PHYSICS OF REALITY OR GHOST PHYSICS - 2

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Excerpts from Baggott's and comments

In the "figures" I have put excerpts of Baggott's book, "Farewell to Reality", Pegasus Books, London 2013.

> Newtonian physics is characterized by a determinism founded on a strong connection between cause and effect. In the old version of empirical reality described by Newton's theories, if I do *this*, then *that* will happen. No question. One hundred per cent.

Figure 1: Determinism

Here we have a very big problem with the correct interpretation of physics. Newtonian physics is characterized by determinism, **but only in the case of simple systems interacting under linear interactions, when the initial conditions are not changed by the evolution of the same systems**. In traditional physics (encompassing both physics before 1900, quantum mechanics and relativity and today's mystic- or ghost-physics) the only objects subject to the interest of physicists are the equations. But equations mean nothing isolated from initial and boundary conditions, and in traditional physics these conditions are not considered in physical detail. In the same careless way that traditional physics speaks of *"the hydrogen atom"* or *"the point mass"* , the initial conditions are **implicitly** considered to be able to be fixed with arbitrary precision. In the same way, boundary conditions are considered to be independent of the systems studied.

But these **implicit** assumptions are very wrong. There are no systems in nature, in the universe, that are **isolated**. For instance, electrons are always subject to a huge number of varying interactions. There is no such thing as *the* hydrogen atom, and there are no mass points. Nature can **never** repeat initial conditions, and we ourselves, although we be assume **implicitly** that we can repeat them in our machines, we are in error. In one of the best class of machines ever built by humans, the chronometers, when the hands come back to the original position, let us say 00:00, some atoms of the mechanism have been displaced from the escapement and the springs due to friction. In atomic clocks the atoms themselves change because the crystals are never 100% pure and other atoms act in interaction with the main ones. In nature there are no interaction-free systems.

And here we must remember a part of traditional physics that has been slowly fading out of physicists' considerations: The *error* in the interaction between systems, usually called *measurement error*. When interactions are between a "big" system and another "small" one, interaction errors in the big system can be neglected. But never in the small one. When the interactions are between similar systems, errors are considerable. As there is nothing among stable systems smaller than an electron, its motion is always in *"error"* that is, indeterminate, because it is impossible to shield electrons from electromagnetic fields. Even isolated electrons in the middle of the universe far from material objects are subjected to EM fields or EM waves, chaotic in their properties, as they reach the electron position from incoherent sources.

Newtonian determinism arises only for idealized notions. In reality, no system can be assumed to answer an isolated cause, and therefore the effects are impossible to determine with arbitrary precision. In newtonian mechanics, if I do *this*, *that* will happen only **if I am a big system surrounded by small ones**. But as soon as the systems in study are of a similar *size* and the interactions are non-linear (almost all interactions) the systems move in a non deterministically way (double penduli, coupled penduli, gravitational systems, electrical charges, etc.).

Many physicists, including some of the best ones, forget that in physics equations are only tools, similar to the meters, pincers, and screwdrivers in the laboratory. They are useful to try understanding nature's evolution, but they are nothing more that tools.

Photoelectric effect

Einstein figured that if light actually consists of self-contained bundles of energy, with the energy of each bundle proportional to the frequency of the light, then the puzzle is solved.[4] Light quanta with low frequencies don't have enough energy to dislodge the electrons. As the frequency is increased, a threshold is reached above which the absorption of a light quantum knocks an electron out of the lattice of metal ions at the surface. Increasing the intensity of the light simply increases the number (but not the energies) of the light quanta incident on the surface. He went on to make some simple predictions that could be tested in future experiments.

Figure 2: Photoelectric effect

If I hit one of the strings of a piano with a sledgehammer I can produce a considerable deformation that probably breaks the piano and not the steel string. However, if I keep injecting energy at a resonant frequency the string will probably break under a small amount of power (energy/unit time) provided.

Are the electrons ejected from the metal because the energy **comes** in quantum units, or do the electrons **absorb** energy only in quantum units? The difference is important: It brings the problem from the radiation (waves that are continuum phenomena) to the crystal that is a grid of individual and separated particles, of quantum units? Quantification is natural in matter (it is almost its definition) but very difficult and needless in extended fields.

Description 1) We can think of an electron as of an entity spread around the nucleus (no velocity?). A concentrated photon interacts in one point with this extended entity and the entity changes its place of spreading. Fine.

Description 2) We can assume that the electron is a locally concentrated particle with velocity and the photon is an extended wave, any part of which can interact with a spatially concentrated electron.

The difference between these two almost equivalent pictures is that the electron has mass, and the photon is massless. It seems rational (and perhaps we would like physics to be rational and not a mystic endeavor) to assign waves to massless entities and particles to entities with mass.

Interaction is surely quantum. But that is not a big conceptual problem, as in classical physics resonant interactions are quantized. Do we need quantum photons and phonons to study quantum interactions between extended waves and locally concentrated particles? Or can we keep the ideas of particles, waves and quantum interactions?

I know that renouncing to the ideas of photons is alike to renouncing to the ideas of angels, for some people. But angels are unnecessary and its existence is a matter of mysticism.

Mystery. A mystical physics?

> We now make a further important assertion. The amplitude of the wavefunction at a particular point in space and time provides a measure of the *probability* that a photon is present.* When the wavefunction corresponding to a single photon interacts with chemicals in the photographic emulsion, it 'collapses'. At this point the photon mysteriously appears, as an indivisible bundle of energy, and a white dot is formed on the film. Such dots are more likely to be formed in regions of the photographic plate where the amplitude of the wavefunction is high, less likely where it is low. After

Figure 3: A mystical physics?

Why must a “photon” **mysteriously** appear? If we force an ordinary oscillator with a vibration of the right frequency, the oscillator will be broken. Waves can produce changes in the chemical composition of the film, if they have the adequate frequency, and at very fine spatial points.

Complete quantum theory?

> Quantum probability is quite different. The Copenhagen interpretation insists that in a quantum system like the two-slit interference experiment with single photons, there are no other variables of which we are ignorant. There is nothing in quantum theory that tells us how an indivisible photon particle navigates its way past the two slits. This doesn’t necessarily mean that we’re missing something; that the theory is somehow incomplete. What it does mean is that the particle picture is not relevant here and we can’t use it to understand what’s going on. We use the wave picture instead and revert to the particle picture only when the wavefunction collapses and the photon is detected.

Figure 4: A complete quantum theory?

There is nothing in **nature** that forces an indivisible photon to navigate past two spatially separated slits. Therefore, any good physicist will deduce that no photon is passing two slits, but that an extended EM wave does. After that, the EM wave produces, by interaction with the photographic emulsion, or by its interaction with the photodiodes of a camera, isolated effects.

Let us take an example from classical physics: I have a certain harmonic oscillator (a spring, a pendulum) with natural frequency ν. If I drive it with a motor with frequency ν I can make it “jump” to another orbit (break it, simply). Must I say that the motor is quantized and is a *“moton”* ? My rational, not mystical, reaction is to assign the quantification of the transmission of energy to the resonant interaction between motor and oscillator, not to some unexpected characteristic of the motor.

And in the two-slit experiment with very low intensity EM waves, we need to know how the waves interact with the electrons in the slits, that are of the same spatial order of magnitude as the wavelengths. Here there are no hidden variables, but very public and explicit ones, the interactions between EM waves and electrons in solids.

The founders of QM, mainly Bohr, Heisenberg, Pauli, Dirac, Born, were members of society in which the result of the actions were the product of the characters of its members. The society was the final summary of 400 years of calvinism, and its insistence on the individual person, and culminated in Freud's theories of the inner mind. These founders assigned properties to entities, when the most probable reality is that the effects they were analyzing derived from the interactions between these entities.

Quantum Probability

> We need to be very careful here. Quantum probability is not like 'ordinary' probability, of the kind we associate with tossing a coin. When I toss a coin, I know that there's a 50 per cent probability that it will land 'heads' and a 50 per cent probability that it will land 'tails'. I don't know what result I'm going to get for any specific toss because I'm ignorant of all the variables involved — the weight of the coin, speed of the toss, air currents, the force of the coin's impact on the ground, and so on. If I could somehow acquire knowledge of some of these variables and eliminate others completely, then I might actually be able to use Newton's laws of motion to compute in advance what result I'm going to get.

Figure 5: Quantum Probability

When Baggott speaks about "ignoring all the variables involved" he speaks not of hidden variables but of present and very open and public variables. A tossed coin can be converted into a rather simple system, tossing always with similar initial conditions differing one from another with a "physics" relative error of 0.00001%, in a room into which vacuum has been done. Then the coin will fall almost always with the same face up. We have eliminated the interactions, we have one of the simple systems pertaining to quantum mechanics, these isolated systems that agree with the calvinistic meme of individual entities in presence of its god.

At the atomic scales, however, the myriad interactions that act randomly on any particle are always there. The electromagnetic fields of any container inside which we study any simple system are always there as are these EM fields in the middle of empty space far away from any galaxy. There is no interaction-free situation for atomic scale particles. There are no hidden variables. All the variables are open and public, but they change very fast and in a random way when they act on small particles.

We have a really open, public random world. On the other hand, at macroscopic scales (macroscopic in comparison with the amounts of electrical charge and mass of the electron, and radii of the atoms) the systems average away the random motions and interactions, at least when the interactions are between big and small systems (the Sun and the planets). **However, intrinsic randomness appears again as soon as the we have similar systems, as for instance three suns of similar masses under gravitational interaction. In this case Heisemberg uncertainty principle is also at work, if we use to measure any of the suns' velocities or positions other systems of similar dimensions.**

Randomness is nothing intrinsic of isolated systems, but a property of the interaction between systems, and more precisely, of the relative scales of the systems in interaction. Probability pertains to QM, not thanks to any "mysterious" situation, but simply because any particle at the atomic and smaller scales is never interaction free.

The big problem with the derivation of QM was that physicists proposed an intellectual schema based on the physics of ideal bodies isolated from real interactions. Physics at the atomic and nuclear scales must be done under a schema of huge numbers of random interactions. In fact, QM is really the surface appearance of a really 3-D statistical theory.

Another problem in QM is its very anthropic insistence on the "homo sapiens" measuring nature, i.e.: Interacting with particles and waves trajectories. But measurement is what nature does continuously in time: Any wave or particle interacts steadily with zillion of others, so human measurements are nothing special.

To finish this part of the series Ghost Physics, I want to coment on an excerpt of

"The concept of quantum state: new views on old phenomena" , by M. Patty.

> and physical magnitudes by their «operators». At this level of representation, it is not necessary to go back, for each magnitude and each state, to the practical circumstances of their determination that refer ultimately to observations with the help of classical apparatuses.
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> For theoretical thought at the quantum level, the classical systems constituting these apparatuses are only intermediary in the process of constitution of data, that are in the end translated in quantum terms. The data being acquired, the quantum domain let itself be conceived and explored in full conceptual and theoretical independence with respect to the classical domain.

Figure 6: Quantum States or Quantum Playing

It seems that the "Quantum State" is necessary and useful for playing with concepts in a separate world, like the one in Salamanca in 1480, with contact neither with reality nor with experiment (that must be done with classical? systems designated as apparatuses).

Then, it enters the category of Ghost Physics, or Mystic Physics, the brain activity connected with angels, witches, unicorns, centauri, pegasi and the like.