the nature of gravity and quants

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13.11.2025

Abstract

In this paper i will show a extended picture of the nature of gravity.I will show that curvature of spacetime is only one side of the medal.The floating of spacetime is the other side. Furthermore i will show that quants can be described by finit group theory.

Keywords: *gravity; Einstein;Energytensor; black holes;Planck;Riemann*

1. Introduction

Einstein's idea was that gravity is a result of spacetime curvature.
With the tools of Riemann curvaturetensors he created at least his famous Einstein field equation.

$$EFE \qquad R_{\mu\nu} - \frac{R}{2}.g_{\mu\nu} + \Lambda.g_{\mu\nu} = \frac{8\pi G}{c^4}.T_{\mu\nu} \tag{1}$$

Obviously only the constants G (Newtons gravitation constant) and c (speed of light) are present in the EFE.The Planck constant $\hbar$ is missing in EFE.
This is the reason why EFE is independend of quantum theory until today.
We show a way how to bring $\hbar$ into the EFE by a paradigm shift.

1.1. basic equation from the Planck units

$$\frac{G\hbar}{c^3} = l_p^2 \tag{2}$$

l_p^2... Planck length

$$\Rightarrow \frac{G\hbar}{c} = l_p^2.c^2 \tag{3}$$

Now we make the right values l_p *and* c variable by replacing l_p with r (radius) and c by v (velocity).

$$\Rightarrow \frac{G\hbar}{c} = r^2.v^2 \tag{4}$$

$0 < v \leqslant c$
$l_p \leqslant r < \infty$

$$\Rightarrow \frac{1}{r^2} = \frac{c}{G\hbar}.v^2 \tag{5}$$

On the left side of the equation we have the Gaus curvature on a ball with radius r.
We divide both sides by the Einstein gravitational constant $\kappa = \frac{8\pi G}{c^4}$ then

$$\Rightarrow \frac{c^4}{8\pi G}.\frac{1}{r^2} = \frac{c^5}{8\pi G^2\hbar}.v^2 \tag{6}$$

The equation now is an energydensity or pressure.The constant factor $\frac{c^5}{8\pi G^2\hbar}$ is a Planckdensity. On the left side of the equation we have variable curvature like in the EFE (Einsteins field Equation) and on the right side we have variable speed.
Remark that on the right side we have the Planck constant as a part of the game which is not the case on the left side of the equation!
But what does speed v stands for?Speed of what?
On the left side we have curvature and we know it is the curvature of spacetime if we extend the euqation to spacetime dimensions.
Therefore we assign the speed to the floating of spacetime itself.

$$v = \frac{\triangle x_i}{\triangle t} \tag{7}$$

So the equation (6) is similar to a Bernoulli equation

$$P_{dyn} = \frac{\varrho}{2}.v^2 \tag{8}$$

P_{dyn}... *pressure*
ϱ... *massdensity*

Now we want to expand the equation to an Energy tensor $T_{\mu\nu}$.

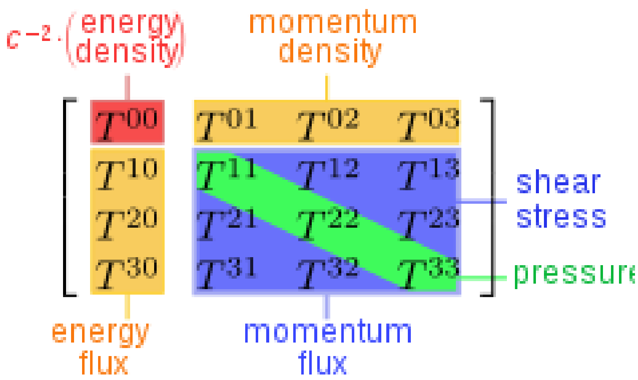
$$T_{\mu\nu} = \frac{c^5}{8\pi G^2\hbar}.\begin{pmatrix} v_{00}^2 & v_{01}.v_{10} & v_{02}.v_{20} & v_{03}.v_{30} \\ v_{10}.v_{01} & -v_{11}^2 & v_{12}.v_{21} & v_{13}.v_{31} \\ v_{20}.v_{02} & v_{21}.v_{12} & -v_{22}^2 & v_{23}.v_{32} \\ v_{30}.v_{03} & v_{31}.v_{13} & v_{32}.v_{23} & -v_{33}^2 \end{pmatrix} \tag{9}$$

Hint: we have 16 different speedvalues in the tensor!

$$\Rightarrow V_{\mu\nu} := \frac{8\pi G}{c^4}.T_{\mu\nu} = \frac{c}{G\hbar}.\begin{pmatrix} v_{00}^2 & v_{01}.v_{10} & v_{02}.v_{20} & v_{03}.v_{30} \\ v_{10}.v_{01} & -v_{11}^2 & v_{12}.v_{21} & v_{13}.v_{31} \\ v_{20}.v_{02} & v_{21}.v_{12} & -v_{22}^2 & v_{23}.v_{32} \\ v_{30}.v_{03} & v_{31}.v_{13} & v_{32}.v_{23} & -v_{33}^2 \end{pmatrix} \tag{10}$$

$0 \leqslant v_{ij} \leqslant c$ with $0 \leqslant i,j \leqslant 3$

Explanation of the componentes of $T_{\mu\nu}$



1.2. direct consequence of the paradigm shift curvature to speed of spacetime

One first consequence is that the energy tensor ist limited because the floating speed is limited by the speed of light c.It is not possible to get an infinite energydensity and therefore a singularity! The density is limited if we set v=c by the Planck energy density (see equation (9)).

1.3. the field which brings mass and gravity together

Einstein found out that mass curves the spacetime and that this is the reason
why two planets attract each other.
One open mainquestion is why mass is coupled to spacetime?Both could also be independend from each other but they aren't.

In the following i want to show how some special particles are coupled to spacetime.
For that we uses the idea of the SU(2) Higgsfield and expand it to a bigger field with enough place for SU(5) bosons and gravity.

The Higgsfield a Complex Doublet short HF has the shape

$$HF = \begin{pmatrix} \phi_{2\bar{1}}.1 & \phi_{\bar{2}1}i \\ \phi_{00}.1 & \phi_{33}.i \end{pmatrix} \tag{11}$$

Octonionic Quintet short Octoquintenfield OQF

$$OQF = \begin{pmatrix} \phi_{2\bar{1}}.1 & \phi_{01}i_1 & \phi_{02}i_2 & \phi_{03}i_3 & \phi_{\bar{2}1}i_4 & \phi_{\bar{2}3}i_5 & \phi_{\bar{2}4}i_6 & \phi_{\bar{2}5}i_7 \\ \phi_{10}.1 & \phi_{3\bar{1}}.i_1 & \phi_{12}i_2 & \phi_{13}i_3 & \phi_{\bar{3}2}i_4 & \phi_{\bar{3}1}i_5 & \phi_{\bar{3}4}i_6 & \phi_{\bar{3}5}i_7 \\ \phi_{20}.1 & \phi_{21}i_1 & \phi_{4\bar{1}}.i_2 & \phi_{23}i_3 & \phi_{\bar{4}2}i_4 & \phi_{\bar{4}3}i_5 & \phi_{\bar{4}1}i_6 & \phi_{\bar{4}5}i_7 \\ \phi_{30}.1 & \phi_{31}i_1 & \phi_{32}i_2 & \phi_{5\bar{1}}.i_3 & \phi_{\bar{5}2}i_4 & \phi_{\bar{5}3}i_5 & \phi_{\bar{5}4}i_6 & \phi_{\bar{5}1}i_7 \\ \phi_{00}.1 & \phi_{11}.i_1 & \phi_{22}.i_2 & \phi_{33}.i_3 & \phi_{44}i_4 & \phi_{55}i_5 & \phi_{66}i_6 & \phi_{77}i_7 \end{pmatrix} \tag{12}$$

To show that ϕ is a velocity we replace ϕ by v

$$OQF = \begin{pmatrix} v_{2\overline{1}}.1 & v_{01}i_1 & v_{02}i_2 & v_{03}i_3 & v_{\overline{2}1}i_4 & v_{\overline{2}3}i_5 & v_{\overline{2}4}i_6 & v_{\overline{2}5}i_7 \\ v_{10}.1 & v_{3\overline{1}}.i_1 & v_{12}i_2 & v_{13}i_3 & v_{\overline{3}2}i_4 & v_{\overline{3}1}i_5 & v_{\overline{3}4}i_6 & v_{\overline{3}5}i_7 \\ v_{20}.1 & v_{21}i_1 & v_{4\overline{1}}.i_2 & v_{23}i_3 & v_{\overline{4}2}i_4 & v_{\overline{4}3}i_5 & v_{\overline{4}1}i_6 & v_{\overline{4}5}i_7 \\ v_{30}.1 & v_{31}i_1 & v_{32}i_2 & v_{5\overline{1}}.i_3 & v_{\overline{5}2}i_4 & v_{\overline{5}3}i_5 & v_{\overline{5}4}i_6 & v_{\overline{5}1}i_7 \\ v_{00}.1 & v_{11}.i_1 & v_{22}.i_2 & v_{33}.i_3 & v_{44}i_4 & v_{55}i_5 & v_{66}i_6 & v_{77}i_7 \end{pmatrix} \quad (13)$$

The red v's are for the 24 SU(5) bosons similar to the 3 SU(2) bosons on the Higgsfield.
Total we have 5 x 8 = 40 degrees of freedome so 40 - 24 = 16 velocity degrees of freedome left.
This is exactly what we need for our energytensor $T_{\mu\nu}$ in equation (9).
We ingnore the visible matter like electrons,quarks aso. and define the SU(5) bosons as dark matter particles with planckmass.Dark matter is the majority mass in the universe which is a source for gravity.

In the Einstein Field Equation EFE (1) the energytensor $T_{\mu\nu}$ is used as the source for the Gravitationfield.
So for example outside of a planet as a source the energytensor vanishes $T_{\mu\nu} = 0$ in EFE (1).
But i want to use the energytensor (9) which i have deduced in general this means for mass(density),pressure... and gravityfield.
We know that the energydensity of a gravityfield is negative therefore we must allow in equation (9) imaginary speeds $v_{00}, v_{11}, v_{22}, v_{33}$. $T_{\mu\nu} = \frac{c^5}{8\pi G^2\hbar}.v_{00}^2 < 0$ only if v_{00} is imaginary.

So we have to expand the OQF (13) to

$$OQF = \begin{pmatrix} v_{2\overline{1}}.1 & v_{01}i_1 & v_{02}i_2 & v_{03}i_3 & v_{\overline{2}1}i_4 & v_{\overline{2}3}i_5 & v_{\overline{2}4}i_6 & v_{\overline{2}5}i_7 \\ v_{10}.1 & v_{3\overline{1}}.i_1 & v_{12}i_2 & v_{13}i_3 & v_{\overline{3}2}i_4 & v_{\overline{3}1}i_5 & v_{\overline{3}4}i_6 & v_{\overline{3}5}i_7 \\ v_{20}.1 & v_{21}i_1 & v_{4\overline{1}}.i_2 & v_{23}i_3 & v_{\overline{4}2}i_4 & v_{\overline{4}3}i_5 & v_{\overline{4}1}i_6 & v_{\overline{4}5}i_7 \\ v_{30}.1 & v_{31}i_1 & v_{32}i_2 & v_{5\overline{1}}.i_3 & v_{\overline{5}2}i_4 & v_{\overline{5}3}i_5 & v_{\overline{5}4}i_6 & v_{\overline{5}1}i_7 \\ (v_{00} + i.\overline{v_{00}}).1 & (v_{11} + i.\overline{v_{11}}).i_1 & (v_{22} + i.\overline{v_{22}}).i_2 & (v_{33} + i.\overline{v_{33}}).i_3 & v_{44}i_4 & +v_{55}i_5 & v_{66}i_6 & v_{77}i_7 \end{pmatrix} \quad (14)$$

44 different speed degrees of freedome.
In another work of mine it was necessary to allow for the speeds $v_{2\overline{1}}$,$v_{3\overline{1}}$,$v_{4\overline{1}}$,$v_{5\overline{1}}$ to be imaginary to get a result.

So the final shape of the Oktoquintefield OQF is

$$OQF = \begin{pmatrix} (v_{2\overline{1}} + i.\overline{v_{2\overline{1}}}).1 & v_{01}i_1 & v_{02}i_2 & v_{03}i_3 & v_{\overline{2}1}i_4 & v_{\overline{2}3}i_5 & v_{\overline{2}4}i_6 & v_{\overline{2}5}i_7 \\ v_{10}.1 & (v_{3\overline{1}} + i.\overline{v_{3\overline{1}}}).i_1 & v_{12}i_2 & v_{13}i_3 & v_{\overline{3}2}i_4 & v_{\overline{3}1}i_5 & v_{\overline{3}4}i_6 & v_{\overline{3}5}i_7 \\ v_{20}.1 & v_{21}i_1 & (v_{4\overline{1}} + i.\overline{v_{4\overline{1}}}).i_2 & v_{23}i_3 & v_{\overline{4}2}i_4 & v_{\overline{4}3}i_5 & v_{\overline{4}1}i_6 & v_{\overline{4}5}i_7 \\ v_{30}.1 & v_{31}i_1 & v_{32}i_2 & (v_{5\overline{1}} + i.\overline{v_{5\overline{1}}}).i_3 & v_{\overline{5}2}i_4 & v_{\overline{5}3}i_5 & v_{\overline{5}4}i_6 & v_{\overline{5}1}i_7 \\ (v_{00} + i.\overline{v_{00}}).1 & (v_{11} + i.\overline{v_{11}}).i_1 & (v_{22} + i.\overline{v_{22}}).i_2 & (v_{33} + i.\overline{v_{33}}).i_3 & v_{44}i_4 & +v_{55}i_5 & v_{66}i_6 & v_{77}i_7 \end{pmatrix} \quad (15)$$

So finally we have 48 different speed degrees of freedome in the OQF.

1.4. what is a quant on the OQF?

The next important question is what is a quant?Why do we have quants?
To give an answer we think about permutations on the OQF.We have 48 degrees of freedom and therefore we have 48! permutations on it.
Permutations have fixpoints and transpositions and this fixpoints and transpositions are candidates for quants.
So we want to use the symmetric group S_{48} to define quants (see references SY01).

Quants on OQF

The OQF is a set of 48 degrees of freedome $:= \{v_1, v_2, ..., v_{47}, v_{48}\}$
This degrees (speeds) can be permutated by the indices of the degrees.
For example a single permutation in S_4 is a bijection

Example 1

1) $\begin{pmatrix} 1 & 2 & 3 & 4 \\ 2 & 3 & 4 & 1 \end{pmatrix} = (1,2,3,4)$

2) $\begin{pmatrix} 1 & 2 & 3 & 4 \\ 2 & 1 & 3 & 4 \end{pmatrix} = (1,2)(3)(4)$

The left side is the so called two-line notation and the right side the cycle notation
(see references PE01)
Now we can use the one- and two-cycles (fixpoints,transpositions) as quants.

The next question is how many quants we have by all permutations in the symmetric group S_{48}?
We know we have 48! permutations in S_{48}
For example we start with S_3 which has 3!= 6 permutations

Example 2

1) $\begin{pmatrix} 1 & 2 & 3 \\ 1 & 2 & 3 \end{pmatrix} = (1)(2)(3)$

2) $\begin{pmatrix} 1 & 2 & 3 \\ 3 & 1 & 2 \end{pmatrix} = (1,3,2)$

3) $\begin{pmatrix} 1 & 2 & 3 \\ 2 & 3 & 1 \end{pmatrix} = (1,2,3)$

4) $\begin{pmatrix} 1 & 2 & 3 \\ 1 & 3 & 2 \end{pmatrix} = (1)(2,3)$

5) $\begin{pmatrix} 1 & 2 & 3 \\ 3 & 2 & 1 \end{pmatrix} = (1,3)(2)$

6) $\begin{pmatrix} 1 & 2 & 3 \\ 2 & 1 & 3 \end{pmatrix} = (1,2)(3)$

Now we count the different one-cycles on the right side (cycle notation).
We count 3!= 6 cycles with length = 1
And we count the different two-cycles on the right side (cycle notation).
We count $\frac{3!}{2} = 3$ cycles with length = 2 (the violet)

Important to see is that we have two red (1) quants which have the same fixpoint (1)
but are different quants!To separate this two quants we have to pair the fixpoint (one-cycle) with its permutation.
For example in 1) (1) with its permutation (1)(2)(3) and in 4) (1) with its permutation (1)(2, 3).
Then finally the two quants are written by ((1),(1)(2)(3)) and ((1),(1)(2,3))

That motivates us to the following definitions.

DEF 1: quants with spin = 1

a quant with spin = 1 is a pair $((i), P)$ where (i) is a fixpoint (one-cycle) of a permutation P with $1 \leq i \leq n$.

DEF 2: quants with spin $= \frac{1}{2}$

two quants (quant and its antiquant) with spin $= \frac{1}{2}$ is a pair $((i,j), P)$ where (i,j) is a transposition (two-cycle) of a permutation P with $1 \leq i < j \leq n$.

It is well known that the count of cycles with length k in S_n is

$$\binom{n}{k} \times (k-1)! \times (n-k)! = \frac{n! \times (k-1)! \times (n-k)!}{k! \times (n-k)!} = \frac{n!}{k} \tag{16}$$

This means we have n! spin=1 quants in S_n.

A special subgroup of S_{48} ist the so called alternating group A_{48}.
It is the subgroup of permutations of S_{48} which are build by even transpositions.
The count of permutations of A_{48} is $\frac{48!}{2}$

First some basics about the symmetry group S_n which is the group of permutations.

1) a transposition is a permutation which has the effect of swapping two elements while leaving everything else unchanged.
For example:

Example 3

$\begin{pmatrix} 1 & 2 & 3 & 4 \\ 2 & 1 & 3 & 4 \end{pmatrix} = (1,2)$ swappes the number 1 and 2 and leaves the rest fixed.

2) every permutation of S_n is a product (chain) of such transpositions.
For example:

$\begin{pmatrix} 1 & 2 & 3 & 4 \\ 2 & 1 & 4 & 3 \end{pmatrix} = (1,2)(3,4)$

3)a permutation is called even if the permutation is a product of even transpositions.
for example: (1,2)(3,4)
4)a permutation is called odd if the permutation is a product of odd transpositions.
for example: (1,2)

Following some important properties of alternating Groups A_n with $n \geq 2$.

1)A_n is a normal subgroup of S_n short $A_n \triangleleft S_n$
For each $s \in S_n$ and each $a \in A_n$ is $s.a.s^{-1} \in A_n$
2)The alternating group A_n is (n-2)-transitive means that any arrangement of n-2 elements can be mapped to any other arrangement of n-2 elements by one element of A_n.
3)Alternating groups A_n with $n \geq 5$ are simple groups their only normal subgroups are the trivial subgroup and the entire group A_n.
4)For each $a \in A_n$ there exist a $a^{-1} \in A_n$ such that $a.a^{-1} = e = Id$
5)A_n is the Commutatorgroup of S_n means that $A_n = \{[a,b] = a.b.a^{-1}b^{-1} \mid \forall a, b \in S_n\}$
6)The factor group (quotient group) $S_n/A_n = \{s.A_n \mid s \in S_n\}$ is abelian. The order of this factorgroup is 2 (even permutations and the odd permutations) and is isomorph to Z_2.
7)The set of even permutations (which is A_n) in S_n is a group but the set of odd permutations in S_n not because the product of an odd permutation and another odd permutation is an even permutation!
even.even= even (1.1 = 1) and odd.even = odd -1.1 = -1 and odd.odd = even -1.-1=1

What does this porperties mean for our $SU(5)$ quants and our OQF (Octoquintenfield) see (12)?

For further investigations we divide the permutationgroup S_n in two sets of permutations where
A_n*...alternating group = even permutations in* S_n *and*
M_n*...the odd permutations in* S_n.
Hint 1: A_n *is a group but* M_n *not.*
Hint 2: M_n *is the coset of* A_n *and* $Ord(M_n) = Ord(A_n) = \frac{n!}{2}$.

$$S_n = M_n \cup A_n \tag{17}$$

<u>Hypothesis 1 Mass particle on the OQF</u>

The fixpoints of the permutations in M_{48} are the $SU(5)$ quants (see Def 1).
On the OQF (see (12)) this are the 24 red excited states.

On equation (9) we saw that gravitation is a product of speedvalues.These values are a part of the other half of the OQF.So we assume that this values belong to the subgroup A_{48} of S_{48}. Following we will show this more concrete.

<u>DEF 3</u>

$M_n^2 := M_n \times M_n = \{m_1.m_2 \mid m_1, m_2 \in M_n\}$

It is easy to see that

1) $M_n^2 \subseteq A_n$ because odd.odd = even.
2) $M_n^2 \supseteq A_n$ because every even permutation can be written as a product of two odd permutations.

then

$$M_n^2 = A_n \tag{18}$$

Then we can write see (17):

$$S_n = M_n \cup M_n^2 \tag{19}$$

Hint 1: *Count of fixpoints (one − cycles) in* $A_n = \frac{n!}{2}$ *for* $n \geq 3$.
Hint 2: *Count of fixpoints (one − cycles) in* $M_n = \frac{n!}{2}$ *for* $n \geq 3$.

For better understanding gravitation we have to investigate the fixpoints and transpositions (quants) on this equation.
We write for $M_n = \{m_1, m_2, ..., m_{n-1}, m_n\}$ and take a look on the squared permutation m_i^2.

Then it is valid if we have fixpoints and or transpositions in m_i that

1) m_i^2 also have the same fixpoints as before and each transposition in M_n generates two new fixpoints.
2) $m_i^2 \in A_n$ $see(18)$

This fixpoints we define as gravitation quants.
In words: every quant generates a gravitation quant by selfinteraction (squared m_i).

Example 4
n=3 with one one-cycle (spin 1 quant) and one two-cycle (quant + antiquant with spin $\frac{1}{2}$)

$$m_i = \begin{pmatrix} 1 & 2 & 3 \\ 1 & 3 & 2 \end{pmatrix} = (1)(2,3) \ then$$

$$m_i^2 = \begin{pmatrix} 1 & 2 & 3 \\ 1 & 2 & 3 \end{pmatrix} = (1)(2)(3) \ = \ id$$

Last but not least we want to show that with our thoughts we can calculate the major mass in the universe which comes from Dark-Matter particles.
With the assumption we made in Hypothesis 1 that the fixpoints of the permutations in M_{48} are the $SU(5)$ bosons with Planckmass we can easily calculate the total mass by this Dark-Matter particles.It is well known that the count of fixpoints in M_{48} is $\frac{48!}{2}$ see (19).
Then the total mass by Dark-Matter particles is

$$\frac{48!}{2}.m_p \approx 0,62 \times 10^{61} \times 2,18 \times 10^{-8} \approx \underline{1,35 \ \times \ 10^{53} \ [kg] \ dark \ matter \ in \ the \ universe} \quad (20)$$

This is in accordance with observations.

2. Conclusion

In mathematic the group theory is a major discipline.One major result of it is that every finite group is a subgroup of the symmetric group.The symmetric group S_n is the set of all permutations with n elements.
So if we understand the symmetric groups and its properties then we understand all finit groups.
Now my thoughts are that quants are discreet objects and schould be describable or explainable by finit group theory.I believe strongly that we have finit particles like electrons,dark matter particles and so on in the universe and then quants should be able to described by basic finit group theory.
The first step we did in 1.4 was to define quants as fixpoints of permutations then we divided the symmetric group S_{48} in two disjoint parts to $S_{48} = M_{48} + A_{48}$ where A_{48} is the alternating group of S_{48} and M_{48} the coset of A_{48}.
We took the latter M for the coset to give a hint that the fixpoints of its permutations are the massparticles.The count of fixpoints (dark matter particles with Planckmass) in M_{48} is $\frac{48!}{2}$.
This is accordance to the all over mass observations in the universe which is a good indication that we are on the right way.
Then we took the coset and showed that $M_{48}^2 := M_{48} \ \times \ M_{48} = A_n$.It is known in other physical units that mass is equal to 1/radius formal $m \hat{=} \frac{1}{r}$ and gravitation is curvature of spacetime formal $gravitation \hat{=} \frac{1}{r^2}$.
With this thoughts we used M_{48}^2 to describe gravitation.
So finally the nature of mass particles and gravity can be described by symmetric groups.
In our case the dark matter particles and gravity by the symmetric group S_{48}.

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