is to develop an alternative interpretation: After having read this book, the following interpretive postulates should seem more reasonable than the Copenhagen-interpretation:

1. Particles *per se* do not exist.
2. A quantum of light-energy is not a particle.
3. Both light and matter always consist of harmonic wave-fields which form intensity-distributions within three-dimensional space.
4. A light-wave moving through vacuum has no inertia and thus no rest-mass energy.
5. A matter-wave always has rest-mass energy, inertia, and thus a centre-of-mass.
6. A light-wave, as well as a matter-wave, is holistic when it is in immediate contact with itself within its intensity-distribution within three-dimensional space; even when the latter is fragmented within three-dimensional space.
7. Holistic waves can entangle to form larger holistic waves.
8. An entangled wave can disentangle into separate holistic waves.
9. Holistic waves can superpose (add together) to form a compound-wave consisting of separately identifiable holistic waves.
10. The shape, size, and intensity of a holistic wave are determined by its boundary conditions.
11. When making a measurement, the boundary conditions are usually changed.
12. A holistic wave morphs when its boundary conditions change.
13. Morphing can occur faster than the speed of light.
14. When a light-wave is absorbed by a holistic matter-wave, it stops moving with the speed of light in order to morph into rest-mass energy which, by entanglement, adds to the rest-mass of the matter-wave.
15. When a light-wave is emitted by a holistic matter-wave, the emitting matter-wave disentangles to form a light-wave with no rest-mass energy, and a holistic matter-wave with a lower rest-mass energy.
16. Identical measurements on an ensemble of identical waves can generate a set of non-identical results, but only when the measuring apparatus allows this to happen.

These postulates seem far more like real physics than concepts like "probability-amplitudes", "complementarity" and "quantum phase-angles": Do they not?

1.10 Back to common sense

Physics is at present terminally ill! Some physicists know it, and have mentioned it in books they have written: For example, Lee Smolin in his book entitled *The Trouble with Physics.* My experience over the past ten years has led me to conclude that if one decides to point out a possible alternative route, which in any way lies outside mainstream-dogma, these same physicists will ignore you, or silence you as quickly as they can. They know something is wrong, but do not want to seek solutions which lie outside the paradigm within which they themselves have been, and still are operating!

The mainstream physicists behave like a person who is searching for his/her wallet under a streetlamp since there is light under the lamp; even though the wallet had been lost further away in the dark! And this is occurring at the time in human history when our survival depends on new paradigm-shifts in physics and other sciences.

It has thus become imperative that we must wrench the control of physics from the hands of people who are consistently suppressing new ideas which could lead to paradigm-shifts. It has become clear to me that one will not be able to convince the mainstream physicists while they have control over "what must be allowed to be known in physics". The time has thus come for the intelligent lay-population to learn about the issues involved and to act in the interest of the future of humankind. We all must enter the debate so that informed and logical conclusions and decisions can be reached.

This book is thus intended for those people with common sense who still have open minds: The type of person who would not be scared to state that the "Physics-Emperor" is walking around naked even though the "expert-physicists" in control of the "physics-church" stand around in admiration, convinced that the Emperor is wearing the finest "strings" ever conceived within eleven dimensions!

It will also be beneficial for the "physics-priests" in control of physics-dogma to read this book: However, I would not be surprised if they will not allow themselves to benefit from such an experience. It is quite amazing how an "expert" can argue against simple compelling evidence when he/she does not want to believe it. This is reminiscent of what happened 400 years ago when Galileo handed a telescope to one of the Church's Cardinals to observe the mountains on the moon: After having "peered" through the telescope at the moon, the Cardinal said: "I do not see any mountains". This confirms the validity of the well-known cliché according to which: "*Nobody is as blind as those who do not want to see*".

I hope this book will help to return physics to its original intent; which is to model nature so that we can visualise it in terms of logical mechanisms that relate to our human experience: Although apparently abhorrent to Heisenberg, I believe that if we cannot visualise physics, we are not practising physics but Voodoo! Our purpose as physicists has always been to model the primary causes responsible for driving the processes in nature; instead of viewing nature as being controlled by the whims of gods: Or as God throwing dice! Or as "spontaneously" changing its symmetry, etc., etc.!

I also hope that this book will serve to wake-up a new generation of younger scientists who will be brave enough to leave the security of the street-lamp of mainstream physics-dogma and venture into the dark where they will surely find the paradigm-shifts which the human race is so desperately in need of at present.