Universe and Matter conjectured as a 3-dimensional Lattice with Topological Singularities
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Conclusion
I - Eulerian theory of newtonian deformable lattices

Coordinates systems

Lagrange coordinates

Euler coordinates

Differential geometries
(Riemann-Cartan, Finsler, Kawaguchi, ...)

I - Eulerian theory of newtonian deformable lattices

Initial points coordinates

Present points coordinates

Displacement field

Velocity field

Joseph Louis Lagrange (1736-1813)

Leonhard Euler (1707-1783)
I.a - Geometrokinetic equations and distortion tensors

Temporal variations of the lattice « distortions » are linked to the spatial variations of the velocity field.

Vectorial representation of the distortion tensors

Relation with the volumic density \( n \) of sites and the volume \( v \) per site of the lattice:

\[ \tau = -\ln \frac{n}{n_0} = \ln \frac{v}{v_0} \]
I.b - The three necessary physical principles

**Axiom of Newtonian dynamics**

\[ e_{cin} = \frac{1}{2} m \ddot{\phi}^2 \]

**Continuity principle for the Newtonian inertial mass**

\[ \frac{\partial \rho}{\partial t} = S_m - \text{div}(\rho \ddot{\phi} + J_m) = S_m - \text{div}(n \vec{p}) \quad (1) \]

**Axiom of the first principle of thermodynamics**

\[ dU = \delta W + \delta Q \]

**Continuity principle for the total energy**

\[ n \frac{du}{dt} + n \frac{de_{cin}}{dt} = S_w^{ext} - \text{div} \vec{J}_w - \text{div} \vec{J}_q - u S_n - e_{cin} S_n \quad (2) \]

**Axiom of the second principle of thermodynamics**

\[ dS \geq \frac{\delta Q}{T} \]

**Continuity principle for the entropy**

\[ n \frac{ds}{dt} = S_e - \text{div} \left( \frac{\vec{J}_q}{T} \right) - s S_n \quad (3) \]
**I.c - Geometrocompatibility equations and contortion tensors in a perfect lattice**

**Distortion and contortion tensors and geometrocompatibility equations**

Continuity of the displacement field

\[ \oint_C d\mathbf{u} = -\sum_k \int_S \mathbf{rot} \beta_k d\mathbf{S} = 0 \quad ; \quad \forall C \]

No singularity by divergence of the rotation field

\[ \oint_S \omega d\mathbf{S} = \iint_V \mathbf{div} \omega dV = 0 \quad ; \quad \forall S \]

Continuity of the rotation field associated to the deformations

\[ \oint_C d\mathbf{\omega}^{(c)} = \sum_k \int_S \mathbf{rot} \mathbf{\omega}^{(c)} d\mathbf{S} = \sum_k \int_S \mathbf{rot} \mathbf{\omega}^{(c)} d\mathbf{S} = 0 \]

No singularity by divergence of the flexion field

\[ \oint_S \chi d\mathbf{S} = \iint_V \mathbf{div} \chi dV = \sum_k \int_S \mathbf{rot} \mathbf{\chi} d\mathbf{S} = \sum_k \int_S \mathbf{rot} \mathbf{\chi} d\mathbf{S} = 0 \]
Incompatibility equations and charge tensors in the presence of topological singularities

**Discontinuity of the displacement field**

\[ \vec{B} = \vec{u}_B - \vec{u}_A = \oint_C \delta \vec{u} = - \sum_k \vec{\epsilon}_k \int_S \text{rot} \vec{\beta}_k \, d\vec{S} \]

\[ = - \sum_k \vec{\epsilon}_k \int_S \vec{\lambda}_k \, d\vec{S} \neq 0 \]

**Singularity of the divergence of the rotation field**

\[ Q_\lambda = \oint_S \vec{\omega} \, d\vec{S} = \iiint_V \text{div} \vec{\omega} \, dV = \iiint_V \lambda \, dV \neq 0 \]

Macroscopic scalar charge of rotation

**Discontinuity of the rotation field associated to the deformations**

\[ \vec{\Omega} = \oint_C \delta \vec{\omega} = \sum_k \vec{\epsilon}_k \int_S \text{rot} \vec{\chi}_k \, d\vec{S} = \sum_k \vec{\epsilon}_k \oint_S \theta \, d\vec{S} \]

\[ = \sum_k \vec{\epsilon}_k \oint_S \left( \vec{\lambda}_k - \vec{\epsilon}_k \wedge \vec{\lambda} - \vec{\epsilon}_k \vec{\lambda} \right) \, d\vec{r} \neq 0 \]

Singularity of the divergence of the flexion field

\[ Q_\theta = \oint_S \vec{\chi} \, d\vec{S} = \iiint_V \text{div} \vec{\chi} \, dV = \iiint_V \theta \, dV \neq 0 \]

Macroscopic scalar charge of flexion

**Charges associated to topological singularities**

- First order charges
- Second order charges

**In.d - Charges associated to topological singularities**
Quantification of the topological singularities as strings or membranes in solid lattices

Screw dislocation string

Edge dislocation string

Screw dislocation membrane limited by two twist disclination strings

Edge dislocation membrane limited by two wedge disclination strings
Quantification of the topological singularities as loops and membranes in solid lattices

Edge and mixed dislocation loops

Twist disclination loop with screw dislocation membrane

Wedge disclination loop with edge dislocation membrane
The complete set of equations of spatio-temporal evolution of a charged lattice

**Fundamental equations**

<table>
<thead>
<tr>
<th>Table</th>
<th>Equations of continuity for charges</th>
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</thead>
<tbody>
<tr>
<td>-</td>
<td>[ \rho_t + \nabla \cdot \mathbf{j} = 0 ]</td>
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<tr>
<td>-</td>
<td>[ \mathbf{j}_t + \nabla \cdot \mathbf{E} = \mathbf{J}_F + \mathbf{J}_S ]</td>
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<tr>
<td>-</td>
<td>[ \mathbf{j}_t + \nabla \cdot \mathbf{E} = \mathbf{J}_F + \mathbf{J}_S ]</td>
</tr>
</tbody>
</table>

**Phenomenological equations**

| Equations of motion for charges |
|---|---|
| - | \[ \mathbf{j} = \rho \psi \mathbf{X} \] |
| - | \[ \mathbf{j} = \rho \psi \mathbf{X} \] |
| - | \[ \mathbf{j} = \rho \psi \mathbf{X} \] |

**Additional equations**

| Continuity of charge |
|---|---|
| - | \[ \rho_t + \nabla \cdot \mathbf{j} = 0 \] |
| - | \[ \mathbf{j}_t + \nabla \cdot \mathbf{E} = \mathbf{J}_F + \mathbf{J}_S \] |

| Additional equations |
|---|---|
| - | \[ \mathbf{j} = \rho \psi \mathbf{X} \] |
| - | \[ \mathbf{j} = \rho \psi \mathbf{X} \] |
| - | \[ \mathbf{j} = \rho \psi \mathbf{X} \] |
II - The « cosmic lattice »

**Newton equation of a very special isotropic lattice:**

the « cosmic lattice »

**Conjecture:** elastic state function given per unit volume of lattice and depending also on the elastic rotation

\[
F^{\text{def}} = -K_0 \tau + K_1 \tau^2 + K_2 \sum_i (\tilde{\alpha}_i^{el})^2 + 2K_3 (\tilde{\omega}^{el})^2
\]

Newton equation

\[
n \frac{d\bar{p}}{dt} = -2 (K_2 + K_3) \text{rot} \tilde{\omega}^{el} + \left( \frac{4}{3} K_2 + 2K_1 \right) \text{grad} \tau + \text{grad} \left( K_2 \sum_i (\tilde{\alpha}_i^{el})^2 + 2K_3 (\tilde{\omega}^{el})^2 + K_1 \tau^2 - K_0 \tau \right) + 2K_2 \tilde{\Lambda}
\]

**Analogy with general relativity:** expansion depends on the energy stored in the lattice

rotations and shear stresses  expansions
Circularely polarized transversal wave and longitudinal « local fluctuations »

Newton equation of the cosmic lattice

\[
\frac{dp}{dt} = -2(K_2 + K_3) \text{rot} \omega^a + \left( \frac{4}{3} K_2 + 2K_1 \right) \text{grad} \tau + \text{grad} \left( K_2 \sum_i (\vec{\alpha}_i^a)^2 + 2K_3(\vec{\omega}^a)^2 + K_1 \tau^2 - K_0 \right) + 2K_2 \vec{\lambda}
\]

Analogy with the circular polarization of the photons in quantum physics

Conjectures:

\[
\begin{aligned}
K_2 + K_3 &> 0 \\
\tau_0 < \tau_{0,cr} &= \frac{K_0}{2K_1} - \frac{2K_2}{3K_1} - 1
\end{aligned}
\]

Purely transversal waves are necessarily circularely polarized

\[
c_i = \frac{\omega}{k_i} = \frac{K_2 + K_3}{mn} = e^{\frac{r_0/2}{\sqrt{\frac{K_2 + K_3}{mn}}}}
\]

( linearly polarized transversal waves are necessarily coupled with longitudinal wavelets )

Pure longitunal waves can exist

\[
c_i = e^{\frac{1}{mn} \left[ \frac{4}{3} K_2 + 2K_1(1 + r_0) - K_0 \right]} = e^{\frac{r_0}{\sqrt{\frac{4}{3} K_2 + 2K_1(1 + r_0) - K_0}}}
\]

Only longitudinal «local fluctuations» of the expansion can exist

1/ Analogy with the absence of longitudinal waves in general relativity

2/ Analogy with the vacuum fluctuations in quantum physics
II.b - Wave rays curvature

**Curvature of the wave rays in the presence of an expansion singularity**

\[ c = \frac{\omega}{k} \equiv \sqrt{\frac{K_2 + K_1}{mn}} = c^{\tau/2} \sqrt{\frac{K_2 + K_1}{mn_0}} \]

Analogy with the « photon sphere » of a black hole in general relativity

**Curvature of the wave rays and « perturbation sphere »**

Appearance of a « perturbation sphere »

\[ \tau(r) \]

\[ \tau = 0 \]

\[ \tau = \tau_0 \]

\[ \tau_0 \]

\[ \frac{\partial \tau(r)}{\partial r} \bigg|_{r_{cr}} = \frac{2}{r_{cr}} \]

\[ r = r^{(l)} \]

\[ \xi_2 \]

\[ \xi_1 \]

"sphère de perturbations"
II.c - Lattice cosmological expansion

Cosmological expansion of a spheric lattice with a given total energy

\[ \phi_U(\tau) = \sqrt{\frac{10}{3Nm}} T(\tau) = \sqrt{\frac{10}{3Nm}} (E - F(\tau)) \]

\[ F = \frac{N}{n_0}(K_1 \tau - K_0) \tau e^\tau \]
Two types of pleasant cosmological models of expansion!

1/ Analogy with the cosmological expansion of the universe: «big-bang», inflation, then slowing down followed by an acceleration of the expansion

2/ Possible model with «big-crunch» and «big-bounce»

3/ Origin of the «dark energy»: \[ F = \frac{N}{n_0} (K_1 + K_0) \tau e^\tau \]

Conjecture: \[ K_1 > 0 \quad ; \quad K_0 > 0 \]
III - Maxwell equations at constant expansion

Maxwell equations

Equations of the cosmic lattice (at constant expansion)

\[
\begin{align*}
\rho & \Rightarrow \omega \\
E & \Rightarrow \dot{m} \\
B & \Rightarrow n\dot{p} \\
\vec{H} & \Rightarrow \dot{\phi} \\
\vec{P} & \Rightarrow \omega v \\
\rho & \Rightarrow \omega v \\
\ddot{j} & \Rightarrow \lambda \\
\ddot{j} & \Rightarrow \ddot{j} \\
\end{align*}
\]

\[
\begin{align*}
\tilde{M} & \Rightarrow \frac{1}{n}(\dddot{j}_1 - \dddot{j}_L) \\
\chi_{\text{para}} + \chi_{\text{dia}} \tilde{H} & \Rightarrow (C_1 - C_L)\ddot{\phi} \\
\varepsilon_0 & \Rightarrow \frac{1}{K_2} \\
\mu_0 & \Rightarrow nm \\
c & = \sqrt{\frac{1}{\varepsilon_0\mu_0}} \Rightarrow c_i = \sqrt{\frac{K_2}{mn}}
\end{align*}
\]

1/ Complete analogy with the Maxwell equations of electromagnetism (with dielectric polarisation, para- and dia-magnetism, magnetisation, electrical charges and currents, Lorentz forces)

2/ Magnetic monopoles cannot exist!
Separability of the Newton equation in the presence of topological singularities

**Newton equation of the cosmic lattice**

\[
\begin{align*}
\frac{d\tilde{p}}{dt} &= -2(K_2 + K_3)\text{rot} \tilde{\omega} + \left(\frac{4}{3}K_2 + 2K_1\right)\text{grad} \tau + \text{grad} \left[ K_2 \sum_i (\tilde{\alpha}_i)^2 + 2K_3(\tilde{\omega}^d)^2 + K_1\tau^2 - K_0 \right] + 2K_2 \tilde{\lambda}
\end{align*}
\]

**First partial Newton equation**

for the elastic distortions
associated with the topological singularities

\[
\begin{align*}
nm \frac{d\phi^{ch}}{dt} &= -2(K_2 + K_3)\text{rot} (\tilde{\omega}^{ch}) \\
&+ \left(\frac{4}{3}K_2 / 3 + 2K_1(1 + \tau_0) - K_0\right)\text{grad} \tau^{ch} + 2K_2 \tilde{\lambda}^{ch}
\end{align*}
\]

**Static case:**

\[
\Delta \tau^{\text{statique}} = \frac{-2K_2}{4K_2 / 3 + 2K_1(1 + \tau_0) - K_0} \text{div} \tilde{\lambda}^{ch}
\]

**Calculation of the elastic distortions associated with the topological singularities**

(dislocation and disclination loops)

**Second partial Newton equation**

for the perturbations of the expansion
associated with the topological singularities

\[
\begin{align*}
nm \frac{d\phi^{(p)}}{dt} &= \text{grad} \left[ \frac{4K_2 / 3 + 2K_1(1 + \tau_0 + \tau^{ext} + \tau^{ch}) - K_0}{K_1} \right] \tau^{(p)} + K_1 \left(\tau^{(p)}\right)^2
\end{align*}
\]

**Static case:**

\[
\begin{align*}
K_1 \left(\tau^{(p)}(\tilde{\tau})\right)^2 &+ \left[\frac{4K_2 / 3 + 2K_1(1 + \tau_0 + \tau^{ext} + \tau^{ch} + \tau^{ext}(\tilde{\tau}) + \tau^{ch}(\tilde{\tau})) - K_0}{K_1}\right] \tau^{(p)}(\tilde{\tau}) \\
&+ \left(F_{\text{dis}}^{ch}(\tilde{\tau}) + F_{\text{rot}}^{ch}(\tilde{\tau})\right) = \text{cste} = 0
\end{align*}
\]

**Calculation of the perturbations of the volumic expansion associated with the topological singularities**

(dislocation and disclination loops)
Localized singularities: twist disclination loop and edge dislocation loop

**First partial Newton equation**

\[ nm \frac{d\bar{q}^\text{ch}}{dt} = -2\left(K_2 + K_3\right)\text{rot}\left(\bar{\omega}^\text{ch}\right) + \left(4K_2 / 3 + 2K_1(1 + \tau_0) - K_0\right)\text{grad}\bar{\tau}^\text{ch} + 2K_2 \bar{\Lambda}^\text{ch} \]

**Twist disclination loop**

**Edge dislocation loop**

Rotation charge (analogous to electrical charge)

\[ q_{\lambda, BV} = 2\pi R_{BV} \Lambda_{BV} = -\pi R_{BV} \bar{B}_{BV} \bar{v} \quad \& \quad q_{0, BV} = 0 \]

Source of a divergent rotation field (analogous to an electrical field)

\[ \bar{\omega}_{\text{ext}} = \frac{q_{\lambda, BV}}{4\pi} \frac{\bar{r}}{r^3} \]

**Flexion charge** (analogous to spatial curvature charge)

\[ q_{\lambda, BC} = 0 \quad \& \quad q_{0, BC} = -2\pi \bar{\bar{m}}(\bar{r} \wedge \bar{\Lambda}_{BC}) = 2\pi \bar{\Lambda}_{BC} \bar{m} = -2\pi \bar{\bar{m}}\bar{B}_{BC} \]

Source of a divergent flexion field (analogous to a spatial curvature field)

\[ \bar{\lambda}_{\text{ext}} = \frac{q_{0, BC}}{4\pi} \frac{\bar{r}}{r^3} \]

1/ Perfect analogy between the rotation charge and a localized electrical charge

2/ No analogy in all other theories for the localized curvature charge !!!
Relativistic dynamics of the topological singularities

**Conjecture:**

\[ K_0 = K_3 > 0, \]
\[ 0 < K_1 << K_0 = K_3 \]
\[ 0 \leq K_2 << K_3 = K_0 \]

Same Lorentz transformations for all topological singularities

Relativistic energy of the twist disclination loop

Relativistic dynamics equation for the topological singularities

Relativistic energy of the edge dislocation loop

**Hendrik Anton Lorentz**

(1853-1928)

\[ x_1' = \frac{x_1 - vt}{\gamma} \]
\[ x_2' = x_2'' = x_3 \]
\[ x_3' = x_3'' = x_3 \]
\[ t' = t - \frac{vx_1}{c^2} \]
\[ \gamma = \sqrt{1 - \frac{v^2}{c^2}} \]

All the topological singularities (of dislocation or disclination types) follow exactly the theory of special relativity

**Ratio of the distortions energy stored in the lattice**

**Ratio of the kinetic energy stored in the lattice**

\[ \frac{E_{v'}^{\text{dist}}}{E_v} < \frac{E_{v}^{\text{cin}}}{E_v} \]

\[ \frac{E_{v'}^{\text{dist}}}{E_v} > \frac{E_{v}^{\text{cin}}}{E_v} \]
Effects of the Lorentz transformation of the special relativity

Measuring rods contraction and clock slowing down for the local observers HS

Verification of the Michelson-Morley experiments

\[
\begin{align*}
\frac{x_1'}{x_1} &= \frac{x_1 - \mathbf{v}t}{\gamma t} \\
\frac{x_2'}{x_2} &= \frac{x_2}{\gamma t} \\
\frac{x_3'}{x_3} &= \frac{x_3}{\gamma t} \\
t' &= \frac{t - \mathbf{v}x_1}{c^2} \gamma t
\end{align*}
\]

The new « aether » is arrived!

Albert Einstein (1879-1955)
Effects of the Lorentz transformation of the special relativity

Impossibility for the local observers HS to measure their own velocity with regard to the lattice

Verification of all the Doppler-Fizeau experiments

Simple explanation of the famous twin paradox of the special relativity

1/ Complete analogy with the Lorentz transformation and the special relativity

2/ The cosmological lattice behaves as an « aether » which verifies the Michelson-Morley experiment and the Doppler-Fizeau effects, and which explains very simply the twin paradox.

3 / The local observers HS cannot measure their own velocity with regard to the lattice!
**V - Gravitation**

Perturbation of the external expansion field of a topological singularity

\[ K_1 \left( \tau^{(p)}(\hat{r}) \right)^2 + \left[ \frac{4 K_2}{3 + 2 K_1} \left( 1 + \tau_0 + \tau^{\text{ext}}(\hat{r}) + \tau^{\text{ch}}(\hat{r}) \right) - K_0 \right] \tau^{(p)}(\hat{r}) + \left( F^{\text{ch}}(\hat{r}) + F_{\text{pot}}(\hat{r}) \right) = \text{cste} = 0 \]

**Second partial Newton equation**
*(in the static case)*

**Effect of the energy of a singularity**
\[ E^{\text{amas}}_{\text{dist}} + V^{\text{amas}}_{\text{pot}} \]

**Effect of the flexion charge of a singularity**
\[ Q_0 \]

\[ Q_0 > 0 \Leftrightarrow \text{vacancy type} \]
\[ Q_0 < 0 \Leftrightarrow \text{interstitial type} \]

**Effect of the rotation charge of a singularity**
\[ Q_\lambda \]

\[ \tau_0 < \tau_{0\text{cr}} \]

**Effect of a macroscopic vacancy singularity**
\[ R_L = \sqrt{\frac{3 N_L}{4 \pi n_0 c}} \]

**Effect of a macroscopic interstitial singularity**
\[ R_I = \sqrt{\frac{3 N_I}{4 \pi n_0 c}} \]

\[ \tau_0 > 1 - \tau^{\text{excess}}(R_L) \Leftrightarrow \text{black hole!} \]

\[ \tau_0 > - \left( 1 + \tau^{\text{excess}}(R_I) \right) \]

Collapse of a cluster with \[ Q_0 > 0 \]

Collapse of a cluster with \[ Q_0 < 0 \]

**pulsar!**
External expansion field of a topological singularity of vacancy or interstitial type

\[ K_1 \left( \frac{\tau \text{ (p)}(\vec{r})}{c} \right)^2 + \left[ 4 K_2 / 3 + 2 K_1 \left( 1 + \tau_{0} + \tau^{\text{ext}}(\vec{r}) + \tau^{\text{ch}}(\vec{r}) - K_0 \right) \right] \tau^{\text{p}}(\vec{r}) + \left( F^{\text{disk}}(\vec{r}) + F^{\text{pot}}(\vec{r}) \right) = \text{cst} = 0 \]

Second partial Newton equation (in the static case)

Effect of the energy of the singularity

\[ E_{\text{amas}} + V_{\text{amas}} \]

Effect of the flexion charge of the singularity

\[ Q_0 \]

Conjecture:

Flexion charge:

\[ \begin{align*}
Q_0 > 0 & \iff \text{vacancy type} \iff \text{analogous to anti – matter} \\
Q_0 < 0 & \iff \text{interstitial type} \iff \text{analogous to matter}
\end{align*} \]

1/ The gravitational field of a vacancy type cluster (anti-matter) is slightly higher than that of an interstitial type cluster (matter)
**Collapse of clusters of vacancy or interstitial type: black holes and pulsars**

\[ K_l \left( \tau^{(p)}(\vec{r}) \right)^2 + \left[ 4K_2 / 3 + 2K_l \left( 1 + \tau_0 + \tau_{\text{ext}}(\vec{r}) + \tau_{\text{int}}(\vec{r}) \right) - K_0 \right] \tau^{(p)}(\vec{r}) + \left( F_{\text{dist}}(\vec{r}) + F_{\text{pot}}(\vec{r}) \right) = \text{cst} = 0 \]

**Second partial Newton equation (in the static case)**

**Conjecture:**

**Flexion charge:**

\[
\begin{align*}
Q_\theta &> 0 \iff \text{vacancy type} \iff \text{analogous to anti – matter} \\
Q_\theta &< 0 \iff \text{interstitial type} \iff \text{analogous to matter}
\end{align*}
\]

1/ The collapse of a cluster with \( Q_\theta > 0 \) (anti-matter) leads to a macroscopic vacancy singularity

2/ If \( \tau_0 > 1 - \tau_{\text{ext}}(R_L) \), the macroscopic vacancy becomes a black hole

3/ The collapse of a cluster with \( Q_\theta < 0 \) (matter) leads to a macroscopic interstitial singularity

4/ The macroscopic interstitial has to correspond to a pulsar !!!

\[
\begin{align*}
R_L &= \sqrt[3]{\frac{3N_L}{4\pi n_0 e}} \\
R_I &\approx \sqrt[3]{\frac{3N_I}{4\pi n_0 e}} \left( 3n + \tau + \tau_{\text{ext}}(R_L) \right)
\end{align*}
\]
Calculations of the interaction forces between two elementary singularities due to their expansion perturbations

Gravitational interaction force between two clusters of elementary singularities

Gotlib

1/ Analogy with Newton gravitation

2/ Small corrections at very short distances as in general relativity, but different!

3/ Gravitational parameter G is not a constant. It depends on the expansion background
Invariance of the maxwellian formulation of the physics laws for the local observers HS

**Absolute frame of the external observer GO and local frames of the observers HS**

**Behaviours of the measuring rods and local clock of the HS observers insuring the invariance of their physics laws**

\[
\begin{align*}
1/ & \text{ Analogy with the Scharzschild metric of the general relativity} \\
2/ & \text{ Measuring rods and clocks of the HS observers depend on local expansion of the lattice} \\
3/ & \text{ Physics laws are invariant for the local observers HS} \\
4/ & \text{ Only an external observer GO can describe the effects of the local expansion, because he owns universal measuring rods and clock}
\end{align*}
\]
Agreement and disagreement with the general relativity

\[
y_i = e^{\frac{G_{\text{grav}}M_0^\text{amass}}{c_i^2 r}} \quad t_i = \left(1 + \frac{G_{\text{grav}}M_0^\text{amass}}{c_i^2 r} \right)^{\frac{r}{t}}
\]

\[
y_r = e^{\frac{G_{\text{grav}}M_0^\text{amass}}{c_i^2 r}} \quad t_r = \left(1 - \frac{G_{\text{grav}}M_0^\text{amass}}{c_i^2 r} \right)^{\frac{r}{t}}
\]

Relations of our theory

Relations of the Schwarzschild metric in general relativity

At very short distances, disagreement with general relativity: example of the characteristic radii of black holes

Schwarzschild radius

Radius of photon sphere

Radius where the time dilatation of falling observers becomes infinite

Our theory

General relativity

\[
R_{\text{Schwarzschild}} = \frac{2G_{\text{grav}}M_0^\text{amass}}{c_i^2}
\]

\[
R_{\text{Schwarzschild}} = \frac{2G_{\text{grav}}M_0^\text{amass}}{c_i^2}
\]

\[
R_{\text{photon}} = \frac{2G_{\text{grav}}M_0^\text{amass}}{c_i^2}
\]

\[
R_{\text{photon}} = \frac{3G_{\text{grav}}M_0^\text{amass}}{c_i^2}
\]

\[
R_{\text{time dilatation}} \rightarrow \infty \rightarrow 0
\]

\[
R_{\text{time dilatation}} \rightarrow \infty \equiv \frac{G_{\text{grav}}M_0^\text{amass}}{c_i^2}
\]

The characteristic radii of a black hole obtained by our theory seem much more satisfactory than those obtained from the Schwarzschild metric of general relativity.
Spatial curvature of the lattice as seen by the observer GO compared to the spatio-temporal curvature of the general relativity

Equations of the 4D space-time curvature of the general relativity for the local observers

\[ G = 8\pi T \]

\[ G_{\mu\nu} = R_{\mu\nu} - \frac{1}{2} g_{\mu\nu} R \]

Motion equation

\[ \nabla \cdot G = \nabla \cdot T = \nabla \cdot [ ............... ] = 0 \]

Curvature charge

Curvature tensors

Energy-momentum tensors

Equations of the 3D space curvature of the lattice as seen by the external observer GO

\[ \tilde{\chi} = \frac{1}{2K_2} \left[ \frac{d\tilde{\rho}}{dt} - \left( \frac{4 K_2}{3} + 2K_1 \right) \nabla \tau - \nabla \tilde{F}^{\text{el}} \right] \]

\[ \tilde{\chi} = - \text{rot} \tilde{\omega}^{\text{el}} + \tilde{\lambda} \]

Newton equation of the lattice!

1/ Analogy with the general relativity:

- curvature equations with curvature tensors and energy-momentum tensors

- divergence of the curvature tensors -> motion equations

2/ For the external observer GO, who owns an universal clock, the lattice curvature is purely spatial

3/ For the local observers HS, who own local clocks, the curvature has to be a space-time curvature

4/ The concept of curvature charge is COMPLETELY NEW, as it does not exist in general relativity

G is of «fine marble», when T is of «low quality wood»!

Albert Einstein (1879-1955)
VI - Weak interaction

Dispiration formed by a twist disclination loop associated to an edge dislocation loop

Combination of a twist disclination loop with an edge dislocation loop to form a dispiration loop

Weak interaction capture potential between $Q_\lambda$ and $Q_\theta$ with a very short range

1/ Analogy with the weak interaction force of the standard model of particles

2/ The weak interaction is strongly associated to the gravitational interaction between a flexion charge and a rotation charge
### Hierarchy of the gravitational interaction

Behaviours of the gravitational interaction forces as a function of the lattice expansion background.

<table>
<thead>
<tr>
<th>Force Interaction</th>
<th>Attractive</th>
<th>Repulsive</th>
<th>Zero</th>
</tr>
</thead>
<tbody>
<tr>
<td>$F_{\text{grav}}$</td>
<td>$F_{\text{grav}}^{\text{X-X}}$</td>
<td>$F_{\text{grav}}^{\text{X-Y}}$</td>
<td>$F_{\text{grav}}^{\text{X-Y}}$</td>
</tr>
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<td>$F_{\text{grav}}^{\text{X-X}}$</td>
<td>$F_{\text{grav}}^{\text{X-X}}$</td>
<td>$F_{\text{grav}}^{\text{X-Y}}$</td>
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<td>$F_{\text{grav}}^{\text{X-Y}}$</td>
<td>$F_{\text{grav}}^{\text{X-Y}}$</td>
</tr>
</tbody>
</table>

**Conjecture:**

Due to the flexion charge of the particle, these interactions are repulsive.

1. The interactions $\nu^0 - \nu^0$ and $X - \nu^0$ with a neutrino are repulsive!!!

2. All the other interactions are attractive (or very small)

3. Attractive interaction between particles is slightly lower than attractive interaction between anti-particles

4. The slight asymmetry existing between matter and anti-matter is due to the flexion charge of the edge dislocation loops (which DOES NOT EXIST in all other theories!)
Plausible scenario of cosmological evolution of matter in our universe

1/ big-bang
2/ inflation and hypothetic solidification of the lattice with formation of numerous topological singularities
3/ annihilation of topological singularities with formation of photons coupled to the topological singularities
4/ condensation of the remaining topological loops in particles and anti-particles
5/ decoupling of matter and photons to form the cosmic microwave background
6/ phase transition by precipitation of clusters of particles and anti-particles to form galaxies inside a sea of repulsive neutrinos
7/ segregation of the anti-matter in the center of the galaxies due to the slightly higher gravity of anti-matter
8/ under gravity, collapse of the anti-matter nucleus in gigantic black holes (macroscopic vacancies) in the center of galaxies
9/ evolution of the remaining matter to form the stars and planet systems
10/ under gravity, collapse of stars of matter to form pulsars (macroscopic interstitial clusters)

Stages of cosmologic expansion of the lattice

1/ Explains the formation of the galaxies and of gigantic black holes in the center of the galaxies
2/ Explains the disappearance of anti-matter inside the universe
3/ Explains the «dark matter»: the repulsive neutrino sea acts as a strong pressure on the galaxy periphery
4/ Explains simply the Hubble constant, the galaxy redshift and the cooling of the cosmic microwave background
Gravitational fluctuations of the expansion field associated to a mobile singularity

Immobile singularity

=> static external gravitational field

Mobile singularity

=> dynamic external gravitational field

\[
\tau_0 < \tau_0 c
\]

\[
\tau^{(p)}(\vec{r},t) \equiv \psi(\vec{r},t) e^{\pm i \omega_f(\vec{r},t) t}
\]

Wave equation for the amplitude and phase of the dynamic fluctuations of the gravitational field, which should contain information on relativistic energy and relativistic momentum of the singularity

\[
\frac{\partial^2 \psi}{\partial t^2} \pm 2 i \omega_f \frac{\partial \psi}{\partial t} - \omega_f^2 \psi \equiv - c_t^2 \Delta \psi
\]

Conjecture:

Use « a priori » the quantum physics operators with the relativistic dynamic relations

\[
\begin{align*}
E_v &= M_0 c_t^2 = E_0^{\text{dist}} + V(\vec{r},t) \\
M_0 c_t^2 &= E_0^{\text{dist}} + V(\vec{r},t) \\
\vec{P}_v &= M_0 \vec{v} = \frac{\vec{F}^{\text{dist}} + V(\vec{r},t)}{\gamma c_t^2} \vec{v}
\end{align*}
\]

Complex frequency of the gravitational fluctuations, and relativistic wave equation (different from Dirac equation!)

\[
\hbar \omega_f = \pm \frac{E_0^{\text{dist}} + V(\vec{r},t)}{\gamma} 
\left( 1 \pm \frac{\vec{v}}{c_t} \right)
\]

\[
\hbar \frac{\partial^2 \psi}{\partial t^2} + 2 \frac{E_0^{\text{dist}} + V(\vec{r},t)}{\gamma} \left( 1 \pm \frac{\vec{v}}{c_t} \right) i \hbar \frac{\partial \psi}{\partial t} - \frac{\left( E_0^{\text{dist}} + V(\vec{r},t) \right)^2}{\gamma^2} 
\left( 1 \pm \frac{\vec{v}}{c_t} \right)^2 \psi \equiv - c_t^2 \hbar^2 \Delta \psi
\]
Solution for a relativistic quasi-free singularity

\[ \tau_{rel}(\vec{r},t) \equiv \psi_0 e^{-\frac{i}{\hbar c^2} \left[ \frac{1}{2} m c^2 \left( E_{0}^{\text{dist}} + V(\vec{r},t) \right) \right]} \cos \left[ \frac{1}{\hbar c^2} \left( E_{0}^{\text{dist}} + V(\vec{r},t) \right) t \right] \cos \left[ \frac{1}{\hbar c^2} \left( E_{0}^{\text{dist}} + V(\vec{r},t) \right) \frac{\vec{v}}{c^2} x_2 \right] \pm \psi_0 e^{-\frac{i}{\hbar c^2} \left[ \frac{1}{2} m c^2 \left( E_{0}^{\text{dist}} + V(\vec{r},t) \right) \right]} \sin \left[ \frac{1}{\hbar c^2} \left( E_{0}^{\text{dist}} + V(\vec{r},t) \right) t \right] \sin \left[ \frac{1}{\hbar c^2} \left( E_{0}^{\text{dist}} + V(\vec{r},t) \right) \frac{\vec{v}}{c^2} x_2 \right] \]

Oscillations with a frequency, a wavelength and a range which depend on the relativistic velocity:

\[ f = \frac{E_{0}^{\text{dist}} + V(\vec{r},t)}{2\pi \hbar} = \frac{E_{0}^{\text{dist}} + V(\vec{r},t)}{2\pi \hbar \sqrt{1 - \vec{v}^2 / c^2}} \]

\[ \lambda = \frac{2\pi \hbar c^2}{(E_{0}^{\text{dist}} + V(\vec{r},t))} = \frac{2\pi \hbar c^2}{(E_{0}^{\text{dist}} + V(\vec{r},t))} \sqrt{1 - \vec{v}^2 / c^2} \]

\[ \delta = \frac{\hbar c \gamma}{E_{0}^{\text{dist}} + V(\vec{r},t)} = \frac{\hbar c_0}{E_{0}^{\text{dist}} + V(\vec{r},t)} \sqrt{1 - \vec{v}^2 / c^2} \]

Schrödinger equation for a non-relativistic singularity submitted to a potential

\[ \gamma = \sqrt{1 - \vec{v}^2 / c^2} \rightarrow 1 \quad \& \quad \hbar^2 \frac{\partial^2 \psi}{\partial t^2} = -E_{0}^{\text{dist}} + V(\vec{r},t) \psi \Rightarrow \text{Schrödinger equation} \]

\[ i\hbar \frac{\partial \psi}{\partial t} = \frac{-\hbar^2}{2M_0} \Delta \psi + \left( E_{0}^{\text{dist}} + V(\vec{r},t) \right) \psi \]

Oscillations of the dynamic gravitational field

Erwin Schrödinger
(1887-1961)

1/ The Schrödinger equation is a wave equation deduced from the second partial Newton equation of the cosmic lattice

2/ It allows one to calculate the amplitude and the phase of the gravitational fluctuations of frequency \( \omega_f(\vec{r},t) \) associated to a non-relativistic moving singularity submitted to a potential

3/ All the well-known consequences of quantum physics can be applied: stationary wave equation, commutators, uncertainty principle of Heisenberg, probabilistic interpretation of the wave function, etc.

4/ It allows also to understand the origin of the bosons and fermions, and the exclusion principle (not presented here).
Dynamic internal gravitationnal field of a singularity: the spin of the singularity

1/ No static solution for the internal gravitational field of a singularity loop if

$K_1 > 10^{-21}$

=> the singularity loop has really to turn around an axis

2/ Solution of the stationary Schrödinger equation:

$\Rightarrow$ quantified spin of the singularity loop, with $j=1/2, 1, \ldots$

3/ The argument of the pionners of quantum physics against a real rotation of the charge based on the fact that the equatorial velocity of the charge would be higher than the light velocity is wrong if

$K_1 < 1.8 \cdot 10^9$

due to the enormous static expansion in the vicinity of the loop.
Transversal wave packets: the photons

Transversal wave packets: needs helicity to present a constant energy.

1/ A constant energy of the wave packet needs helicity

=> energy of the wave packet depends on packet physical dimensions and wave amplitude

2/ The energy of formation is related to a state transition of a topological singularity

=> quantified energy of the wave packet proportional to the frequency of the wave

3/ there is a « plasticity » of the physical dimensions of the wave packet

=> explanations of non-locality, momentum, wave-particle duality, diffraction, interference, entanglement, decoherence, etc.
A « coloured » cubic lattice

1/ Introduce a « coloured » cubic lattice with three simple rules concerning the alternance and the rotation of the coloured planes

The three rules

Rule 1: the alternation of planes R, G, B cannot be broken (either by impossibility or by a very large energy associated with a surface stacking fault energy )

Rule 2: in a given direction of space, there may appear a stacking fault corresponding to a shift in the alternation of planes R, G, B, which possesses a surface stacking fault energy which is not null

Rule 3: if a plane with a given color undergoes a rotation by an angle, or it changes color according to table 3.1, which corresponds to the existence of a given axial property of the lattice.

Stein Weinberg, Abdus Salam and Sheldon Glashow
Standard model of elementary particles: quarks and leptons

2/ Combine edge dislocation loops and screw disclination loops

Stacking fault energy

<table>
<thead>
<tr>
<th>name</th>
<th>$\Omega_{rt}$</th>
<th>$\eta_{ext}$</th>
<th>edge loop</th>
<th>$\eta_{int}$</th>
<th>color</th>
</tr>
</thead>
<tbody>
<tr>
<td>$d$</td>
<td>$+\pi /2$</td>
<td>$-e^3 k_{11} /2$</td>
<td>vacancy</td>
<td>$-2\text{ma}$</td>
<td>R, G, B</td>
</tr>
<tr>
<td>$u$</td>
<td>$-\pi$</td>
<td>$+\pi /2$</td>
<td>vacancy</td>
<td>$-2\text{ma}$</td>
<td>R, G, B</td>
</tr>
<tr>
<td>$\bar{d}$</td>
<td>$-\pi /2$</td>
<td>$+e^3 k_{11} /2$</td>
<td>vacancy</td>
<td>$+2\text{ma}$</td>
<td>R, G, B</td>
</tr>
<tr>
<td>$\bar{u}$</td>
<td>$+\pi$</td>
<td>$-e^3 k_{11}$</td>
<td>vacancy</td>
<td>$+2\text{ma}$</td>
<td>R, G, B</td>
</tr>
<tr>
<td>$W^-$</td>
<td>$+3\pi /2$</td>
<td>$-3e^2 k_{11}$</td>
<td>-</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>$W^+$</td>
<td>$-3\pi /2$</td>
<td>$+3e^2 k_{11}$</td>
<td>-</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>$Z^0$</td>
<td>$(-3\pi /2)+(-3\pi /2)$</td>
<td>0</td>
<td>-</td>
<td>0</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>symbol</th>
<th>$\Omega_{rt}$</th>
<th>$\eta_{ext}$</th>
<th>edge loop</th>
<th>$\eta_{int}$</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\nu_e$</td>
<td>$+3\pi /2$</td>
<td>0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>$e^-$</td>
<td>0</td>
<td>$-3e^2 k_{11}$</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>$\bar{\nu}_e$</td>
<td>$-3\pi /2$</td>
<td>0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>$e^+$</td>
<td>$-3\pi$</td>
<td>$+3e^2 k_{11}$</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>$W^-$</td>
<td>$+3\pi /2$</td>
<td>$-3e^2 k_{11}$</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>$W^+$</td>
<td>$-3\pi /2$</td>
<td>$+3e^2 k_{11}$</td>
<td>-</td>
<td>0</td>
</tr>
<tr>
<td>$Z^+$</td>
<td>$(+3\pi /2)+(-3\pi /2)$</td>
<td>0</td>
<td>-</td>
<td>0</td>
</tr>
</tbody>
</table>
Standard model of elementary particles: baryons, mesons and strong interaction

3/ Combine two or three dispiration loops (quarks)

Stacking fault energy => strong interaction

<table>
<thead>
<tr>
<th>combination</th>
<th>symbol</th>
<th>$\Omega_{1\Delta}$</th>
<th>$\Omega_{1\pi}$</th>
<th>edge loop</th>
<th>$\Omega_{3\pi}$</th>
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<tbody>
<tr>
<td>$d\bar{u}\bar{d}$</td>
<td>$\Delta^+$</td>
<td>$+3\pi/2$</td>
<td>$-3\pi^2/R_{1\pi}$</td>
<td>Interstitial</td>
<td>$-6\pi$</td>
</tr>
<tr>
<td>$d\bar{u}\bar{u}$</td>
<td>$n,\Delta^0$</td>
<td>$0$</td>
<td>$0$</td>
<td>Interstitial</td>
<td>$-6\pi$</td>
</tr>
<tr>
<td>$u\bar{u}\bar{d}$</td>
<td>$p,\Delta^-$</td>
<td>$-3\pi/2$</td>
<td>$+3\pi^2/R_{1\pi}$</td>
<td>Interstitial</td>
<td>$-6\pi$</td>
</tr>
<tr>
<td>$u\bar{u}\bar{u}$</td>
<td>$\Delta^0$</td>
<td>$-3\pi$</td>
<td>$+3\pi^2/R_{1\pi}$</td>
<td>Interstitial</td>
<td>$-6\pi$</td>
</tr>
<tr>
<td>$d\bar{d}\bar{d}$</td>
<td>$\Delta^+$</td>
<td>$-3\pi/2$</td>
<td>$+3\pi^2/R_{1\pi}$</td>
<td>Vacancy</td>
<td>$6\pi$</td>
</tr>
<tr>
<td>$d\bar{d}\bar{u}$</td>
<td>$n,\Delta^0$</td>
<td>$0$</td>
<td>$0$</td>
<td>Vacancy</td>
<td>$6\pi$</td>
</tr>
<tr>
<td>$d\bar{u}\bar{u}$</td>
<td>$p,\Delta^-$</td>
<td>$+3\pi/2$</td>
<td>$-3\pi^2/R_{1\pi}$</td>
<td>Vacancy</td>
<td>$6\pi$</td>
</tr>
</tbody>
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<th>symbol</th>
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<th>$\Omega_{3\pi}$</th>
<th>edge loop</th>
<th>$\Omega_{3\pi}$</th>
</tr>
</thead>
<tbody>
<tr>
<td>$d\bar{d}$</td>
<td>$n,\rho^0$</td>
<td>$0$</td>
<td>$0$</td>
<td>-</td>
<td>$0$</td>
</tr>
<tr>
<td>$d\bar{u}$</td>
<td>$\pi,\rho^-$</td>
<td>$+3\pi/2$</td>
<td>$-3\pi^2/R_{1\pi}$</td>
<td>-</td>
<td>$0$</td>
</tr>
<tr>
<td>$d\bar{u}$</td>
<td>$\pi^+,\rho^-$</td>
<td>$-3\pi/2$</td>
<td>$+3\pi^2/R_{1\pi}$</td>
<td>-</td>
<td>$0$</td>
</tr>
<tr>
<td>$u\bar{u}$</td>
<td>$\eta,\omega^0$</td>
<td>$0$</td>
<td>$0$</td>
<td>-</td>
<td>$0$</td>
</tr>
</tbody>
</table>
Standard model of elementary particles: *gluons, strong and weak interactions*

4/ Exchange edge dislocation loops or twist disclination loops

**gluons**

**strong interactions**

**gauge bosons**

**weak interactions**
Standard model of elementary particles: the three families of particles

5/ Replace edge dislocation loops by wedge disclination loops

three families of quarks

three families of leptons

C1: $\Omega = +90^\circ$, $\Theta = +\pi / 2$

C2: $\Omega = +180^\circ$, $\Theta = +\pi$

$\bar{C}1$: $\Omega = -90^\circ$, $\Theta = -\pi / 2$

$\bar{C}2$: $\Omega = -180^\circ$, $\Theta = -\pi$
Conclusion

- Maxwell equations
- general relativity
- spatial curvature of the lattice for the observer GO

**Newton equation of cosmological lattice**

\[
\frac{d\phi}{dt} = -2(K_1 + K_2) \text{rot} \tilde{\omega}^\alpha + \left( \frac{4}{3} K_1 + 2K_2 \right) \text{grad} \tau + 2K_1 \tilde{\lambda} + \frac{nm\tilde{\phi}}{dt} - \frac{nm\tilde{\phi}_i}{dt} \frac{dC_{ik}}{dt} + \text{other terms}
\]

- pure transversal waves coupled with longitudinal wavelets
- special relativity and Lorentz transformation
- spatiotemporal curvature of space for the observers HS

- spatial curvature of the lattice

- Newtonian gravity

- standard model of elementary particles, quarks, leptons, strong and weak interactions

- modern cosmology

- black holes, black matter, black energy

- bosons, fermions, exclusion principle

- quantum physics

- relativistic and non-relativistic Schrödinger equation

- concept of spin

- uncertainty principle, photons, gravitons, multiverses, quantum vacuum state
Thank You!

Turk et De Groot

Theory of Everything

Gotlib