

# 1 Quantifying gravity

We have introduced a network of point masses to satisfy a vanishing energy condition for each point. The next step is to replace the pure point by a fundamental neutral bound system, a particle-antiparticle pair bound state which mass gives the vacuum mass at each point in the network. The gravitational vanishing energy condition for this system in the network is of course still satisfied provided its mass includes also its gravitational potential internal energy contribution. Both particle and anti-particle wave functions are understood to be described by a standing wave vibration inside the volume delimited by a (Pioneer like) discontinuity. The gravitational potential energy  $E$  of the particle wave function in the mean central static gravitational field of its partner in the bubble, considering only the fundamental mode, is given by:

$$E = G_N m^2 \frac{\int_0^d \frac{1}{r} \frac{\sin^2(\pi r/d)}{r^2} 4\pi r^2 dr}{\int_0^d \frac{\sin^2(\pi r/d)}{r^2} 4\pi r^2 dr} = \frac{2.43 G_N m^2}{d} \quad (1)$$

As a consequence, a spherical wave can be gravitationally absorbed or emitted by this fundamental bubble only in packets or energy quanta  $E$ . We get in that way the quantized energy which is inversely proportionnal to the bubble radius  $d$  thus proportionnal to the fundamental frequency ( $E = h_G \nu$ ), the coefficient  $h_G$  being determined through

$$\frac{h_G c}{d} \simeq \frac{G_N m^2}{d} \Rightarrow h_G \simeq \frac{G_N m^2}{c}$$

thus a direct link between the gravitational Planck constant and vacuum network mass is established and the fundamental relation of quantum mechanics  $E = h_G \nu$  is derived. This is a major result since the uncertainty principle follows in straightforward way thanks to Fourier analysis and wave physics.

# 2 Quantum gravity in the solar system

Angular momentum must be quantized in the solar system according :

$$mvr = n\hbar_G$$

Considering that the protoplanetary disk had constant surface density the mass found between radius  $r$  and  $r+dr$  is  $m(r) \propto r$  while the fundamental relation of dynamics yields

$$v(r) \propto r^{-1/2}$$

if the gravitationnal field of our central protostar was dominant. Thus the disk must have fragmented and concentrated at quantified radii  $r_n$ :

$$r_n^{3/2} \propto n\hbar$$

The rotation period  $T$  is a quantity proportionnal to  $r^{3/2}$  and must therefore be quantized. It was indeed shown by JM Souriau that solar system periods are not only approximate multiples of 30 days, but also occupy a Fibonacci suite of frequencies, in such a way that neighbour planets are minimally resonant (cf ). After fragmentation of the primordial disk, protoplanetary masses grew in such a way that  $m(r) \propto r$  was lost while radii and periods remained in the same proportions. If so  $\hbar_G$  can be estimated. Given that the protoplanetary disk radius was approximately the present solar system radius  $r_{Ort}$  and its mass  $10^{-3}$  solar Mass, its initial surface density was

$$\sigma = \frac{M_{\odot}}{1000\pi (r_{Ort})^2}$$

and

$$\sigma 2\pi r_n (r_{n+1} - r_n) \frac{2\pi}{T_n} (r_n)^2 = n\hbar_G$$

If 30 days is the fundamental period then Venus and Earth are at  $n=11$  and  $n=12$  respectively but may be the smaller self-rotation period in the solar system, 10 hours for Jupiter, is a more likely fundamental one in which case  $n_{venus} \approx 990$  and  $n_{earth} \approx 1080$  (L. Nottale formula has a 3 days fundamental period).

$$\hbar_G \approx \frac{4\pi}{1000} \frac{M_{\odot}}{1000T_{venus}} \frac{(r_{earth}-r_{venus})(r_{venus})^3}{(r_{Ort})^2} = 6.10^{29} Js$$

to be compared with the Planck constant of electromagnetism

$$\hbar_q = 10^{-34} Js$$

It follows that

$$m_{vacuum} = \sqrt{\frac{\hbar_G c}{G_N}} \sim 10^{24} kg$$

of the order of one fifth of the earth mass.

$$d_{vacuum} \approx \frac{G_N m_{vacuum}}{c^2} 1.7 \sim 1mm$$

Can vacuum effects related to this network of masses be tested? All laboratory experiments involve masses moving at about 300 km/sec relative to our vacuum masses provided these are at rest with respect to the CMB frame. Being alternatively attracted and repelled a free mass test should vibrate or be submitted to deformations with typical frequencies of the order of 10 MHz in vacuum. Anyway it is probably difficult to extract such signal from the noise since it affects in almost the sameway the experimental setup. No doubt that the optimal conditions are those of free motion with highly reduce noise i.e. free fall in space. Gravity Probe B is a free falling apparatus having an extremely good control of deformation and motion of its gyroscopes (the most spherical ever man-made objects), rotating at 0.03 mm from their stator, and a read-out system highly torque sensitive which should render it optimal for the detection

of our vacuum effects. It appears that indeed the experiment has discovered unexpected new phenomena among which resonance peaks in the drift rate of the gyroscopes axis.

If we were to adopt a more conservative point of view , we would have a single fundamental Planck constant for both gravity and electromagnetism and  $m_{vacuum} \sim 3.10^{-8}kg$  and  $d_{vacuum} \sim 3.10^{-35}m$ .

### 3 Quantifying electromagnetism

The same method used to quantify gravity allows us to quantify electromagnetism with another Planck constant  $h_Q$  .

$$\frac{h_q c}{d_e} = \frac{q^2}{4\pi\epsilon_0 d_e} \Rightarrow h_q = \frac{q^2}{4\pi\epsilon_0 c} = \frac{e^2}{c} \quad (2)$$

assuming that in the same bubble we have in addition a genuine positronium electromagnetically bound state. But now the vanishing energy condition should apply by compensating the electromagnetic potential energy of the pair by its spin-spin magnetic energy.

$$\left(\frac{q\hbar_q}{2m}\right)^2 \frac{1}{c^2 4\pi\epsilon_0 d_e^3} = \frac{q^2}{4\pi\epsilon_0 d_e} \quad (3)$$

Yielding the bubble radius  $d_e = \frac{\hbar_q}{2m_e} = \frac{137}{2} r_e \approx 2.10^{-13}m$  where  $r_e$  is the classical radius of the electron ( $2.8 \cdot 10^{-15}m$ ).

Motivated by the approximate  $z_{CMB} = 1000 \approx 2\pi.137$  in

$$h_q = z \cdot \frac{e^2}{c} \approx 2\pi.137 \cdot \frac{e^2}{c}$$

we suspect cosmological expansion to be responsible for a coevolution of  $\alpha = \frac{e^2}{\hbar c}$  and the masses scale.

### 4 Gravity, Quantum mechanics and Spirituality

For several decades and in spite of theoreticians sustained efforts, quantizing gravity has raised the major issue, not solved to date, of the compatibility between the conceptual foundations of General Relativity and Quantum Mechanics, the two pillars of contemporary physics. Indeed, these appear radically antinomic, the main obstacle at the origin of this incompatibility between MQ and GR certainly being the inexistence of any privileged coordinate system and in particular the impossibility to define an absolute time in GR. It is already encouraging to realize that such kind of obstacle immediately disappears within the framework of a theory as DG which is built starting from an absolute and non dynamical flat space-time, a familiar framework for quantization. But well beyond, it is not only the simple perspective of unification between two ways

of thinking nor applying a quantization program that opens up with DG. Indeed the theory, appears to generate quantization from its own principles and does much more than throwing some new light on the well known interpretation issues of QM: it solves them for the most part.

In DG we find two cohabiting modes of gravity: a continuous source one having propagating wave solutions and a discrete source one, a network of point masses structuring the vacuum, each point being able to communicate via instantaneous gravity with all the others and having in its neighborhood and being the center of isotropy of a stationary wave system oscillating inside a finite volume delimited by a gravity discontinuity. As we have already shown, each such system can emit a spherical centrifugal wave or absorb a spherical centripetal wave thereby a packet of energy (quantum) proportional to the wave frequency. The fundamental relation of quantization linking energy and frequency of the absorbed/emitted wave,  $E = h\nu$ , is therefore a consequence of the theory. On the other hand, the network points, while absorbing and emitting in a non local and concerted way a new system of spherical waves, is perfectly able to trigger the collapse of any QM wave packet.

We can now reconsider the most important interpretational issues of QM and explain which kind of solution DG offers in each case. We advise the reader to first read the first ten pages of "The transactional interpretation of Quantum Mechanics" by JG Cramer where the seven issues (Identity, Complexity, Collapse, Non locality, Completeness, Predictivity and the uncertainty Principle) are introduced and discussed within the Copenhagen Interpretation.

- Identity

What is the state vector (or wave function) of QM? The wave packet collapse is a so enigmatic and unacceptable process for most physicists that a positivist interpretation which does not take serious the physical reality of the wave function eventually stood out, interpretation according to which it is no more than a tool for efficiently computing relations between observables. At the contrary we believe that QM waves are as real and on the same footing as classical electrodynamics wave solutions of Maxwell equations. The state vector thus describes a purely wave phenomenon propagating in the continuous space-time of DG. Only when detection occurs (interaction or measurement) and the wave packet collapses, a very different physical process than the propagating one, does the more localised particle aspect manifests itself. This way of thinking is not new actually: it is the a priori most obvious way first considered and studied by de Broglie and Heisenberg then criticized and unfortunately abandoned due to the non locality issues this approach raises.

- Non Locality

The main reason why the collapse of the wave packet is so disturbing is that it is essentially non local. This is not only a prediction of the QM formalism but now an experimental fact after many historical experimental results (noticeably the A Aspect one) have firmly established the

existence of QM non local correlations in entangled systems. Thus one must recognize the strong physical reality of this process. DG allows to go one step beyond in the acceptation and visualisation of the process. The discrete mode of vacuum, the points network, by annihilating or creating a system of spherical waves, can trigger the collapse of any wave packet. This collapse is allowed to be non local (we already explained elsewhere why DG instantaneous gravity is not in conflict with special relativity) since all points can communicate via DG instantaneous gravity.

- The Wave Packet Collapse (Why?, How?)

The collapse has to be concerted ("decision taken in common by all involved network points") in order to respect the Born probability law: the energy of the vibration at each space-time point determines the probability for the wave packet to collapse there. But there is no need for the transactional interpretation of J.G Cramer to justify this point. It simply results from the fact that for instance light intensity at each point is according classical electrodynamics given by the signal energy there, i.e the mean of the squared signal, i.e. the squared modulus of the complex amplitudes sum that enter in the composition of this signal. For what concerns a light beam which photons are emitted one after the other, in between the emitter points and receiver points we have nothing else but a wave packet  $s(x,y,z,t)$ , with energy at  $x,y,z$  always given by the temporal mean of  $s^2(x, y, z, , t)$ . But absorption or energy emission (involved in detecting a photon) can only occur in quantum packets ( $E = h\nu$ ) by the network points. Naturally we then expect that an energy absorption will be more probable when the available energy at a given point that the wave brings there is more important on the mean (at the particular time "chosen by the point networks" for the collapse during one period, if the instantaneous amplitude is not enough to provide the minimum energy at a given point the quantum will not be absorbed there). Therefore it is not surprising that the energy determines at least the mean probability that the wave packet collapse takes place at that point. ACTually the collapse is not only possible but mandatory because of the discrete way network points can absorb or emit energy. The particle aspect is only manifested in the collapse: there is no more necessity for the obscure if not paradoxical wave-particle duality of the Copenhaguen interpretation in our framework, since the wave and particle aspects are not really dual aspects of the same reality: they now just stand for the influence of the two independent DG modes of vacuum! The wave packet propagating and spreading in the continuous mode of vacuum space is just from time to time transformed into a new more localized wave-packet by the non local and concerted action of the discrete mode of vacuum.

- Complexity

Complex numbers have no particular ontological status in QM: as in classical physics they just remain a computing tool allowing to manipulate expo-

nentials and treat phase shifts in a simpler way by avoiding trigonometry. The Schrodinger equation is complex only because it is non relativistic (inacceptable) and must be replaced by a real and relativistic equation (Klein-Gordon...). Even the first order Dirac equation, makes it possible (cf Gell-Mann) to adopt a representation of Pauli matrices in such a way that everything is real..though this makes the computation much more complicated. Advanced waves of the transactional interpretation ( positive energies going backward in time or negative energies going forward intime) are not available having been rejected from the formalism of modern Quantum Field Theory since at a second quantization level these are completely understood in terms of annihilation operators. The Born probability law thus can not be interpreted as a transaction between a retarded field and its complex conjugate advanced field. By the way, let us recall that antiparticles are not advanced waves since when they go backward in time temps following the Feynmann point of view, they are negative energy objects (see [www.darksideofgravity.com/antimatiere.htm](http://www.darksideofgravity.com/antimatiere.htm)).

- Predictivity

May be could we hope to be able to compute more than just a probability if we had access to more than a temporal mean of  $s(t)$ , its instantaneous value or mean on the reduced time interval where the collapse decision is taken by the point networks. It would allow hopefully to eliminate much of the indeterminism. If there is a hidden determinism that makes appeal to blind physical processes (a non spiritualist understanding), it is totally unknown and remains to be explored.

- The Uncertainty Principle

We know from Fourier analysis that the better the space-time localisation of a signal the poorer its localisation in the space of frequencies. The time-frequency principle of uncertainty is therefore purely classical and not a mystery. Only when energy is substituted to frequency thanks to the quantization relation in the uncertainty principle do interpretational issues arise. In our framework, the time frequency uncertainty principle comes with the wave physics that takes place in the continuous mode of vacuum. The discrete mode of vacuum on the other hand establishes the link between energy and frequency, so that we can derive immediately the energy frequency uncertainty principle that only deals with the detected quantum and the recreation of a new more localized wave paquet. The same for all other uncertainty relations. Interpretational issues most often related to the obscure concept of duality are avoided in this way (see previous paragraphs)

Should the QM formalism evolve, leading to new possible testable effects? Certainly if more determinism is hidden. Even at the new level of understanding implied by DG, for the collapse to be possible by the discrete vacuum mode probably the usual formalism must already be modified since the spherical waves

base restricted to waves having as isotropic centers the network points is complete and considerably reduced compared to the more usual one which isotropy centers scanned the whole continuum.

There is still an important issue : what triggers and when the wave packet collapse by the network ? We should not neglect the firmly spiritualist way of understanding motivated by a deep analogy that we find between the vacuum network and a more familiar one: the neural network of our branes. In the same way as a correspondance exists between the activity states of billion neurons in a brain and mental or consciousness states, in the same way the states (vibration modes) of all points in the vacuum cosmic network could represent the physical manifestation of a spirit or consciousness of the universe, the living mode of vacuum, the one which eventually triggers the collapse of all wave packets and by the way the periodic reactualisation of the universe. The inter-subjective if not objective character of reality for all individual minds would be insured in this way. The individual minds could be those of all living beings in the universe, may be as many components of the larger and encompassing cosmic one, the neural network being in interaction, in a way that remains to be studied, with the global vacuum network in the volume occupied by our brane.

Cerebral neural networks play the role of a fundamental interface if their activation is an essential step in the process that leads to the collapse of wave packets for instance if they provide the global network with the information (our brains would be the senses of the universe) necessary for it to decide the way the wave packets should collapse may be by introducing in the process a certain level of indeterminism hence ordering and favouring in a discreet but efficient way some states among those that the probability amplitude gives equiprobables. Metaphysical outlooks are fascinating, notably the idea that our states of consciousness are shared by the global spirit which in turn could enlarge our faculties (if we are willing to morally improve ourselves) and give our intuition an access to an infinite bank of knowledge through modified consciousness states. Mind survival to the brain death and integration into the universal mind is one of the most fascinating possibility in this perspective.