PHYSICS OF REALITY OR GHOST PHYSICS - 3

A comment on the book: "Farewell to reality" , by E. Baggott (1)

Physics at the atomic and nuclear scales. A half full or a half empty glass of wine.

Quantum behavior as resonances of matter. We can observe no quantum behavior in light, save when light interacts with matter. We can assume that light is quantized (Einstein's hypothesis) or that the interactions are quantized. The first assumption brings the weird and unnatural hypothesis of the dual nature of EM radiation (it is very difficult to assume that radio waves in the marine radio band, λ=0.6 km, are photons, but they have nothing at all to distinguish them from light or X-Ray wavelengths). On the other hand, there is no problem in assuming matter as quantized, as the definition of matter requires, demands, separation between objects. Can we accept as physics an universe as a continuous solid (solid, not atomic solid) ball, surface or table?

A half full or a half empty glass of wine. The same glass. We can say that a very concentrated in space, almost a point of an electromagnetic (EM) system interacts with a stationary and spatially extended cloud of electricity (an electron). Or we can say that an extended EM wave interacts with a concentrated electric charge. The second one has the advantage of relating a concentrated charge with an entity that has mass. A seemingly mathematical point without mass is something rather less interesting in the description of the interaction between light and matter, that a massive small particle.

Particles, mainly electrons, protons and neutrons inside nuclei, are essentially quantum, individual, concentrated in small space regions. They move, when in interaction with others, in resonant orbits or paths. Quantification of motion is natural.

Wave character of matter boils down to the images of electrons in the electron bi-prism, when a beam of individual electrons generates interference patterns. Or buckyballs of carbon going past a multiple slit screen and creating also interference patterns. But electrons in the bi-prism, and buckyballs interact with very regular (periodic) structures. There is no interference if there is no interaction with periodical matter. Are these particles waves, or what is quantized is the interaction? Do individual electrons show some wavelike characteristics? Individual electrons pass through a system of metallic plates and a metallic cylinder, that is, they interact with the EM fields of trillions of other electrons and protons. What we see in the electron bi-prism experiment is the result of EM interactions, not the interference of one wave via Huyghens principle. Same with the buckyballs.

Entanglement

The "**problem**" seems to be that if I prepare a pair of photons to have the same spin, and then send them in different directions, when one of them interacts with some object and is discovered to have, for instance, spin up, instantaneously, faster than the speed of light, the other changes from a mixture of spin directions to the direction shown by the first photon. With that some physicists deduce that it is possible to influence actions far away at speeds faster than the one of the light.

The idea is that, while traveling, both photons are in a mixture of states, that "**collapses**" to only one at the interaction of one of the photons with some other system. But the change from a mixture of states to only one demands that the other photon interacts also with a different system. Reality, as distinct from imagination, from mixtures, from possibilities, is interaction between systems and it is the interaction what we should study.

The experiments are done with photons, but can be done also with a prism and a sphere of obsidian, for instance. A prism and a sphere are put in two very similar black boxes. The boxes are given to another person that returns them after having moved them, not telling us anything about the boxes. We pick one of them and send it to San Diego. Arriving in San Diego, we can say that we don't know what is inside, or we can say that the object inside the box is in a mixture of prism and sphere. Or in a mixture of any object we could imagine in the universe. The object inside the box will remain, as the objects in a Christmas tree, in a mixture of states until we interact with them. The box in Madrid is opened under some light and we see that the object inside is a prism. The object in San Diego changes instantaneously from an unknown to an obsidian sphere. From a mixture of (possible) states to a brilliant ball.

If we don't interact with objects or waves, the world can be anything we could imagine. The reality is provided by the continuous interaction between physical systems.

To speak, to analyze, to play with isolated systems is not physics, not ever metaphysics, it is mysticism.

Real entanglement would be to be seeing simultaneously here in Madrid a square and a circle on a screen, and suddenly seeing only a circle, knowing some milliseconds later that in Sydney, Australia, the entangled member of a pair became a square at exactly the same time. Real entanglement would be to see the mixture of states, not simply to think "there is a mixture" .

But if I see nothing, and then I see a square in my screen, and some milliseconds later I receive an EM wave signal telling me that the member of the entangled pair in Australia showed a circle, I conclude that the member of the entangled pair in my laboratory was always a square, and has not changed from circle to square because the australian member of the pair has decided to be a circle.

In the same way, if I put a roach inside a box, and some random mechanism can kill or leave it living in the interval of one hour, and after that interval I open the box, I bring neither death nor life to the roach when I open the box. The roach **was not** in a mixture of states inside the box. It was dead from minute 10 on, o live after 60 minutes, independently of my opening or leaving closed the lid of the box. The idea of superposition of states and, moreover, linear superposition, is a postulate that can be useful, true or false, but it is an arbitrary and useless postulate, valid only for non interacting systems.

The wave function of the roach can simply be living going on to death, as with any living being, and we need not to assume that its wave function is a superposition of living and dead, as we don't assume that we are in a superposition lo life and death during our living years. We can say that, at the time of death, the coefficient of the term of dying in the mixture of states has jumped from zero to one, while other coefficients have gone down to zero. It is a possible way to see the universe, but not the most interesting one, as the situation we are interested in is the evolution of the coefficients not related to the dead component, that we try to forget during all of our life. The glass is the same. It can be viewed as half full or half empty.

We could assume that we are, from birth on, in a mixture of living and death, and that we are in a mixture of all possible states of wealth and poverty, and of health, from completely sane to very ill, and ... . It is a way of seeing the world. I am entangled with a rich uncle. If he dies and leaves his fortune to me, one of the many-worlds possibilities will obtain faster than light but, which is the sense of that description? We can adopt that way, but it is not especially quantum, and I don't see what advantages brings to the description of reality. For once, we should be able to specify -all- the possible states of -all- the possible interacting objects in the universe. A difficult task.

We always can see a glass half full of wine, or see it half empty. We can use Heisemberg's or Schroedinger's, or Dirac's description of reality. We can think a roach goes on living and then dies, or we can say that the roach is half live/half dead all the time it is inside the box, and that we kill or allow it to go on living when we open the lid.

As with many other situations, the description we use is the one that provides the more adequate answers to the situation we are interested in. If we are afraid that a friend will become intoxicated if he drinks some wine, we can be happy that the glass is half empty. If we want to get a depressed friend to become lively we can also be happy that the glass is half full still.

There is nothing especially mysterious in the question of entanglement.

Measurement

Small particles, electrons, for instance, interact constantly, continuously in time with measurement apparatuses: All other electrons in a copper cable are measuring their positions and velocities. The collapse of the wave function is a consequence of the algebraical-mathematical method of describing electrons (for instance) and has really nothing to do with reality. An electron can really be in any position, inside a copper cable, or in a collection of hydrogen atoms in interaction with the electrons and protons that form the container in which the hydrogen atoms are moving. Or in the far away space surrounded by an arbitrary number of EM waves that move it. These interactions make the position of the electron something able to be determined only as probability. Quantum mechanics is a theory of free particles and waves. It has nothing to say of the real interactions between particles, as for instance the interactions between the electrons of a system and the electron of another system called measuring apparatus. The linear theory of superposition of states forces the mathematical formulation to give probabilities added as squares. We must look at the problem of according a real uncertainty in position and velocity, of any electron, due to the unavoidable many non-linear interactions and feedbacks with many others and the Schroedinger amplitude

Uncertainty

In any case, Heisemberg uncertainty principle is nothing magic. An electron moves constantly in a very tangled path. To locate it we must illuminate it with some EM wave, or make it interact with some EM field. As soon the wave or the EM field interacts with the electron, it changes its position, so there is nothing mystic in the uncertainty relationship. It is the simple physical fact that the mass of the electron is the smallest one of the stable interesting particles in nature, and as it is very small, any interaction forces the change of its position and velocity. We can consider what would happen if we tried to determine the position and velocity of a moving car by the collision with it of an elastic ball of steel of a mass similar to the one of the car. (Neutrino's mass is smaller, but neutrinos are not sensationally interesting).

Consideration

So there is nothing very different between the small scales and the large ones, save that when a small object pushes against a wall, it doesn't move the wall: $\vec{v} = 0$ and position are determined with an error of atomic dimensions, but when any object pushes an electron, the errors in the subsequent velocity and position are of the same order of the change in the same magnitudes: around 100% error. Quantum effects are simply the consequence of relative sizes (masses, charges, etc.) of the interacting systems.