Measurements of Quantum Curvature: New measurements of Curvature Based in Concepts of Gravitational Waves Measured by Electromagnetic Waves (I)

Eduardo Hernández, Alberto A. Sánchez, Francisco Bulnes

Abstract— In quantum theory of fields, the theory of gravitational norm it is refere to enforce that extend the Yang-Mills theory, which gives an universal explanation of the fundamental interactions, to describe the gravity. Based on the concept of quantum gravity in the model of gravitational wave we use the norm of Lorentz to describe quantized elements of the gravity, and the re-normalization of these to their finite representation in electromagnetic units. In particular, this point of view is useful when it is wanted to pass to a quantized version of the curvature where the space is distorted by the strong interactions between particles. This could demonstrate that curvature and torsion effect in the space-time are caused in the quantum dimension. Also this permits the observational verification and encodes of the gravity through the light fields deformations.

Index Terms—Background radiation, gravitational waves,

I. INTRODUCTION

THE curvature perception in the space is associated increasingly with their interpretation as a distortion of the micro-local structure of the space - time due to the interaction of particles of the matter and energy with diverse field manifestations. The matter is shaped by hypothetical particles that take like base the background radiation of the space, in which the last studies due to QFT, SUSY-theory [1] and brane theory [2], the strings are organized and tack to form spaces of major dimensions represented by diverse particles of the matter as they are gravitons, barions, fermions of three generations, etc., shaping the gravity at quantum level, obtaining representations of the same one for classes of cohomology of the QFT, like for example the FRW-cohomology, which considers diverse symmetries of cylindrical and spherical type for the gravity modeling like a wave of gravitational energy “quasi-locally”. Their integrals of action define a energy density (Hamiltonian) given by the gravitational case like [3, 4];

\[ H_{TOTAL} = \frac{1}{8\pi G} \int_M \Gamma + \frac{1}{2} L^\alpha T_{\alpha\beta} X^\beta, \] (1)

where \( L^\alpha \) is the Lagrangian, \( T_{\alpha\beta} \) is the corresponding tensor of matter and energy, \( \Gamma \) is a Hamiltonian density and \( X^\beta \) is the corresponding field of displacement of the particles in the space moving for action of \( L^\alpha \), influenced by the tensor one of matter and energy \( T_{\alpha\beta} \); it is necessary to indicate that \( L^\alpha \), has component that is invariant yet under movements influenced by the tensor \( T_{\alpha\beta} \), which is their electromagnetic component \( L_{MAX} \) (Maxwell Lagrangian (see table 1)).

In case of the energy and through the neo-relativistic models of strings it was possible to have established that this is only a manifestation of the matter in their deep level, being a product of the interaction with particles as the electro-strong interactions that produce dispersion and cosmic rays in the whole universe [5], causing backreaction in propagation of photons that can be shaped through hypothetical particles or dilatons [6, 7], using a strings of heterotic model [6] on the base of a 10-dimensional space-time defined for \( m = SU(2)_{\omega} \times \mathbb{R}_4 \times K^6 \). Then 4-dimensional strings (curved part of the background) can be interwoven to form strings that give birth to the quantum gravity that can be measured by the energy due to the backreaction of the photons with the background through a deviation (distortion) in their Lagrangian, reflected the above mentioned deviation in the action dilaton-gravity that would take in the space - time as an electro-gravitational wave with gravitational norm obtained by quantized electromagnetic fields interacting with the gravity. In this interaction dilaton-gravity, the field action is given theoretically [8]

\[ \mathcal{Z} = \int \left[ \frac{1}{2k}(\partial \Phi - \omega[\Phi] \Phi) \frac{\partial}{\Phi} \frac{\partial}{\Phi} V[\Phi] \right] \sqrt{-g} dx^\rho, \] (2)

where \( R \) is the curvature, \( \sqrt{(-g)} dx^\rho \), is the quantized metric of the metric tensor and \( \Phi \), is the dilaton potential.

In the following table we do an inventory of the Lagrangian actions that will be used in our measurements.
### Electromagnetic Lagrangian Action

\[ \mathcal{A}(x(s)) = \int_M L_{\text{MAX}} (x(s)) \, d(x(s)) \]

#### Electromagnetic Interaction

<table>
<thead>
<tr>
<th>( L_{\text{MAX}} )</th>
<th>Classic electromagnetism</th>
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<tbody>
<tr>
<td>( \mathcal{A} = \int R_\gamma \wedge \Sigma_\gamma - \frac{1}{2} )</td>
<td>Quantized electromagnetism</td>
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### Electromagnetic String

#### Photons (Bosons)

\[ \mathcal{A} = \frac{1}{2\pi} \int d^2 z (G_{\mu\nu} + B_{\mu\nu}) \partial \chi^\mu \partial \chi^\nu + \frac{1}{4\pi} \int \sqrt{-g} F_0(x^1), \]

#### Gravitational heterotic string (gravitons)

\[ \mathcal{A} = \int d^3 x \sqrt{g} e^{-2\Phi} [R + 4(\nabla \Phi)^2 - \frac{1}{12} H^2 - \frac{1}{4 g^2} (F_0)^2 + C], \]

### Electro-gravitational string-dilaton-graviton

\[ \mathcal{A} = \frac{1}{2\pi} \int d^2 z [\partial \phi + \cos \theta \partial \lambda], \]

\[ \delta \mathcal{A} = \sqrt{\frac{\lambda}{g}} \, \mathcal{H} \int d^2 z \, [\partial \phi + \cos \theta \partial \lambda], \]

\[ \delta \mathcal{A} = \frac{1}{4} \int d^2 z \, [\partial \phi + \cos \theta \partial \lambda], \]

### Magnetic distortion (backreaction)

\[ \mathcal{A} = \frac{1}{4} \int d^2 z \, [\partial \phi + \cos \theta \partial \lambda], \]

<table>
<thead>
<tr>
<th>Table 1. Lagrangians to electromagnetic interactions [Jemaa].</th>
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<tbody>
<tr>
<td>The present research has the target to measure and to obtain</td>
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<tr>
<td>some models through electromagnetic waves of gravitational</td>
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<td>waves (background) that enter in reaction (backreaction) for</td>
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<td>propagation of photons [9] under certain additional hypotheses</td>
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<td>for the representation of the gravitational waves in quantum</td>
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<td>gravity [10], the distortion that they produce in the space-</td>
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<td>time, their macroscopic effect in the space-time both in their</td>
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<td>conformability and in their apparent homogeneity. Finally</td>
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<td>and based on curvature model for spaces with singularities of</td>
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<td>spherical type, we will obtain electromagnetic models of</td>
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<td>space-time and the design and development of a detector of</td>
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<td>quantum curvature.</td>
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## II. ELECTRO-GRavitational NORMS AND THEIR QUANTIZATION

We use the generalization of the Maxwell theory given in [11], and let's express the Maxwell-Lagrange operators according to the operator of form or connection and its curvature. Let \( S_G(M)^0 \), be a bundle of vector fields on \( M \), with structural topological group \( G \). Let \( D \), be the operator of the form in \( S_G(M)^0 \), defined by the correspondence to a field \( X \mapsto D(X) \),

\[ X \mapsto D(X), \quad (3) \]

and let \( \mathcal{D} \), be the action defined by the form of curvature corresponding to the operator of the form \( D \), defined in (3). The form operator this way definite induces a transformation in the bundle vector fields \( S_G(M)^0 \),[11]. We could realize gauge transformations on the space \( M \), through generalizing vector fields [11], since there it are the electromagnetic fields of \( \mathcal{E} \otimes \mathcal{H} \),[11], in the structural context given by the topological group of finite actions, \( G = SU(n) \), of \( M \), with the Hamiltonian formulation given in the section 2.

The Hamiltonian formulation mentioned can be obtained like solution to a variation problem directly of the Maxwell equations [11], namely: Let \( \Psi_{ijkl} \), be a form on volume in \( M \), and let - be the Hodge operator defined by the metric of \( M \). Then \( * F_{ij} = \Psi_{ijkl} F_{klj} \), and the Maxwell Lagrangian \( L_{\text{MAX}} \), it is possible to express like

\[ L_{\text{MAX}} = -\frac{1}{4} F_{ij} F^{ij}, \quad (4) \]

This way, Maxwell equations are precisely the Euler-Lagrange equations of the corresponding variation problem. Its action is given by corresponding Maxwell Lagrangian. But we want curvature under the action of these Maxwell fields using the minimal trajectories \( \gamma \), possible of movement of the particles in a microscopic space-time \( M \) [11]. Then the finite action originated from the curvature must be that comes from a finite action of Maxwell fields in Hamiltonian regime as it is defined from (1) to (4), more the action defined by the form of curvature corresponding to the operator of form \( D \), defined in (3) and that is related to Maxwell fields for the form of curvature described in terms of the Maxwell tensor \( F \):

\[ R_D = D^2 = F_D, \quad (5) \]

\[ \forall \quad F_D \in \Lambda^2 (\text{End}(S_G(M)^0)) \cong \Omega^2(M). \]

The tensor defined in (5) is the quantized version of the curvature tensor [11], in this way, is necessary to apply to define the curvature according to bundles of light [11, 12]. In fact it is possible to surmise that the reinterpretation of the curvature by electromagnetic fields is established from a quantum or microscopic level using their spinor fields of light [11]. From the Lagrangians described and their gauges (electromagnetic fields), given the following classification of curvature [8]:

### Maxwell Equations

<table>
<thead>
<tr>
<th>( D \circ F = 0 )</th>
<th>( F_D = D^2 )</th>
</tr>
</thead>
<tbody>
<tr>
<td>( S_G F \in \mathcal{E} \mathcal{L} ) ( \mathcal{L} F (dF = 0, dF^* = 0) )</td>
<td>( F_D = \phi \omega + \omega \wedge \phi )</td>
</tr>
<tr>
<td>( DF_D = 0 )</td>
<td>( F = \phi \omega + 1/2 [\phi \omega, \omega] )</td>
</tr>
<tr>
<td>( \varepsilon \otimes \mathcal{H} = 0 ) ( \mathcal{F}_1 \otimes \mathcal{F}_2 - \mathcal{F}_2 \otimes \mathcal{F}_1 )</td>
<td>( F = \frac{1}{2} [\varepsilon, \varepsilon] \forall \varepsilon \in \Omega^2 )</td>
</tr>
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| Table 1. Electromagnetic norms by Maxwell tensors |

Be considered to be a connection for this phenomenon of quantum curvature the form operator,

\[ \Xi_D = F_D + \Theta_D, \quad (6) \]
where $F_D$ is the linear connection used in (5), (that is the linear connection of the gauge transformation (quantized electromagnetic fields) and $\Theta_D$, the connection of movement (translation) of the affine connection describing a small distortion of the space with respect to a reference inertial frame, due to this electromagnetic-gravitational interaction.

Then $\Theta_D = \Theta^{\mu}_\nu dx^\nu \otimes A_\mu$, where $A_\mu = A^\alpha_\mu \partial_\alpha$, is a non-holonomic frame. Then the connection $\Theta_D$, must be considered to be like the connection of the censoring that contains quantum curvature.

The usual gravitational norm cannot describe a measure of the singularity. In fact, the general theory of the relativity only gives a suitable description of the gravitation and space-time to scales major than the Planck length

$$l_P = \frac{\hbar G}{c^3} \approx 10^{-33} \text{ cm},$$

where $\hbar$, is the Planck reduced constant, $G$, is the constant of universal gravitation, and $c$, is the velocity of the light. Under this quantum limit, the theory of the relativity stops being adapted when there predicts a curvature (distortion) of the order of $l_P^2$, things that happen very close to the singularities like the existing ones inside the diverse types of black holes. Then it becomes necessary to use a gravitational norm in terms of the theory of norm on natural bundles of fields of particles of bosons. Be $X$, a world manifold for such particles and be $FX$, linear bundle of the frame.

These norm fields are linear connections on a world manifold $X$ defined as the main connection on the linear bundle of the frame $FX$, and the metrics of the gravitational field play the role of a field of Higgs responsible for the spontaneous rupture of symmetry of the general covariant transformations. But such field of Higgs can be disturbed using a field photon.

The spontaneous symmetry rupture is a quantum effect when the gap is not an invariant under group transformations. In the theory of classic norm, the rupture happens if the structure of the group $G$, of a principal bundle $P \to X$, it is possible to reduce to a closed sub-group $H$, that is to say, a principal sub-bundle exists of $P$ with the group structure $H$. This means that the micro-local structure at this quantum level is preserved by the apparent homogeneity of the space (background), without being like that for the gravitational field in question for which must be to exist an additional norm term.

By virtue of a well-known theorem, a correspondence exists one to one between the limited principal subbundle of $P$, with the structure of a group $H$, and the global sections of the bundle quotient $P/H \to X$. These sections are studied like classic Higgs fields.

The idea of a Pseudo-Riemannian metrics as a field of Higgs appears while there are constructed induced non-linear representations of the general linear group $GL(4, \mathbb{R})$, [13], in which the group of Lorentz is a sub-group [14]. The principle of equivalence postulates the existence of a reference frame in which the Lorentz invariance is defined on the finished manifold of world, which establishes a theoretical justification of which the structure of group of the linear frame of the bundle $FX$, it comes to reduce the Lorentz group, which justifies ours to proceed on measuring gravitational fields through electromagnetic fields at micro-local level of the space-time. Then the definition of a pseudo-Riemannian metric on the manifold $X$, (the model of variety that more fits to our world variety is a variety pseudo Riemannian) as a global section of the quotient bundle

$$FX/O(1,3) \to X,$$

it takes us to its physical interpretation like a Higgs field.

The physical reason for the rupture of the world symmetry is the existence of a fermion of Dirac $o$, whose group of symmetry is universal covering two parts $SL(2, \mathbb{C})$, of the restricted group of Lorentz, $SO^*(1,3)$.

Using the Higgs fields, interpreting them as the background (gravity), we use photons fields, to describe distortion of the space understanding to the distortion as the rupture of symmetry of the space-time for being more Dirac fermions at the moment of the distortion, being this an evidence of the back-reaction suffered by the propagation of photons in gravity when they interact with the gravity, being the last one shaped across gravitational waves (gravitons).
III. MODELS OF GRAVITATIONAL WAVES USING MAGNETIC WAVES

Using a magnetic dilaton $\Phi$, on background of the space-time, which we describe though the 4-dimensional component given by the string space $SO(3)_{\kappa,\ell} \times \mathbb{R}^4_\rho$, we have the following interpretation deduced of the distortions given in flat space model given by the figure 1.A:

Fig 1. In the figure A, we have a Flat-$\kappa$.Worldsheet of distortion angle obtained for the electromagnetic backreaction with the background radiation (gravity). In the figure B, we have the wave propagation of the background radiation (green), propagation of quantum electromagnetic waves, without background radiation (black) and propagation of quantum electromagnetic waves distorted with background radiation (blue). The stripe in brown represents the flat space with the corresponding distortions that create the angle $\theta$, in the figure A). The difference between the two waves come reflected in the corresponding hollows of the figure B. Also this figure B, give us the micro-local aspect of the space-time in Max Planck dimension (this figure appear published in the Journal of Electromagnetic Analysis and Applications [8]).

B

Fig 2. Dilaton measuring distortion due to quantum gravity, according to the model computacional magnetic $\Phi = y\sqrt{y+1} - ((1/2)\log(x + 1/x + (x - 1/x))\cos\theta$ (see equation (19)). The surface in a), represents the space-time area before the photons back-reaction with background radiation, their magnetic model is $\Phi = y\sqrt{y+1} - ((1/2)\log(x + 1/x + (x - 1/x))\cos\theta$ . In the surface b), the distortion is measured by the magnetic oscillations $\cos\theta$, that is to say, the term of tough deviation $\theta$, in the figure 1. In c), the distortion is attenuated by the background increasing the undulations $\cos\theta$ and increasing their amplitudes being not detectable for being under the background (green line) (this figure appear is published in the Journal of Electromagnetic Analysis and Applications [8]).

IV. DESIGN AND DEVELOPMENT OF ELECTRO-GRAVITATIONAL CENSOR DETECTOR OF CURVATURE

There are no instruments for detection and direct measurement of the electromagnetic back-reaction, we can propose the design of an indirect detector based on the concept of cosmic censoring to detect curvature in regions near to a singularity of the space-time.

Nevertheless we can use certain studies of the models of the space of de Sitter, to determine through Hilbert inequality and based on certain bound of cosmic censoring constructed by Penrose [15], the possible integral expression of the total Hamiltonian of electromagnetic energy, establishing a condition of domineering energy [16], when there is curvature (that is to say, if the energy is given by this cosmic censor, there is curvature measured like energy that makes the censoring appear).

The latter condition is in a certain sense similar in the mathematical context to the property of obstruction to the integrability of the field equations but in a practical form (similar physicist) who can serve to us to design a detector and curvature meter at quantum level, using theoretical hypotheses [17].

To realize curvature detection it is necessary to be sure, that the above mentioned property or observable it comes from an intrinsic property of the gravitational field in the space-time, which create the geometric stage of the space.

But the space is influenced by this field on every particle that composes it, that is to say, an intersection between the cone of light in every particle and the infinity null exists in the gravitational field that creates the distortion of the space [9]. In these intersections exist the detectable and measurable part that can be measured through microscopic electromagnetic fields and on the other hand that has the gravitational nature that provokes the curvature, generating enough energy to be bounded by the cosmic censor of Penrose [18].

Relative studies to curvature from quantum distortions (like established in the previous section), confirm the hypotheses of consider the Lagrangian to be able to measure curvature from a quantum level, the above mentioned with the geometric hypotheses on a cinematic model of the predefined space for the geometry for the case of curvature.

We consider the kinematic models given by the spaces that are asymptotically de Sitter and anti-de Sitter [19].

**Proposition 1. VIII.** Considering the Cosmic Censorship hypothesis given by Penrose [15], we have that the area $A$, of a singularity (black hole visualized as a spherically symmetric space) is proportionally minor that the quasi-local mass around
of singularity given for $16\pi M^2$ [16]. Then in the events of the
space like one asymptotically de Sitter space has:

$$\left( \int_{S^2} \Omega (1 - \nabla^2 \log \Omega) \right)^2 \geq 4\pi \int_{S^2} \Omega^2,$$  \hspace{1cm} (20)

which represents the curvature measured like energy doing to appear the censure given in the second member of the
inequality and that it goes out to re-shine for the Lagrangian
action of gravitational field moving away or approaching the
singularity (asymptotically de Sitter and anti-de Sitter spaces).

**Proof.** [18, 20].

The minimum energy (second member of (20)) must be obtained
directly of geometrical condition given by an invariant of curvature.
From the exponential of empty expect value $e^{-\phi}$, of the effect action given by (17), we obtain the
coefficient constant $g$, and as by the generalized Gauss-Bonnet
theorem we have [14, 21]

$$\int R = 2^n \pi^n \chi,$$ \hspace{1cm} (21)

then $n = 2/2 = 1$, since $\dim M = 2$. To compact worldsheets
where the Euler characteristic $\chi = 2 - 2g$ (see figure 3). But
(21) is the curvature invariant given to the spherical map $M \to S^2$.

For the case of $M$, we see it like a space 4-dimensional, it is
necessary to consider the spherical map $\delta M \to S^2$, where for
this case the electromagnetic fields can be used like gauges
remembering that $SU(2) \cong S^3$.

![S^3](image1)

Then the cohomological classes of the Cartan forms $\omega_1$, and $\omega_2$
are annulled $(H^1(SU(2), \mathbb{R}) = 0$, that is the case of the
integrals, $\int \omega_1 = 0$ \hspace{1cm} (\int \delta A^i = \delta (\int A^i) = 0$). Also it does

$$H^3(M, \mathbb{R}) = 0,$$ \hspace{1cm} (22)

remaining only the cohomological group generated by $\omega_3$, to
know, $H^3(SU(2), \mathbb{R})$ [2, 14]. Then the value of the integral of
this group of cohomology is [14, 21]:

$$\frac{1}{8\pi^2} \int_{SU(2) \cong S^3} \omega_3 = 2 < F, F >$$ \hspace{1cm} (23)

But by the background radiation of the Minkowski space M,
where the energy of the matter is, it is had that $J^a = k^\alpha T^{\alpha\beta}$,
where $k^\alpha$, is the density of background radiation which establishes for the curved part of the space (that in this case has spherical symmetry) together with the energy and matter tensor that

$$\frac{1}{4\pi G} \int_{S^2} T_{ab} k^a d\sigma^\beta \geq \int_{S^2} J^a d\sigma^\beta \geq 2\pi \chi$$ \hspace{1cm} (24)

Then the value of the integral of

$$\frac{1}{16\pi^2} \int_{SU(2) \cong S^3} \omega_3 \leq 1$$ \hspace{1cm} (25)

since the electromagnetic energy with respect to the energy of
background radiation can fulfill that

$$4\pi \int_{S^2} \Omega^2 \geq 8\pi \int < F_{ij}, F^{ij} >$$ \hspace{1cm} (26)

Then from (22), (24) and (25), the condition is had

$$16\pi M^2 \geq A$$ \hspace{1cm} (27)

which is (20) for a singularity detected of spherical type [20, 22].

![Surface of waves of “energy-density” in the quasi-local mass region of the space-time (16, 22). This surface include the waves given in the incise b). In b), The same way as it is moving away from the gravitational field (interaction with the gravitons), these stop producing detectable energy for our cosmic sensor, tending to a flat space in the infinite nullity. This tendency can be observed like the similar hyperbolic of a space of Minkowski or Anti-de Sitter space [23]. In this analysis, cylindrical waves [10], of the form are used $M_\lambda(R)/R^2 = 1 + \exp(-R) (J, z, R, R, \lambda)$, $\forall \lambda \in (0, 1)$.](image2)
V. THEORETICAL FACTIBLE ELECTRO-GRAVITATIONAL DEVICES

Theoretical devices to measure gravity it has designed from the first serious affirmations on gravitation given by Galileo and Newton. Nevertheless, with the step of the time and due to born of new theories of the universe based in studies inside the field theory from the theory of the relativity, up to the theory M, they have marked the need to design using gauge theories, instruments that could measure at least indirectly or by means of sophisticated methods of metrology based on dimensional relations gauge field that are constructed by Gaussians units or of another type observables of field as the curvature.

An example of such devices are the electro-gravitational devices that try to use electromagnetic waves and electromagnetic field interactions to measure gravity using the concept of background radiation and the traces of particles obtained in the laboratories of the atomic accelerators as the given in the CERN (Organisation européenne pour la recherche nucléaire), measuring the distortion of these waves based on the traces of the particles left in the fog cameras of the accelerators. Other better attempts have been realized by the CMB (Cosmic Microwave Back-ground), radiation spectrums being obtained in the direct measurements by the satellites in the space, for example SMAP.

One of the important ideas inside the study of the microscopic space-time there are the group representations of SU(2), where one of which considering the super-symmetry is $S^3$ (sphere of dimension 3) [22, 24]. In her the topological invariant of their 2-form $\omega_3$, given in (2) and whose cohomology in not null (see section III) it shows clearly that the gravity presence can be warned at least on the surface of this sphere, which can be considered to be a mini-twistor in the presence of gravity considering a ambitwistor space of couples $(Z^\alpha, W^\alpha)$, to the microscopic space-time, where $Z^\alpha$, are the fields of gauge nature (in this case electromagnetic fields) and the fields of particles of the gravity (gravitons), (that in this case is the background).

Based on it, and considering the value of curvature to be the contour deformation on a surface (initial idea created by relativity to understand curvature in a space-time surface [13, 24]), at the same time that a field distortion created like a wave in the space time for back-reaction by photon propagation in the presence of gravity (see figure 1B, y 2 (using string theory)), we can extrapolate this idea to the design of a type of accelerometer that can be connected to the devices of navigation of a traveling satellite by the space, whose accelerometer involves in their interior a sensor of ultr-sensitive gravity based on a solid sphere $S^3$, of material similar to a colloid, captured the changes of the weight of a liquid also of colloid type (perhaps of major density that of the ball $S^3$) due to the universal factor $G$.

Fig 5. [8] (a) Classical accelerometer in the earth’s gravity. (b) The curvature will be able to express itself like a Gaussian curvature according to spherical harmonics given by Legendre polynomials. The sensor is a sensor of free fall that can register different force factors $G$. The actions of change can be reprogrammed by the proper device considering these to be a Lagrangian action of the section III [4].

Other measurements of curvature consider the photon back-reaction, the fluctuations of the gravitational potential to these scales and the obtained inflation by the inflation factor $h$, of the background radiation.

Even though the anisotropies are very small, they have been measured quite precisely by the WMAP satellite, and one can study how the variations in temperature are correlated by their angular separation in the sky. This gives the power spectrum of the CMB, where once again theory and experiment agree quite nicely (see figure 6 a)).

Fig 6. a). Comparison between the theoretical norm obtained by the connection given by (6) (whose distance formula) is (red curve) and WMAP-Satellite measurements (black and blue curve) b). Measuring the
In order to obtain a theoretical prediction about how the power spectrum should look like, it is important to understand how the universe behaved before recombination occurred. This is where inflation, an important part of the standard cosmological model, comes in. The inflationary epoch occurs very soon after the universe leaves the Planck regime (where quantum gravity effects may be important), and during this period the universe’s volume increases by a factor of approximately $e^{210}$, in the very short time about $10^{-33}$ seconds (for more information about inflation, see the previous blog post). Inflation was first suggested as a mechanism that could explain why (among other things) the CMB is so isotropic: one effect of the universe’s rapid expansion during inflation is that the entire visible universe today occupied a small volume before the beginning of inflation and had time to enter into causal contact and thermodynamically. This thermal pre-inflation can explain why, when we look at the universe today, the temperature of the cosmic microwave background is the same in all directions. But this is not all: using inflation, it is also possible to predict the form of the power spectrum. This was done well before it was measured sufficiently precisely by WMAP and, as one can see in the graph in the figure 6a), the observations match the prediction quite well! Thus, even though inflation was introduced to explain why the CMB’s temperature is so isotropic, it also explains the observed power spectrum. It is especially this second success that has ensured that inflation is part of the standard cosmological model today.

The ultimate answer is that we treat the expansion of the universe to be occurring in another dimension orthogonal to the usual 3 dimensions. If the expansion was taking place in the usual 3 dimensions then there really would be a center to the expansion. So orthogonality allows the use of the Pythagorean Theorem. The calculation of total path length of a photon is similar to the path length of a spiral in planar geometry although there are some complications because we don’t think the “pitch” of the spiral in the case of cosmology is constant. It is this changing “pitch” of the spiral which must be obtained from some specific cosmological model. For red-shifts greater than 0.8, the relationship between red-shift and distance is more complex, as account has to be made of many other factors (figure 6 a)). This is the distance formula

$$D_c = \frac{c}{H_0} \sqrt{\Omega_{M0} (1 + z^2) + \Omega_K (1 + z^2) + \Omega_r},$$

(28)

where the primary CMB anisotropy alone, allowing $\Omega_{M0} + \Omega_r$ to deviate from 1, introduces parameter degeneracy between $H_0$ and $\Omega_K$, as shown in the figure below. The spectrum can break this degeneracy, because the amount of clustering varies for different $\Omega_K$, values given by $H_0$, which leads to different spectrum amplitudes.

Using fractal models of the space considering the concept of inverse porosity [26], we can obtain an image of the universe where the pores in this case are the material intersidereal parts (stars, galaxies, etc) that realizes depressions where exists this interstellar matter, which due to their density create a stage geometric and constructed by functions of weight that shape the tensor of matter $T^p_{\mu\nu}$, and whose entire image recovers across dimension transforms [9, 24, 26]. Nevertheless this method depends on the fractal measure considered for such an effect.

This way for example, considering a Dirac measure on a superplane $(\xi, x) = p$, where this Dirac measurement considers the pores of certain weight to define the density on the plane $\Delta(W_{\|})$, considered in the computacional tomography of the space, we have that for dimension transform (fractal dimension) [26]:

$$\dim_{\mu} \pi(ll(x, \xi)) = \int_{W_{\|}} \dim_{\mu} l(l(W_{\|} = 0)_{\text{hyper-plane}}(W_{\|}))$$

$$= \int_{W_{\|}} \dim_{\mu} l(l(W_{\|}) \mid \delta(p - (x, \xi))dx$$

$$= \int_{W_{\|}} \Delta(W_{\|}) \sum_{x_0} T(x_0) \delta(p - (x, \xi))dx,$$  

(29)

being

$$T(x_0) = \int_{-\infty}^{\infty} T^{\mu\nu}(x) \delta(x - x_0) \delta_{\mu\nu}(x)dx,dx, \quad (30)$$

The deduction and demonstration of these integral formulae can be studied in [24, 26].
Using a quantum extrapolation of these weights with certain material density designed for such effect and manipulating them inside the context of the Dirac wave equation, we can create an electro-gravitational model of the quantum gravity. For it we think that it is a sufficient material for another research paper [26].

VI. CONCLUSIONS

The method for back-reaction by propagation of photons needs to consider the detectors design very thin ultra-sensors capable of detecting changes of polarization (figure 9) of the density of electromagnetic currents in the space-time, to generate a detectable magnetic dilaton for the above mentioned sensor and to decode the above mentioned information in information of quantum gravity.

But these methods are based in the gauge theory and of the information of the gravity through models of gravitational waves by means of electromagnetic waves where the detection will be realized by means of spiraling created for the back-reaction that will take place through traces of a electro-gravitationally observable type, whose geometry is a 6-dimensional superstring.

The method that we propose in the section IV, might adapt itself at quantum level capturing these small interactions and recording in information of quantum gravity codified by field elements already classified under the different types of sub-particles that define at quantum level material forces.

REFERENCES


