Pointlessness and dangerousness of the postulates of quantum mechanics.

Jacques Moret-Bailly *

December 12, 2001

Abstract

The formalism of quantum mechanics produces spectacular results, but its rules, its parameters are empirical, either deduced from classical physics, or from experimental results rather than from the postulates. Thus, quantum mechanics is purely phenomenological; for instance, the computation of the eigenvalues of the energy is generally a simple interpolation in the discrete space of the quantum numbers. The attempts to show that quantum electrodynamics is more precise than classical electrodynamics are based on wrong computations. The lack of paradoxes in the classical theory, the appearance of classical, true interpretations of the wave-particle duality justify the criticism of Ehrenfest and Einstein.

The obscurity of the quantum concepts leads to wrong conclusions that handicap the development of physics. Just as building a laser was considered absurd before the first maser worked, the concept of photon leads to deny a type of coherent Raman scattering necessary to understand some redshifts of spectra in astrophysics, and able to destroy the two fundamental proofs to the expansion of the universe.

Résumé

Le formalisme de la mécanique quantique conduit à des résultats spectaculaires, mais ses règles et ses paramètres sont empiriques, déduits de la physique classique ou des résultats expérimentaux plutôt que des postulats. Ainsi, la mécanique quantique est une pure phénoménologie, par exemple le calcul des valeurs propres de l'énergie est une interpolation sur l'espace discret des nombres quantiques. Les efforts tendant à démontrer que l'électrodynamique quantique est plus précise que l'électrodynamique classique démontrent seulement qu'il convient d'être rigoureux. L'absence de paradoxes en théorie classique, l'apparition d'interprétations classiques véritables de la dualité onde- corpuscule paraissent une justification des critiques d' Ehrenfest et Einstein.

L'obscurité des notions quantiques amène à des conclusions inexactes qui handicapent le développement de la physique; ainsi, de même que le concept de laser a été nié avant la démonstration expérimentale, la notion de photon

*Laboratoire de physique, Université de Bourgogne, BP 47870, F- 21078 Dijon cedex, France. jmb@jupiter.u-bourgogne.fr

conduit à nier une forme d'effet Raman cohérent nécessaire à l'explication de rougissements de spectres en astrophysique et susceptible de détruire les deux preuves fondamentales de l'expansion de l'univers.

> "Llewlyn Thomas, a noted Columbia theorist, told me flatly that the maser could not, owing the basic physics principles, provide a pure frequency[ ]; so certain was he that he more or less refused to listen to my explanations[ ].On visiting Niels Bohr, the pioneer of quantum mechanics, in Denmark, he exclaimed: "But that is not possible"[ ] John von Neumann declared "That can't be right"[ ]. To physicists steeped in the uncertainty principle, the maser's performance made no sense at all" (C. H. Townes [1]).

1 Introduction.

At the beginning, relativity and quantum mechanics were strongly criticised; but, while relativity is now widely accepted, so many physicists share now the scepticism of Ehrenfest and Einstein about quantum mechanics that the supporters of this theory look for an absolute proof of its necessity. On the contrary, this paper tries to show that the postulates of quantum mechanics must be rejected.

Quantum mechanics was an important tool in the development of physics in the twentieth century, but using the *formalism* of quantum mechanics does not require the *postulates*.

The following section shows that the symmetry properties often considered as a part of the formalism of quantum mechanics may be justified classically, while the computation of the eigenvalues of the energy uses so disparate methods that it appears phenomenological, and may be bound to either theory. It is only examples because they are too many applications of quantum mechanics.

The next section reinforces the previous one in the field of optics: the defenders of quantum mechanics performed experiments to prove an inadequacy of the classical theory but they used naive hypothesis, so that their demonstrations fail. The flimsiness of quantum mechanics leads to introduce absurd concepts, such as the photon, as a particle, leading to an absurd wording of the EPR experiment. At low lighting, the linearisation of optical effects in function of the amplitude of the electric field appears as a nearly trivial but very useful property.

Next section is a tentative explanation of the wave particle duality by (3+0)D solitons whose existence is demonstrated.

It appears finally that the photon leads the astrophysicists to reject the coherent Raman scattering (just as the maser was rejected), giving them the two main (and probably fallacious) proofs of the expansion of the universe.

Consequently, they need to imagine fantastic explanations about observations on quasars and other massive objects.

2 Classical justification of the formalism of quantum mechanics.

A criticism of quantum mechanics is difficult because the frontiers of this theory are not well defined. The symmetries are often introduced by "active transformations" in which the particles are moved by the physicist; the active transformations are, as often claimed, a concept of quantum mechanics. In classical physics, the theoretician observes, does not change the system he observes, using "passive transformations" which act on mathematical tools, such as reference frames, only.

2.1 Molecular symmetries

The molecular symmetries are an easy to explain example of symmetries [2] generally studied by "active transformations". Show that classical physics introduces naturally the rules postulated by the theory of active transformations.

The classical problem is setting, at a given instant, the variables which allow to describe a molecule made of punctual atoms, taking into account the hypothesis of the existence of a remarkable configuration (called here equilibrium configuration), generally a configuration for which the potential function is minimal.

Suppose first that the molecule is made of different atoms $A, B, C, ...$ of masses $m_A, m_B, m_C, \ldots$. The equilibrium configuration is a geometrical, solid figure of points $a, b, c, ...$, defined within a displacement. The real molecule is distorted; the equilibrium configuration must be bound to the molecule, for instance to study small movements, considering that the atoms $A, B, C, ...$ are displaced from the corresponding points $a, b, c, ...$ For instance, this binding is done using the conditions set by Eckart: First a centre of mass O of the equilibrium configuration is defined by

$$m_a\overrightarrow{Oa} + m_b\overrightarrow{Ob} + m_c\overrightarrow{Oc} + .. = \overrightarrow{0}, \tag{1}$$

The first condition sets that O is the centre of mass of the molecule:

$$m_a\overrightarrow{aA} + m_b\overrightarrow{bB} + m_c\overrightarrow{cC} + .. = \overrightarrow{0}, \tag{2}$$

The second condition is:

$$\overrightarrow{Oa} \wedge (m_a\overrightarrow{aA}) + \overrightarrow{Ob} \wedge (m_b\overrightarrow{bB}) + \overrightarrow{Oc} \wedge (m_c\overrightarrow{cC}) + .. = \overrightarrow{0}. \tag{3}$$

A mobile reference frame $O'xyz$ may be bound to an equilibrium configuration independent of the molecule, obtaining a "reference configuration" which is a mobile, geometrical solid; the reference configuration may be defined by a table of coordinates which will be the components of $\overrightarrow{O'a}, \overrightarrow{O'b}, \overrightarrow{O'c}, \ldots$ in $O'xyz$. The frame is bound to the molecule superposing by a displacement the reference configuration with the equilibrium configuration bound to the molecule by the Eckart conditions. The relative coordinates are defined.

If, in the set $A, B, C, ...$ two or more points have the same mass (with an assumed approximation), they will be designed by the same letter, so that the displacement vectors such as $\overrightarrow{aA}$ are not uniquely defined; at a given time, the ambiguity may generally be solved setting, for instance that the sum of the modulus of the displacement vectors is minimal. If, during the movement, the definition of the displacement vectors is not changed, the molecule is said "semi-rigid". To define the coordinates, indices distinguish the $a, b, c \ldots$ points (thus the displacement vectors), when necessary in the table which defines the reference configuration.

If the equilibrium configuration has symmetries, superposing the reference and bound configurations has not a single solution; shifting from a solution to an other by the "symmetry operations", is formally : i) a transformation of the coordinates; ii) a convenient permutation of the indices.

This classical explanation is not trivial, but it does not require postulates. As the transformations do not move the atoms, it is not necessary, when there are interactions with external fields, to move the whole universe or to correct, strangely, the symmetries.

2.2 Computation of the energy levels

When quantum mechanics started to develop, the quantum hamiltonians of simple systems were obtained by the correspondence principle, it led to partial derivative equations which were solved using standard computations. Later, it appeared that the resolution of the equations was easier using the raising and lowering operators; finally, it remained only Lie algebra (see an example of this evolution in [3]). Thus, one may think that the quantum theory is a method to introduce these algebra; however, the Lie algebra are now chosen arbitrarily, with the single aim to get good fits of the experimental results. The physical starting point is lost, in molecular, atomic spectroscopy, and elementary particle theories as well. It does not remain much of the old computations: a linear dependence of the energy of the one dimension harmonic oscillator; the remarkable function $j(j+1)$ for the energy of a rotator or a three dimensional harmonic oscillator comes from the isotropy of the space, the O(3) group and its algebra. Thus, the results which bring more than an interpolation over the discrete space of quantum numbers, come from the symmetry of the rotation (or, better, the Poincaré) group which must be taken into account in any problem of physics; the spin comes from the homomorphism of the SO(3) and SU(2) groups. More astonishing, the physicists use other interpolation methods where they work better, for instance the Padé approximants in molecular spectroscopy of diatomic and "spherical top" molecules.

Eigenvalues of the energy appear in most problems of classical mechanics because the potential energy has many relative minimums. Unhappily, their computations are often difficult, involving nonlinearities. We may use the phenomenological formalism of quantum mechanics as an interpolation method convenient to find these classical eigenvalues: the formalism of quantum mechanics gives approximate results of classical (or relativistic) mechanics.

3 Classical and quantum electrodynamics in the vacuum

3.1 The fundamental unconsciousness of quantum electrodynamics

First, what is an optical mode for the linear Maxwell's equations? Set physically correct boundary conditions in particular that the fields have zero values for infinite space-time variables; then a mode is *any* solution of Maxwell's equations. Setting $w(\nu)\mathrm{d}\nu$ the energy of the mode between the frequencies ν and $\nu + \mathrm{d}\nu$, the mode may be normalised by

$$\int_0^\infty \frac{w(\nu)\mathrm{d}\nu}{\nu} = h \tag{4}$$

where h is the Planck's constant. Two modes are orthogonal if the energy of the system of the two modes is the sum of the energies of the two modes; a complete set of orthogonal modes (sentence often oversimplified into "set of modes") allows developing any mode on this infinite set of modes.

The fundamental postulate of quantum electrodynamics is the identification of a monochromatic optical mode with a harmonic oscillator. But, if the used set of modes is changed, the quantified energy of the modes is split .... A solution of this problem is "the reduction of the wave packet", a postulate which allows the physicist to identify any mode with any other. This postulate is for me the strongest paradox, no, the strongest absurdity of quantum mechanics: how is it possible to work on objects whose definitions depend on the mood of the physicist?

3.2 Some elementary, classical electrodynamics

During a transition, a small, isolated mono- or polyatomic molecule emits a nearly monochromatic wave; an oscillating dipole (or quadrupole ...) which radiates in nearly all directions generally models the radiating molecule. Suppose the frequency low enough to consider the source as small compared to the wavelength.

The electromagnetic energy in a sphere centred on the molecule, and whose radius is small compared to the wavelength allows evaluating the energy radiated by the molecule. If there is no external field, this energy is positive, the molecule loses energy; but an external field may cancel partly the molecular field, so that the molecule may absorb energy or radiate no energy; if it absorbs, it scatters too.

A consequence is that the energy $h\nu$ lost by a molecule cannot be absorbed by a single other molecule, the absorption requires an infinity of molecules, an infinite time: thus the universe is full of residues of electromagnetic fields, the "stochastic" or "zero point" field. It is fundamental to remark that this classical field is an ordinary electromagnetic field, that it must not be neglected, or studied independently of the other fields. The existence of the stochastic field explains, for instance, that the electron of the hydrogen atom generally does not lose energy although it radiates a field (except to reach the Lambshifted frequency).

The evaluation of the stochastic field requires the second Planck's law, not the first which, neglecting the stochastic field, sets that the energy in a mode is:

$$e = \frac{h\nu}{\exp(h\nu/kT) - 1}. \tag{5}$$

Supposing a high enough temperature, the exponential is developed:

$$e \approx \frac{h\nu}{h\nu/kT + (h\nu/kT)^2/2 +} \approx kT - h\nu/2 \tag{6}$$

From thermodynamics, it must be kT; thus $h\nu/2$ is added to the energy of the mode to get the second, good Planck's law. This energy is a stochastic electromagnetic energy in the mode [4, 5]; its building shows that the corresponding field is an ordinary electromagnetic field; it provides the field which is necessary to compensate, in the average, the energy lost by radiation; if a system, such as a photoelectric cell requires a low energy to be excited, the long and particularly powerful fluctuations of the stochastic field are able to excite it, it is the noise observed at the lowest temperatures. Marshall and Santos [6] showed a local equivalence between the classical electrodynamics including the stochastic field that they call "stochastic electrodynamics", and quantum electrodynamics. Paradoxically, this equivalence is often used now to set that stochastic electrodynamics is an approximate fruit of quantum electrodynamics, while classical electrodynamics is older.

In the excitation or de-excitation of an electron, the electron provides the quantization of the electromagnetic field, just as the bottles quantify the wine. A common error is setting that this quantization is absolute while it applies only to systems that start from, and end at stationary states. The laws of refraction work at the lowest light levels while a lot of atoms are involved by the refraction by a prism. The temporary absorption of energy by each molecule of the prism during a light pulse is evidently much lower than $h\nu$. At the beginning of the pulse, when the field increases, the atoms get a slight excitation, remaining near their stationary state; if the prism is transparent, its atoms return their excess of energy to the tail of the pulse.

As the atoms are able to amplify the modes of the decreasing field, they are surely able to amplify other modes, but slightly (Rayleigh scattering) without the help of the coherence. Thus, the local stochastic field is increased during a pulse of light, the atoms and the fields get nearly an equilibrium, reversibly unless a big fluctuation of the amplified stochastic field excites an atom up to a transition.

In his thesis, Monnot [7] set a model of two energy levels atom, supposing that the amplitude of its radiating dipole is a quadratic function of the energy of the atom, equal to zero in the two stationary states. He puts a set of such atoms in a reflecting box; the energy of almost all atoms remains next to the eigenenergies, and the stochastic field keeps a nearly constant value; trying to increase or decrease the stochastic field is inefficient, provoking transitions of the convenient number of atoms. In conclusion "photon" must mean "quantity of energy $h\nu$", not particle; W. E. Lamb [8] is not far from this point of view, but he does not make the last step, the rejection of the postulates of quantum electrodynamics.

3.3 Experiment of Einstein, Podolsky and Rosen in optics

The emission of a photon is followed by an excitation of an atom by a photon only in the average. A source amplifies the stochastic field, so that the emission of a photon increases the probability that the fluctuations of the stochastic field grow up to values that pump atoms to higher states.

The paradoxes come from the quantization of the electromagnetic field; making a choice between the two locally equivalent theories, paradoxical quantum electrodynamics appears as an approximation of classical electrodynamics.

3.4 Optical effects at low light levels

Einstein considers two types of emission of light: the spontaneous emission, evaluated by the A parameter and the stimulated emission evaluated by B. The experiments show that these parameters are not independent, the spontaneous emission being an emission stimulated by the stochastic field.

Suppose that a certain optical effect is a non-linear function $f(E)$ of the amplitude of the electric field of an incident beam of light; E is produced by an amplification in a source of a stochastic field E_0 and may be written $E = E_0\beta$ where β is the amplification coefficient of the source. It is E which is written in $f(E)$ because the stochastic component of the field is an ordinary field which cannot be split from the remainder of the field.

If the light level is low, β is nearly 1, so that

$$f(E) = f(E_0\beta) = f(E_0(1+\beta-1)) \approx f(E_0) + (\beta-1)f'(E_0). \qquad (7)$$

As the stochastic field is, in the average, constant, the effect is a linear function of the electric field, either $E = E_0\beta$, including the stochastic fraction, or $E_0(\beta-1)$ excluding it, as usual [9]. In particular, a photocell detects the available energy it receives, that is the difference between the received energy, including the stochastic field, and a restored stochastic field; at a low level, the signal is proportional to

$$E^2 - E_0^2 = (E_0\beta)^2 - E_0^2 \approx 2E_0^2(\beta - 1). \tag{8}$$

It is proportional to the amplitude, not to the intensity.

Seeming to ignore this elementary classical property, many authors gave wrong classical interpretations of experiments to show that quantum electrodynamics is "the good electrodynamics"; they used photon counting to get sub-Poissonian statistics [10, 11], or second order interferences:

3.5 Second order interferences

All proposed experiments (see, for instance [12, 13, 14, 15, 16]) are fundamentally equivalent, and they show only that their author's classical interpretations are wrong because the stochastic field is neglected.

Neglecting the stochastic field, the elementary explanation of these experiments [17] gives a contrast 1/2 for the fringes, while the experimental value tends to one with a decreasing intensity of the light. Consider the simplest of these equivalent experiments [13]: two small photocells observe the interference of two small, incoherent, weak, monochromatic sources. These interferences are not visible because the sources are incoherent, their relative phase ϕ changes quickly, so that the fringes move too quickly for the eyes. The signal is the coincidences of the "detected photons".

Distinguish the two photocells by an index j equal to 1 or 2, and the differences of the optical paths on the cell j by δ_j; a cell detects proportionnally to the amplitude $\cos(\pi\delta_j/\lambda + \phi/2)$, so that the probability of simultaneous detections is proportional to

$$\cos(\frac{\pi\delta_1}{\lambda} + \frac{\phi}{2})\cos(\frac{\pi\delta_2}{\lambda} + \frac{\phi}{2}). \tag{9}$$

Taking the mean value during an experiment, that is integrating ϕ on 2π, we get a zero value for $\delta_1 - \delta_2 = \lambda/2$, so that the visibility reaches the right value 1.

For higher light intensities, the signal becomes proportional to the intensity, so that the visibility decreases to 1/2.

4 Tentative classical theory of the Wave particle duality.

Quantum mechanics claim that it solves the problem of the wave particle duality; having the choice to consider an object as a particle or as a wave is not a true solution. The maser seemed absurd to people who considered the photon as a particle, but the next section will show that, in despite of the popularity of the lasers, the same arguments persist.

While the photon is not a particle, the electron, proton, neutron ... are particles: they have a centre of mass, they may be static. The solitons are waves in non-linear media, which do not dissipate their energies by radiation;

they are classified by a (p+q)D symbol, where p is the dimension of the wave, and q the dimension of its propagation. Unhappily our present mathematics allow a rigorous study of a few (1+1)D solitons only. The (3+0)D solitons are fields which have the properties of particles: most of their energy is in a limited region of space, and this region may be static. Unhappily, these solitons do not seem to have been studied up to now. Show the existence of (3+0)D solitons.

4.1 Known properties of optical solitons

The nonlinearities which are generally studied in optics are produced by Kerr or photorefractive effects: the permittivity is an increasing function of the electric field, in many computations a quadratic function of this field up to a saturation provided by a sextic term.

The (1+1)D optical solitons have been extensively studied, they are probably used for the transmission of data in optical fibres.

The (3+1)D solitons, called optical bullets, propagate without dispersion, they are similar to particles which could not be stopped.

The optical (2+1)D solitons are light filaments obtained when a powerful laser is focalised in a non-linear medium [18, 19, 20, 21, 22].

The electromagnetic field decreases generally uniformly from the axis to the outside of a slightly converging laser beam, so that the index of refraction is larger near the centre of the wave surfaces; thus, the speed of light is lower near the centre, the curvature of the wave surfaces increases. If the beam is very neat, and the energy not too large, the beam converges to a single filament which is stable if it has exactly a "critical flux of energy", or radiates quickly an excessive energy. If the laser beam is powerful, local fluctuations provoke local convergences; many filaments are produced.

In a filament, the electromagnetic field may be artificially split into two parts: a cylindrical kernel in which the field is high, thus the nonlinearity large, and an evanescent wave whose amplitude decreases quickly with the distance to the kernel, so that it is quickly merged into external fields; the flux of energy in a stable filament free of interactions has the critical value, external fields may slightly change this flux. The properties of these solitons may be deduced from their theory or from their experimental observation.

We are interested here by the solitons in a perfectly transparent medium, but the absorption which occurs in real media brings useful informations: while the filaments lose much energy by molecular excitations, they are nearly parallel and so long [23] that they surely absorb energy from the surrounding field to keep nearly the critical flux of energy; more precisely, there is an equilibrium between the external field and the filament: if the flux of energy in the filament is slightly under the critical value, it absorbs the surrounding field, and vice versa.

An other important result is deduced from the observation: the filaments do not merge, they often make regular figures, they repel each other; but, as they absorb their surrounding field, an interpretation of this repulsion is that the filaments are attracted to the regions where the field is the larger. The theory [24] and the experiments [25, 26] show that the filaments may be curved without a loss of stability by a non-uniform external field, either macroscopic, or created by an other filament.

4.2 Theoretical existence of (3+0)D optical solitons

We consider here perfect, isotropic, non-absorbing media having non-linear properties which enable the propagation of infinite filaments [27]. For a filament centred around Oz with a given pulsation ω, the electric and magnetic fields $\overrightarrow{E'}$ and $\overrightarrow{H'}$ are invariant by translations parallel to Oz, the lengths of which are integer products of a period Λ. Set that the evanescent field is negligible over a distance ρ from Oz

Consider another problem in which the medium has the previous properties and, in addition, a small, perturbing nonlinearity depending on the amplitude of the magnetic field. This perturbation does not destroy the stability of the filament.

Consider a circle C of radius R larger than ρ, whose circumference is an integer multiple of Λ. Set Ω a point of C, ζ_Ω the curvilinear abscissa from Ω of a variable point M of C, $M\xi$ an axis oriented to the centre of C and $M\eta$ the axis making, with a tangent $M\zeta_M$ to C a reference frame. Suppose that, for any point M, in a disk of radius ρ and axis $M\zeta_M$, a daemon makes fields of amplitudes $E(\xi,\eta,\zeta_\Omega) = E'(x,y,z)$ et $H(\xi,\eta,\zeta_\Omega) = H'(x,y,z)$, oriented in $M\xi\eta\zeta_M$ just as $\overrightarrow{E'}$ and $\overrightarrow{H'}$ in $Oxyz$.

As the pulsation ω is a constant, the perturbation may be considered as a function of the amplitude of the curl of the electric field, rather than a function of the amplitude of the magnetic field.

Set Π_M the plane orthogonal to C at abscissa ζ_Ω and Π_N a similar plane at a point N of slightly larger abscissa $\zeta_\Omega + \delta\zeta_\Omega$. Set α the angle of rotation of the tangent to C from M to N, that is the angle between Π_M and Π_N.

In a second order approximation, the component along $M\eta$ of the curl of $\overrightarrow{E}$ supposed polarised along $M\xi$, is $\delta E_\xi(\xi,\eta,\zeta_\Omega,t)/(\delta\zeta_M) = \delta E_\xi(\xi,\eta,\zeta_\Omega,t)/(\delta\zeta_\Omega(1+\xi\alpha)) \approx (1-\xi\alpha)\delta E_\xi(\xi,\eta,\zeta_\Omega,t)/\delta\zeta_\Omega$. As $\delta\zeta_M$ is a decreasing function of $\alpha\xi$, the amplitude of the curl and the index of refraction increase with $\alpha\xi$.

Huyghens' construction applied to the wave in plane Π_M leads to a distorted and, in the average turned wave surface. Happily Huyghens' construction is too imprecise in a filament whose stability shows that the wave surface is not distorted; however, as the variation of the the index of refraction is odd in ξ, the wave surface is turned by an angle β.

The function $f(\alpha) = \beta(\alpha)/\alpha$ may be adjusted, using the variation of the index of refraction as a function of $\overrightarrow{H}$, so that, for a certain value α_0 of α, $f(\alpha_0) = 1$, $\mathrm{d}f(\alpha_0)/\mathrm{d}\alpha < 0$. The daemon is not anymore useful, an autocoherent and stable solution is found. The filament is transformed into a torus that traps the electromagnetic field; as the length of the filament and the flux of energy are fixed by the optical parameters, the energy of the soliton is quantified.

The existence of (3+0)D solitons is demonstrated, but a true study seems to require very powerful computers, with, maybe, the previous torus as starting point. If the properties of the filaments remain true, two toruses repulse each other; the regions where the field at the same frequency is large attract the torus.

Some crystals, tourmaline for instance, have remarkable electric and magnetic properties, but they absorb the light so much that it seems impossible to use them to try optical (3+0)D solitons. Are the balls of fire produced by the lightnings optical solitons? They seem made of ionised gas that could have the required properties.

4.3 Are particles optical solitons ?

Purely electromagnetic interactions, in the γ range can produce electron-positron pairs [28]; this shows that the vacuum becomes nonlinear. Remark that quantum mechanics introduce such nonlinearities through virtual particles. Testing whether matter is made of electromagnetic solitons is a big job! Suppose it is true.

If the kernel of a soliton goes through a Young hole, its evanescent wave propagates through both holes. Over the screen, we have a superposition of incoherent fields and of the interferences coming from the evanescent field; the incoherent fields do not interact much with the soliton; the soliton moves to the regions where the interferences are bright. Thus, the torus may be de Broglie's u field while the evanescent field is the ψ field [29].

A lot of different (3+0)D solitons may be defined in a single medium, using, for instance, the following methods:

- Changing the frequency (consequently R) and the polarisation of the wave;
- Commuting the roles plaid by the electric and magnetic fields;
- Using as index of refraction a function of the amplitudes of the fields which has many maximums;
- Introducing a torsion of the curved filament.

5 Quantum mechanics: a source of errors in astrophysics.

Quantum mechanics pretends find a solution to the wave-particle duality, but it is difficult to understand its rules: Why do a single atom absorbs a photon, while all atoms of a prism are necessary to explain the refraction of a single photon? Saying that the maser cannot work, the best physicists are not conscious to make arbitrarily the choice "particle". For this problem, the other choice works, but the problem of the locality appears ....

Unhappily, the astrophysicists made a wrong choice: Forbidding by a rejection of the coherent effects the alternatives to the Doppler (or expansion) effect they are obliged to imagine extraordinary interpretations of observations.

5.1 Coherent Raman scatterings.

"Coherent Raman scattering" is usually used for the scattering of laser pulses, with frequency shifts. In the region reached first by the laser beam, the emission is spontaneous, then the scattered light is amplified. The process is nonlinear so that few Raman line appear. The experiments show coherence between the incident light and the ability of matter to amplify a Raman frequency. To maintain the coherence of phase in despite of the dispersion between the incident and scattered lights, their directions of propagation must generally be different, a cone of scattered light is obtained.

This possibility fails if the beam is wide, because the wave surfaces are identical for the incident and scattered lights: the amplification is limited to a "coherence length". At the limit, for Rayleigh scattering, the coherence length is infinite and the refraction produced by an interference of the incident beam with the ($\pi/2$ phase shifted) coherently scattered beam, is a large effect.

The "Impulsive Stimulated Raman Scattering" (ISRS), known since 1968 [30] is used mostly in chemical physics [31, 32, 33]; it uses ultrashort laser pulses. "Ultrashort" has two meanings: it may be relative to the shortest available pulses (usually femtosecond pulses) or to the physics of their interaction with matter: following G. L. Lamb [34] "shorter than all relevant time constants".

The name "Impulsive Stimulated Raman Scattering" is not very convenient because "Raman effect" corresponds to a two photon effect in which the initial and final levels differ. ISRS is a four photons effect which does not pump the molecules. However this parametric effect may be considered as a combination of two, nearly simultaneous Raman effects.

With Lamb's definition of the ultrashort pulses, the time between the collisions must be longer than the length of the pulses, so that the coherence of the scattering is not perturbed by the collisions even if the pulses are weak. The period of the beats between the incident and scattered light is larger than the length of the pulses, so that the beams interfere into a single, monochromatic, but frequency-shifted beam; this type of interferences is usually observed with two lasers, or in a Michelson interferometer, when a mirror moves. Thus, a frequency shift is obtained without any blur of the spectral line or of the images. However, as the power is large, the scattered amplitude is generally proportional to the square of the incident amplitude (stimulated scattering), so that the relative frequency shift is proportional to the intensity: the lines of a polychromatic spectrum have different relative frequency shifts.

5.2 Incoherent Light Coherent Raman Scattering (ILCRS)

Natural, incoherent light is made of pulses, the length of which is of the order of 10 nanoseconds.

The first condition to consider it as made of ultrashort pulses is that the collisional time be longer enough than 10 ns; it is an ordinary vacuum, so that the observation of an effect requires a long path.

The second condition is that the period of the beats of the incident and scattered lights are longer enough than 10 ns: The Raman transition must be in the microwaves range, that is the active molecules must have hyperfine structures.

As the power of natural sources is low, the amplitude scattered by ILCRS is proportional to the incident amplitude, the relative frequency shift depends on the frequency by dispersion effects only. The intensity of a parametric effect made of the combination of two effects, is limited by the weaker effect; here the low energy Raman transition, so that, in the visible, the relative frequency shift is almost constant.

ILCRS does not blur either the spectra or the images; it introduces a very nearly constant relative frequency shift: from the spectra and the sharpness of the images, *it is very difficult to distinguish ILCRS redshifts from Doppler redshifts.*

5.3 Application to astrophysics

It seems difficult to observe ILCRS in the labs, but astrophysics provides low pressures and long paths.

Which molecules may be this sort of catalyst, able to transfer energy from the redshifted high frequencies to the slightly heated thermal radiation at 2.7K?

All mono or polyatomic molecules are able to acquire Stark or Zeeman hyperfine structures; often, heavy molecules have such structures, but their density is low. The nuclear spin coupling transition of H_2 at .21 m is weak, but the molecules which have an odd number of electrons have strong transitions in hyperfine structures. NO, OH, NH_2 ... have been observed in the galaxies.

The ultraviolet radiations can ionise H_2 into H_2^+, a very stable molecule where the collisions which destroy it are rare. It is easy to understand that the observation of this molecule is difficult: it has many relatively weak lines which are spread by the redshift produced by the molecules themselves; increasing the pressure, H_2^+ is destroyed by collisions before a decrease of the ILCRS redshift.

The two main proofs of the expansion of the universe, the cosmological redshift, and the existence of the 2,7K radiation should be tested against their production by an ILCRS effect. A number of H_2^+ molecules, of the order of 20 in a cubic metre would produce the whole cosmological redshift [35, 36].

The small dispersion of ILCRS could explain the dispersions observed in the spectra of quasars [37] without the hypothesis of a variation of the constant of fine structure [38].

Near some bright QSOs, powerful thermal radiation observed in the infrared seems produced by heated dust, but the pressure of radiation should push the dust out. Is it an ILCRS effect?

A lot of theories tried to explain the multiplicity of the Lyman lines in the spectra of many quasars; ILCRS proposes a purely static, simple explanation supposing a variable magnetic field in a halo: where the field is low, the lines are written into the spectrum; elsewhere, ILCRS is activated by the Zeeman effect, the spectral lines are so spread by the shift that they are invisible [39].

6 Conclusion

Wanting to understand anything, we are tented to use marvellous explanations; the science needs centuries to destroys the marvellous by theories which are coherent and verified by the experiments.

The usefulness of the quantum theory is not a proof of the rightness of its postulates that the paradoxes show fundamentally incoherent; attributing the formalism of quantum theory to the classical theory seems possible, with the strong advantages of precision and lack of paradoxes.

Unavoidably wrong interpretations of quantum theory led the astrophysicists to neglect the search of an optical theory to interpret a part of the redshifts, thus introducing strange hypothesis, unable however to explain hundreds [40], probably now more than thousand observations.

References

[1] C. H. Townes , *Opto & laser Europe* **69**, 20 (1999)

[2] J. Moret-Bailly *J. Mol. Spectrosc.* **50**, 483 (1974)

[3] B. Bobin & J. Moret-Bailly, *Spectrochimica acta* **51A** , 1231 (1995)

[4] M. Planck , *Verh. Deutsch. Phys. Ges,* **13**, 138 (1911)

[5] W. Nernst , *Verh. Deutsch. Phys. Ges,* **18**, 83 (1916)

[6] T. W. Marshall, & E. Santos , *Phys. Rev.* **A 39**, 6271 (1989)

[7] J.-L. Monnot, *Thèse*, Dijon (1994).

[8] W. E. Lamb Jr., *Appl. Phys.*, **B60**, 77 (1995)

[9] J. Moret-Bailly, arXiv:physics/0105055 (2001)

[10] R. Short & L. Mandel , *Phys. Rev. Lett.* **51**, 384 (1983)

[11] R. J. Glauber . in Physics of Quantum Electronics, Kelley P. L. et al. ed. McGraw-Hill, (1966)

[12] J. F. Clauser , M. A. Horne , A. Shimony & R. A. Holt , *Phys. Rev. Lett.* ,**23**, 880 (1969)

[13] R. Gosh & L. Mandel , *Phys. Rev. Lett.* ,**59**, 1903 (1987)

[14] Z. Y. Ou & L. Mandel , *Phys. Rev. Lett.* , **61**, 54 (1988)

[15] Z. Y. Ou & L. Mandel , *J. Opt. Soc. Am.* , **7**, 2127 (1990)

[16] T. E. Kiess , Y. H. Shih , A. V. Sergienko & C. O. Alley , *Phys. Rev. Lett.* , **71**, 3893 (1993)

[17] J. Moret-Bailly , *J. Optics,* **25**, 263 (1994)

[18] R. Y. Chiao, E. Garmire & C. H. Townes, *Phys. Rev. Lett.* **13**, 479 (1964)

[19] J. H. Marburger *Prog. Quant. Electr.* **4**, 307 (1966)

[20] G. I. Stegeman, D. J. Hagan, L. Torner, *Opt. Quantum Electron.* **28**, 1691 (1996)

[21] Y. S. Kivshar, D. E. Pelinovsky, *Physics Reports*, **331**, 117 (2000)

[22] M. D. Feit & J. A. Fleck, Jr. *J. Opt. Soc. Am.* **B5**, 633 (1988)

[23] A. Brodeur, F. A. Ilkov & S. L. Chin , *Opt. Comm.*, **129**, 193 (1996)

[24] A.A. Zharov & A. I. Smirnov, *Nonparaxial solitons, in Soliton driven photonics*, NATO ASI Series, Ed. A. Boardman (2001)

[25] J. Petter, C. Weilnau, C. Denz, A. Stepten, F. Kaiser, *Opt. Comm.*, **170**, 291 (1999)

[26] M. Shih, M. Segev, G. Salamo, *Phys. Rev. Lett.* **78**, 2551 (1997)

[27] J. Moret-Bailly, arXiv:nlin/0104007 (2001)

[28] V. I. Ritus, *Ann. Of Phys.* **69**, 555 (1972)

[29] L. de Broglie, *Une tentative d'interprétation causale et non linéaire de la mécanique ondulatoire (La théorie de la double solution)* (Gauthier Villars, Paris 1956)

[30] Y. X. Yan , E. B. Gamble Jr. & K. A. Nelson , *J. Chem Phys.* **83**, 5391 (1985)

[31] K. A. Nelson & M. D. Fayer , *J. Chem. Phys* **72**, 5202 (1980)

[32] A. M. Weiner., D. E. Leaird., G. P. Wiederrecht, & K. A. Nelson, *Science* **247**, 1317 (1990).

[33] T. P.Dougherty, G. P. Wiederrecht, K. A. Nelson, M. H. Garrett, H. P. Jenssen & C. Warde, *Science* **258,**, 770 (1992).

[34] G. L. Lamb Jr. , *Rev. Mod.Phys* **43** , 99 (1971)

[35] J. Moret-Bailly, *Ann. Phys. Fr.*, **23**, C1-235 , (1998)

[36] J. Moret-Bailly , *Quantum and Semiclassical Optics* **10**, L35 (1998)

[37] J. Moret-Bailly, arXiv:astro-ph/0103508 (2001)

[38] J. K. Webb, V. V. Flambaum, C. W. Churchill, M. J. Drinkwater and J. Barrow, *Phys. Rev. Lett*, **82**, 884 (1999).

[39] J. Moret-Bailly , *J. Quantit. Spectr. & Radiative Ttransfer* **68**, 575 (2001)

[40] H. Reboul, *J. Astron. Astrophys. Suppl.*, **45**, 129 (1981)