The Physics of Vacuum 3

A Solution of the Second Einstein's Problem

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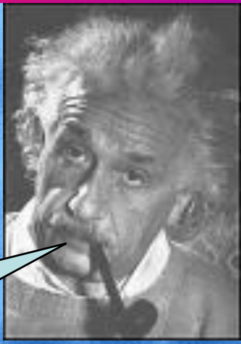
June 16, 2009

Preliminary reflections

$$R_{ij} - \frac{1}{2} R\, g_{ij} = \frac{8\pi G}{c^4} T_{ij}$$



The right hand side includes all those that cannot be described so fare in the unified field theory. Such a formulation is just a temporary answer, undertaken to give general relativity some accomplished expression. That theory of the gravitation field is separated in somewhat artificial manner from the Unified Field of yet unknown nature.

Lovelock's theorem

For Einstein's equations

$$a = \frac{8\pi G}{c^4}, \qquad b = 1$$

David Lovelock

Any non-geometrical energy-momentum tensor in right hand side of the Einstein's equations does not define geometry of the surrounding space-time

$$bG_{ik} = aT_{ik}$$

$$b \neq 0, a \neq 0$$

$$G_{ik} = R_{ik} - \frac{1}{2} g_{ik} R$$

When

$$G_{ik} = 0$$

we always have

$$T_{ik} = 0$$

except in a case

$$G_{ik} = -\Lambda g_{ik}$$

Meetimg Einstein and Cartan

1

Dear Albert!
There is a space of absolute parallelism with zero curvature and nonzero torsion

2

Yes, I used this absolute parallelism geometry (A(4) space) in 13 articles

$$\boxed{e^a{}_i,}$$

Ancholonomic tetrad

Einstein used this

$$\boxed{\Delta^i_{jk} = \Gamma^i_{jk} + T^i_{jk} = e^i{}_a \frac{\partial e^a{}_j}{\partial x^k} = e^i{}_a e^a{}_{j,k}}$$

Connection of A(4) space

$$\boxed{\Delta^i_{[jk]} = -\Omega^{..i}_{jk} = -e^i{}_a e^a{}_{[k,j]} = -\frac{1}{2} e^i{}_a (e^a{}_{k,j} - e^a{}_{j,k})}$$

Torsion of the A(4) space

$$T^i{}_{jk} = -\Omega^{..i}{}_{jk} + g^{im}(g_{js}\Omega^{..s}{}_{mk} + g_{ks}\Omega^{..s}{}_{mj})$$

Torsion field of A(4) space

$$\boxed{S^i{}_{jkm} = 2\Delta^i_{j[m,k]} + 2\Delta^i_{s[k}\Delta^s_{|j|m]} = 0,}$$

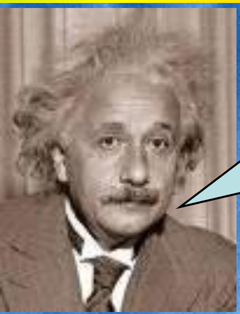
Total curvature of A(4) space

$$\boxed{g_{ik} = \eta_{ab} e^a{}_i e^b_k, \qquad \eta_{ab} = \eta^{ab} = \mathrm{diag}(1 \ -1 \ -1 \ -1)}$$

Metric tensor

$$\boxed{i, j, k... = 0, 1, 2, 3} \qquad \boxed{a, b, c... = 0, 1, 2, 3}$$

Solution of the second Einstein's problem (1976)



If torsion field turns to zero, Riemannian curvature always is equal to zero.

Riemannian curvature

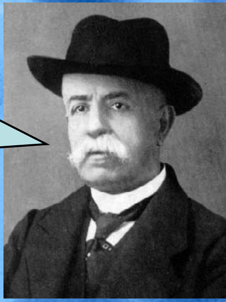
1

Ricci curvature

2

$$S^i{}_{jkm} = R^i{}_{jkm} + \overbrace{2\nabla_{[k}T^i_{|j|m]} + 2T^i_{s[k}T^s_{|j|m]}}^{P^i{}_{jkm}} = 0, \qquad (B)$$

Yes, I introduced this curvature in 1896 and my curvature differs from Riemannian one.



Giorgio Ricci (1853-1925)

3

Forming Einstein's tensor G jm, we have

$$G_{ik} = R_{ik} - \frac{1}{2} g_{ik} R$$

10 equations similar to the Einstein's ones

$$R_{ik} - \frac{1}{2} g_{ik} R = \nu T_{ik} \qquad (B.1)$$

but with geometrized Energy-momentum tensor

$$T_{jm} = -\frac{2}{\nu}\left\{\left(\nabla_{[i}T^i_{|j|m]} + T^i_{s[j}T^s_{|i|m]}\right) - \frac{1}{2} g_{jm} g^{pn}\left(\nabla_{[i}T^i_{|p|n]} + T^i_{s[i}T^s_{|p|n]}\right)\right\}$$

and 10 equations for Wyle tensor

$$C^i{}_{jkm} + 2\nabla_{[k}T^i_{|j|m]} + 2T^i_{s[k}T^s_{|j|m]} = -\nu J^i{}_{jkm}, \qquad (B.2)$$

with geometrized current tensor

$$J_{ijkm} = 2g_{[k(i}T_{j)m]} - \frac{1}{3} T g_{i[m} g_{k]j}.$$

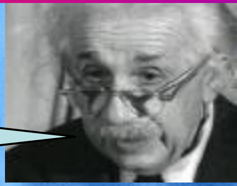
Calculation of the energy-momentum tensor

1

For any solution of the (B) equations we can calculate the energy-momentum tensor in (B.1) equations.

2

It means, that in (B.1) equations a matter tells space how to curve



$$R_{ik} - \frac{1}{2} g_{ik} R = \nu T_{ik} \qquad (B.1)$$

I used such tensor for description of the Universe structure

Willem de Sitter (1872-1934)

Examples:

1. Solution with quark potential

$$T_{ik} = -\frac{\Lambda}{\nu} g_{ik}$$

3

2. Solution with a variable Coulomb-Newton potential

This tensor creates an isotropic radiation of a mass

4

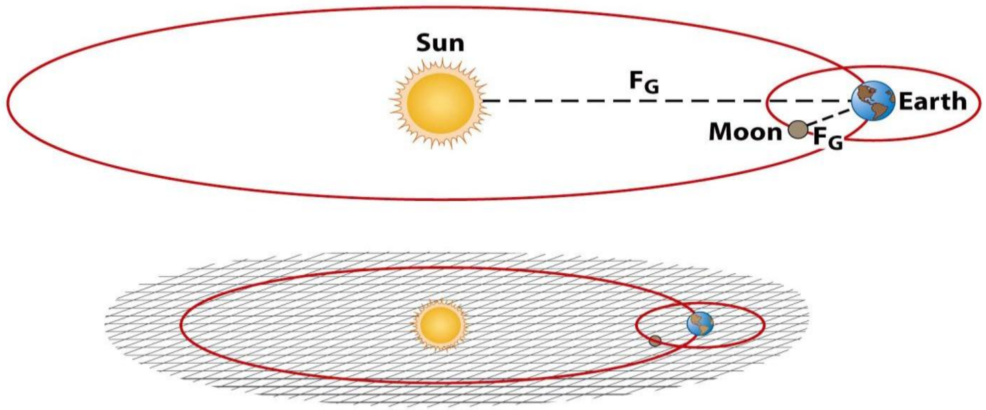
Vaidya P.C.

$$T_{ik} = -\frac{2}{\nu\, r^2} \frac{\partial [r_g(u) + r_e(u)]}{\partial u} l_i l_k, \quad l_k l^k = 0$$

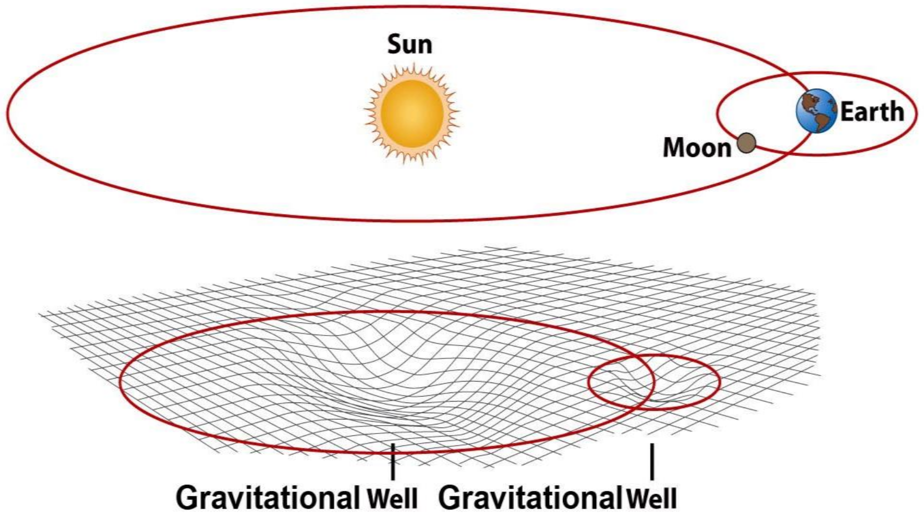
3. And so on...

When Einstein's tensor G ik is equal to zero energy-momentum tensor in (B.1) always equals to zero

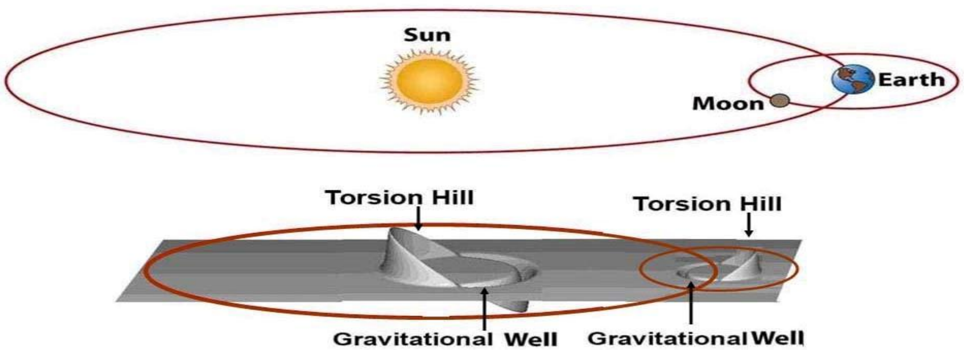
Comparison with Newton and Einstein



Newton: objects move in the 3D flat space under action of forces



Einstein: objects move in 4D space-time curved by a matter



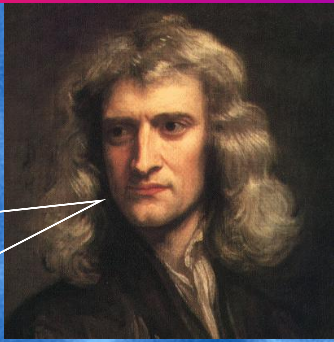
Shipov: curved and twisted vacuum space is perceived by us as objects' motion.

Torsion nature of mass

• Mass is the measure of the amount of matter

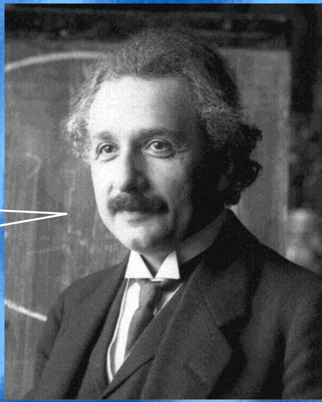
• However, one could also state:

– Mass is a measure of a body’s resistance to motion or a change of motion



Mass is an energy

$$E=mc^2$$

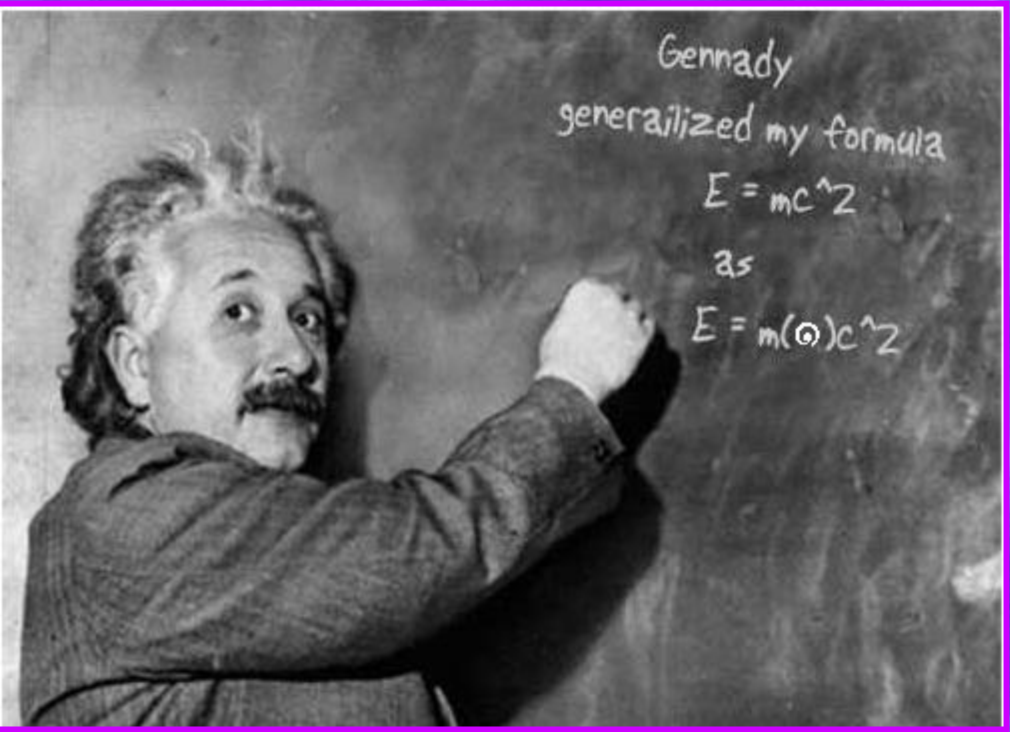


Mass is the torsion of the space

$$E=m(\circlearrowleft)c^2$$

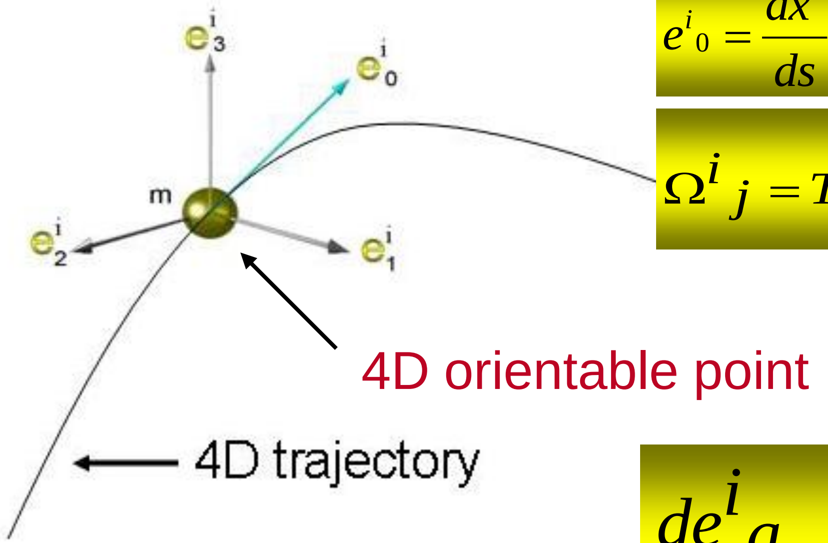
$$m=\frac{2}{\nu c^2}\int(-g)^{1/2}\left\{g^{jm}\left(\nabla_{[i}T^{i}_{|j|m]}+T^{i}_{s[i}T^{s}_{|j|m]}\right)\right\}\mathrm{d}V$$

Time for relaxing



Yes Master,
I simply
followed
your ideas.

Physical interpretation of the torsion field



$$e^i{}_0 = \frac{dx^i}{ds} = u^i \leftarrow \textit{timelike 4D velocity vector}$$

$$\Omega^i{}_j = T^i{}_{jk}\frac{dx^k}{ds} \leftarrow \textit{4D angular velocity}$$

Parallel displacement of the tetrad vectors in absolute sense

$$\frac{de^i{}_a}{ds} + \Gamma^i{}_{jk} e^j{}_a \frac{dx^k}{ds} + T^i{}_{jk} e^j{}_a \frac{dx^k}{ds} = 0$$

For 4D velocity we have

$$\frac{d^2x^i}{ds^2} + \Gamma^i{}_{jk}\frac{dx^j}{ds}\frac{dx^k}{ds} + T^i{}_{jk}\frac{dx^j}{ds}\frac{dx^k}{ds} = 0$$

Torsion Field is Field of Inertia

For Schwarzschild-like solution in non-relativistic limit we have

$$m\frac{d^2x^\alpha}{dt^2} = -m\Gamma^\alpha{}_{00} - mT^\alpha{}_{00} = \underbrace{m\frac{MG}{r^3}x^\alpha}_{\text{Gravitation force}} - \overbrace{m\frac{MG}{r^3}x^\alpha}^{\text{Force of inertia}}$$

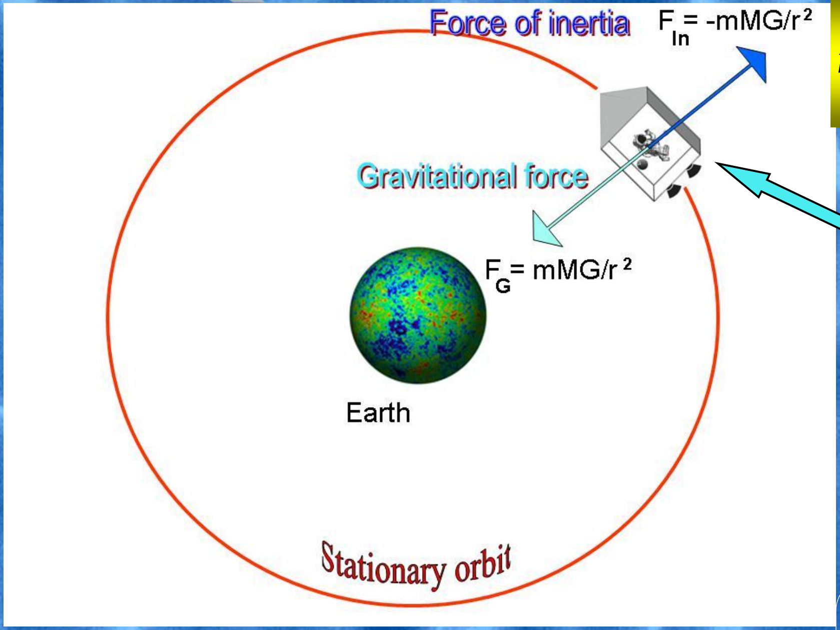
Discussion

2

Yes Master, torsion field is the field of inertia and inertia is the most general phenomena in physics!

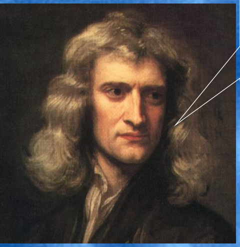
Gennady, maybe torsion field is the unified field which unites all other physical fields?

1



$$m\frac{d^2x^\alpha}{dt^2} = -m\Gamma^\alpha{}_{00} - mT^\alpha{}_{00} = 0$$

3

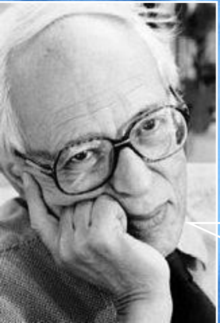


Agree with Gennady.

4

Weightlessness occurs when field of inertia compensates local gravitation field.

Abraham Pais (1918-2000)



6

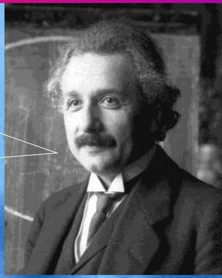
In my opinion the problem of origins of inertia has been and remains the most obscure issue in the theory of particles and fields.

5

It seemed to me that forces of inertia are fictitious .

Jean d'Alembert (1717-1783)

Continuation of the disusion



Gennady, how about my equations of motion?

$$\frac{d^2x^i}{ds^2}+\Gamma^i{}_{jk}\frac{dx^j}{ds}\frac{dx^k}{ds}=0$$

1

2

Master, they follow from the straightness of A(4) geometry

$$\frac{d^2x^i}{ds^2}+\Gamma^i{}_{jk}\frac{dx^j}{ds}\frac{dx^k}{ds}+T^i{}_{jk}\frac{dx^j}{ds}\frac{dx^k}{ds}=0,$$

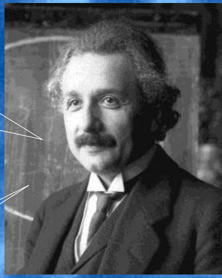
when

$$T^i{}_{jk}\frac{dx^j}{ds}\frac{dx^k}{ds}=0.$$

These equations define quasi-inertial reference frame, where forces of inertia are equal to zero but field of inertia is not equal to zero and defined as

$$T_{ijk}=-T_{jik}=-T_{ikj}=-\Omega_{ijk}$$

3



You prove, that the field of inertia exists even in inertial reference frame?

4

Yes Master, for a long time we studied the dynamic fields of inertia in the inertial frames and we called it - **Quantum Mechanics.**

5

Unbelievable!

Matter density and mass in the quasi-inertial frame

1

In quasi-inertial reference frames matter density looks like

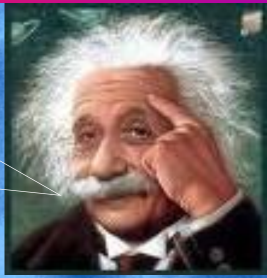
$$\rho = -\frac{1}{\nu c^2}\varphi^2(x^i) = -\frac{1}{\nu c^2} T_s^{\ ji} T_{ji}^{\ \ s}$$

Field of inertia

For Vaidya-like solution in limit $m(t) \longrightarrow m = const$, we have

$$\rho = m\delta(\vec{r})$$

2



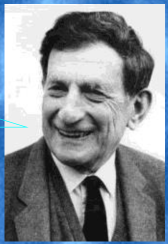
I.e. the point particle (so unloved by me) appears in the field theory in the limit case stationary field formation!

3

I always suspected, that there is a field of a matter, but did not imagine that It Is a field of inertia

Erwin Schrödinger (1887-1961)

4

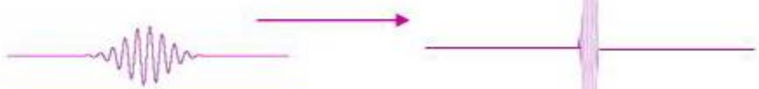


Thus you have got wave-particle duality in the limit m(t) --→ m=const

David Bohm (1917-1992)

Extended particle | **Point particle**

Limit m (t) ⟶ m=const



$$\rho = -\frac{1}{\nu c^2}\varphi^2(x^i) \longrightarrow \rho = m\delta(\vec{r})$$

$$m(t) = -\frac{1}{\nu c^2}\int(-g)^{1/2}\varphi^2(x^i)\,dV \longrightarrow m = const$$

The problem of motion the matter density

In quasi-inertial reference frames energy-momentum tensor looks like

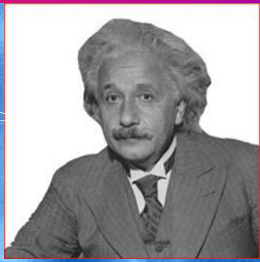
$$T_{jm} = -\rho c^2 \left(u_j u_m - \frac{1}{2} g_{jm}\right),$$

$$u^m u_m = 1, \; \rho = -\frac{1}{\nu c^2}\varphi^2(x^i).$$

1

2

And where is the quantum mechanics hidden here?



From conservation law

$$\nabla^j T_{jm} = 0$$

$$\rho u^j \nabla_j u^m = 0$$

Geodesic motion of a point particle

$$\frac{du^i}{ds} + \Gamma^i{}_{jk} u^j u^k = 0$$

$$\nabla_j (\rho u^j) = 0$$

The equation of continuity

$$\partial_j (\rho u^j) + \rho u^k \Gamma^m{}_{km} = 0$$

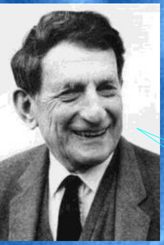
$$\nabla_j \rho = 0$$

Uncompressible “torsion liquid”

$$\partial_j \rho = 0$$

3

4



I think, that the QM is hidden in the equation of continuity.

You are right David, but not quite, QM includes the geodesic equations as well.

Schrödinger-Madelung-Bohm equations for torsion field

Continuity equation.

$$\frac{\partial\rho}{\partial t} + div\rho\vec{v} = 0$$

Geodesic equations in the Hamilton-Jacobi form.

$$g^{ik}\frac{\partial S}{\partial x^i}\frac{\partial S}{\partial x^k} - m^2c^2 = 0$$

Really, God does not play dice!

Torsion field as the Bohm function

$$\psi(\vec{x},t) = \sqrt{\rho(\vec{x},t)}\cdot e^{iS(\vec{x},t)/\hbar}$$

Torsion density

$$\rho = m\psi^*\psi$$

Normalized torsion field

Normalize condition

$$\int\psi^*\psi dV = \frac{1}{m}\int\rho dV = 1$$

3D velocity

$$\vec{v} = \nabla S/m = \frac{\hbar}{i}\nabla\ln\frac{\psi}{\psi^*}$$

Nonlinear Madelung equation

$$\frac{\partial(\psi^*\psi)}{\partial t} + div\ (\psi^*\psi)\vec{v} = 0$$

Linear Schrödinger equation + linear equation for ψ^*.

$$i\hbar\frac{\partial\psi}{\partial t} + \frac{\hbar^2}{2m}\Delta\psi + V(\vec{x},t)\psi = 0$$

Schrödinger equation for torsion field unifies continuity and geodesic equations

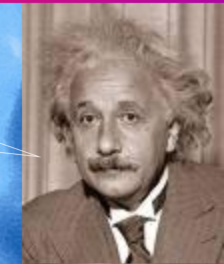
Quantization as a classical gyroscopic effect

1

We should not divide physics into quantum and classical.

2

I always approved it !



3

Similar to me, Gennady wants to introduce the figurative thinking in the quantum physics.

4

Yes, Master de Broglie, old quantum mechanics used to describe the torsion field dynamics in the language known to physicists.

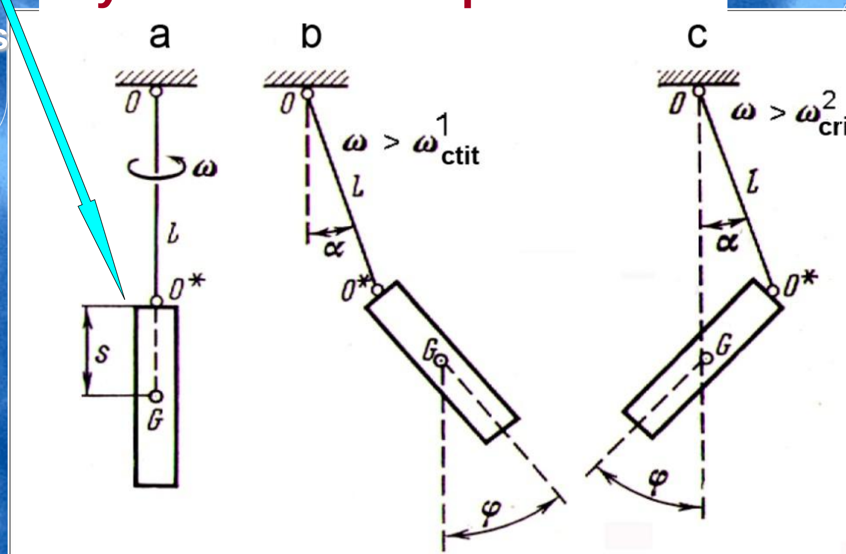
5

Gennady, and what classical image explains quantum step-type behavior?

6

In the classical mechanics a gyro filled with liquid inside it and suspended in gravitational field jumps to step-type direction of an axes of rotation, when it changes its frequency of rotation.

Gyro filled with liquid inside



7

It means, that an electron in atom is torsion liquid gyro with spin s=ħ/2? The reason of quantization is own rotation of an electron!
I like it!

8

At last the figurative thinking comes back in physics and “ intellectual perversion” will now end.

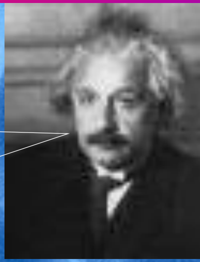
Paul Langevin (1872-1946)

Macroquantum effects in Solar System

Yes, Master, however, the parameters of planets are not identical like masses and charges of electrons in atom. Therefore quantization in the Solar system is more complex than in atomic systems and requires an additional research.

2 1

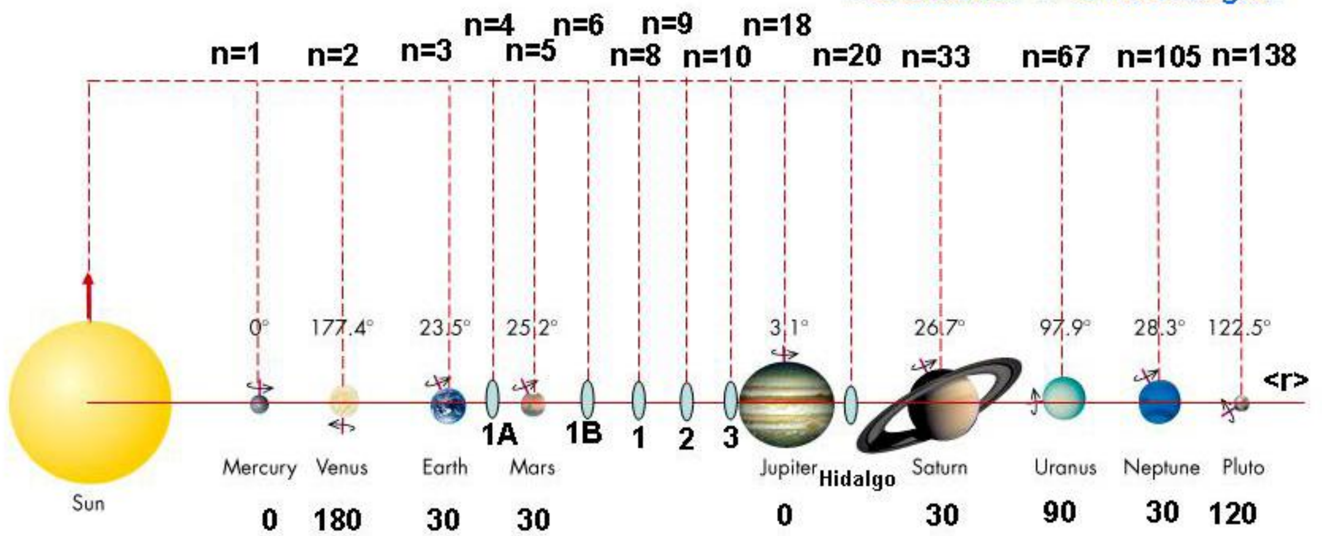
Gennady, planets are too the gyroscopes, “suspended” in a gravitational field of the Sun. Is there a quantization in Solar system?



Quantization of average distances <r> in Solar System

$$<r> = r_0 \left(n + \frac{1}{2}\right), \quad n = 1,2,3..., \quad r_0 = 0.2851 \ AU$$

The scale for <r> is not arranged.



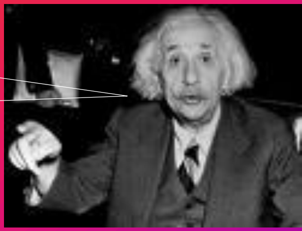
Quantization of orientation of the planets’ axes rotation

Solution of the Second Einstein's Problem and Field of Inertia.

Summary:

- The Torsion field of A(4) space manifests itself as Field of Inertia.
- Field of Inertia defines the energy-momentum tensor in right hand side of Einstein's-like equations.
- In quasi-inertial reference frame Field of Inertia satisfies to the Schrödinger equation.
- A quantization of atomic and gravitational systems occurs due to resonant gyroscopic effects.

It is a key to a more advanced Quantum Theory.



To be continued by
Vacuum 4

Kob Khun Krab!

Thank You for Your Attention !