CERN LHC WG on Forward Physics and Diffraction

16-17 December 2019

HIGH-ORDER DERIVATIVES IN POST-LAGRANGE DYNAMICS OF ADAPTIVE ENERGY FLOWS

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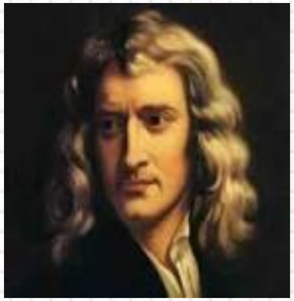
Critical point of the modern particle physics is the millennium problem of the Ancient Greeks

Is space empty in physical reality?

$$\vec{F} = q\frac{Q\hat{r}}{r^2} \equiv qE(r)\hat{r}$$

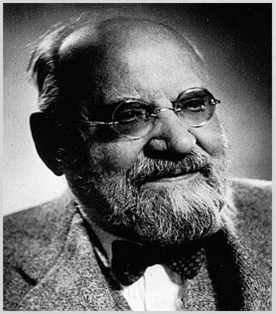
$$div[E(r)\hat{r}] = \frac{1}{r^2}\partial_r[r^2E(r)] \equiv \frac{1}{r^2}\partial_r Q \equiv 0$$



Now all textbooks say Yes, space is empty due to the laws of Newton and Coulomb, where div E = 0 for dual physics of fields and charges

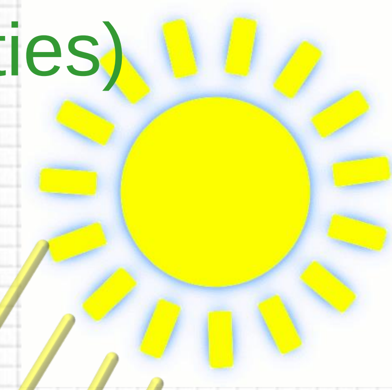
But:

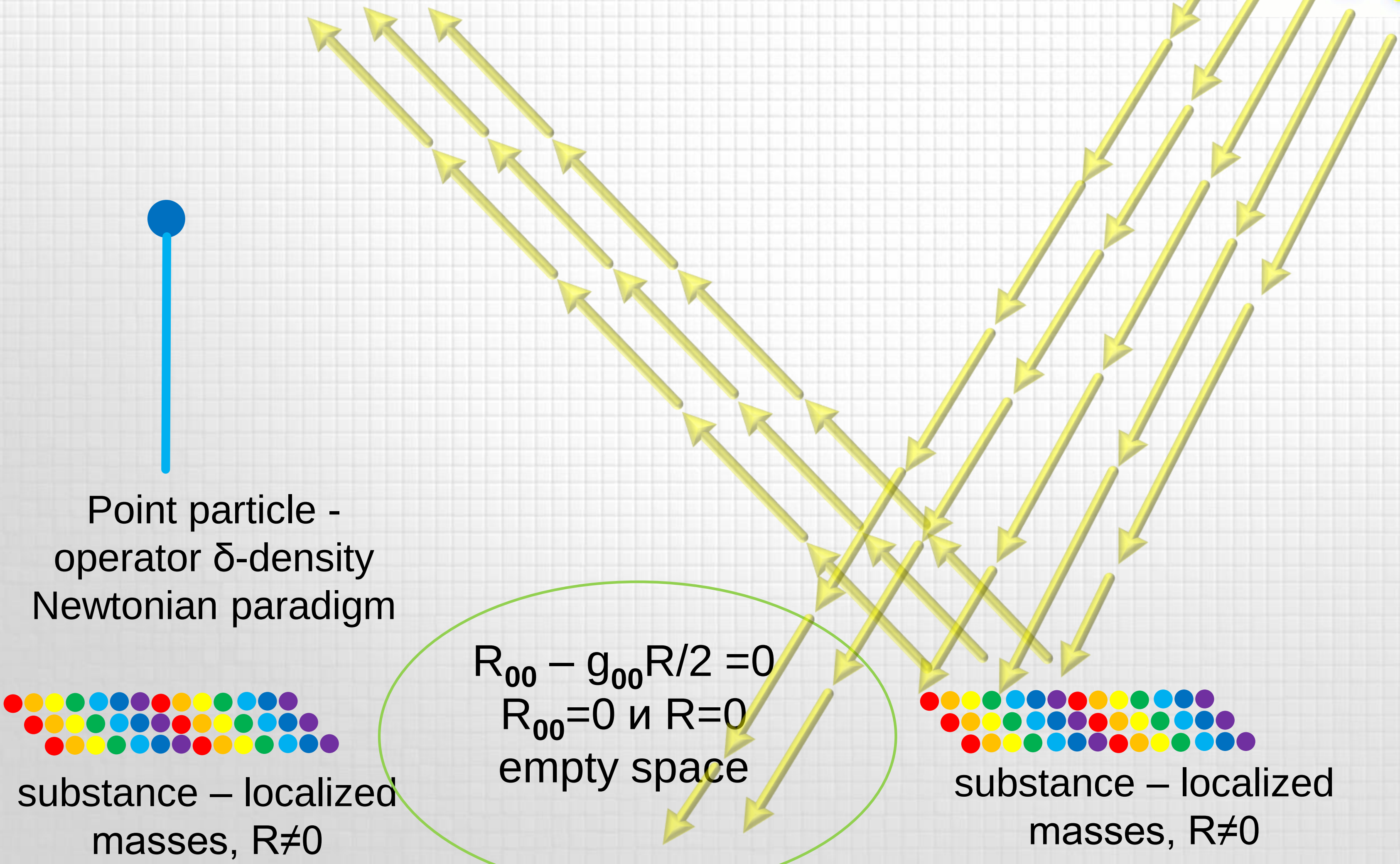
René Descartes *(1596—1650) empty space is impossible - the primary characteristic of matter is extension (res extensa)*



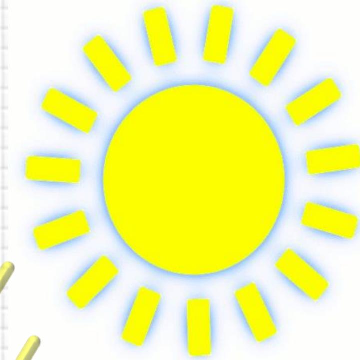
Gustav Mie *(1868-1957) space is not empty and div E = f (|E|) ≠ 0 for continuous sources in nondual physics of charged material fields*

Point matter (leading to singularities) has been postulated from practice rather than from logic or analytical math

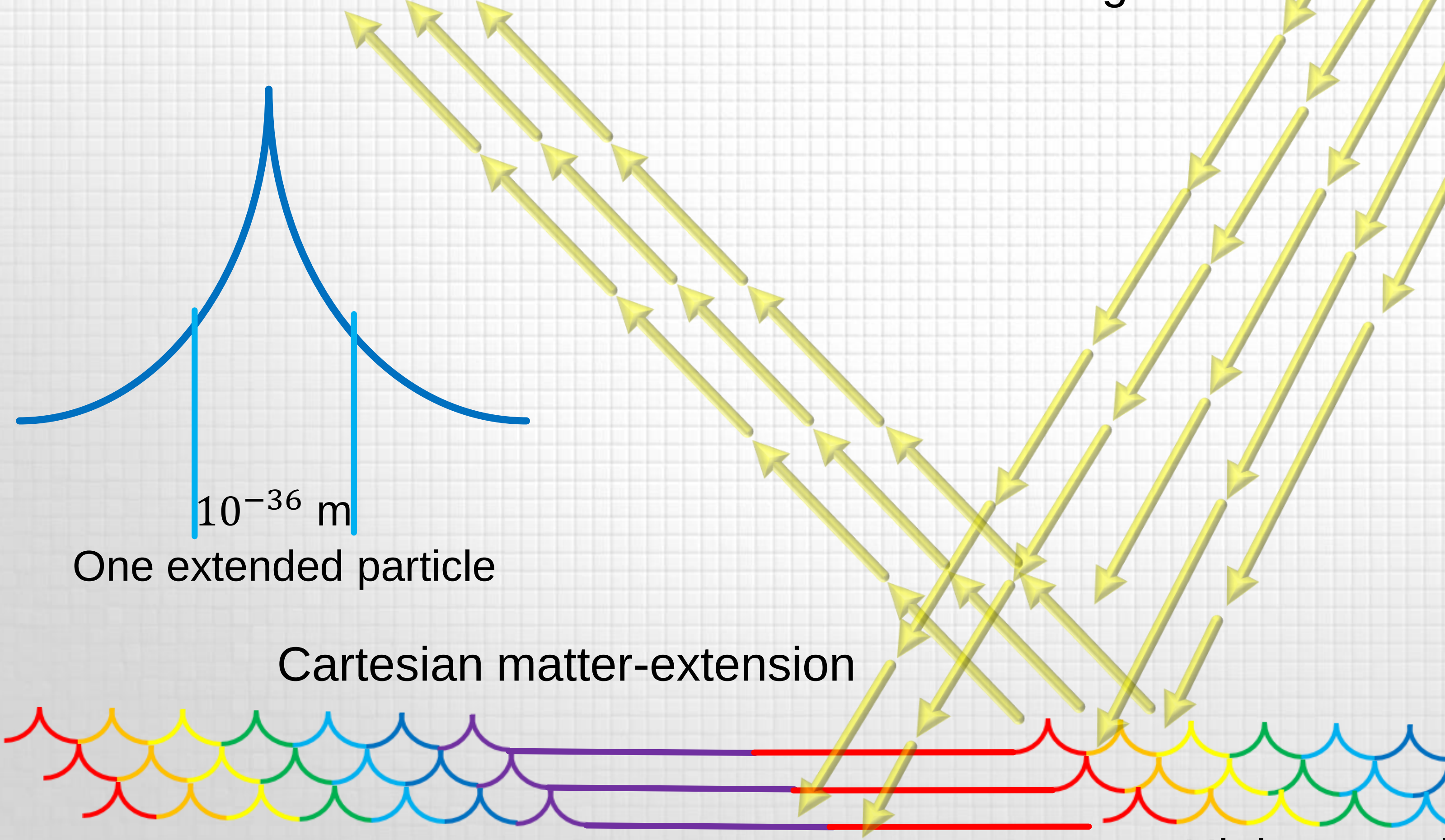


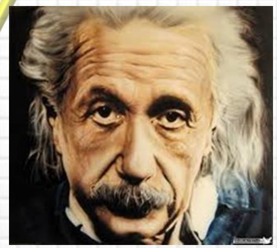


Material space plenum has no metric singularities and complies with the same observations



Einstein’s curvature $R_{00} - g_{00}R/2 = 0$ at $R \neq 0$ leads to static metrics without singularities !





Aristotle
Descartes
Mie
Einstein
Infeld
Schwinger

High mass density: R≠0

Very low mass density: R≠0

High mass density: R≠0

Physics Letters A 383 (2019) 2367–2369

Contents lists available at ScienceDirect

Physics Letters A

www.elsevier.com/locate/pla

Exact solutions for the extended electron

$$div\mathbf{E}' = 4\pi\rho'$$

Thomson 4/3 problem leads to nonlocal continuous charges with Poincaré radial stresses and zero electromagnetic inertia

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$$\rho'(\mathbf{x}', t', q) = \frac{div\mathbf{E}'(\mathbf{x}', q)}{4\pi} = \frac{\mathbf{E}'^2(r', q)}{4\pi\varphi_o} = \frac{q^2\varphi_o}{4\pi r'^2(\varphi_o r' + q)^2}$$

$\varphi_o \equiv c^2/\sqrt{G} = 1.04\times 10^{27} V,\ q/\varphi_o \equiv r_q = const$, and $\mathbf{x} = \mathbf{r}$

- Static equilibrium densities of the radial electron $r_e = |e|\sqrt{G}/c^2 = 1.38\times 10^{-36} m$

Fields in the laboratory system $x^\mu = \{\mathbf{x}, t\}$:

$$\begin{cases} \mathbf{E}(\mathbf{x}, t) = q\gamma(\mathbf{x} - \mathbf{v}t)/r'^2(r' + r_q) \\ \mathbf{H}(\mathbf{x}, t) = [\mathbf{v}\times\mathbf{E}(\mathbf{x}, t)]/c \end{cases}$$

$$\gamma = 1/\sqrt{1-\beta^2}$$

Lorentz relations of co-moving and laboratory coordinates:

$$r'^2 \equiv x'^2 + y'^2 + z'^2 = \gamma^2\left[(\mathbf{r}\cdot\hat{\mathbf{v}}) - vt\right]^2 + r^2 - (\mathbf{r}\cdot\hat{\mathbf{v}})^2 = \gamma^2(x - vt)^2 + y^2 + z^2.$$

Cartesian analog of the Dirac delta-function

$\int qn(\mathbf{x},t,q)d^3x = q$,

$$\rho(\mathbf{x},t,q) \equiv qn(\mathbf{x},t,q) = q\gamma n'(r',q) = \frac{\left[E^2(\mathbf{x},t) - H^2(\mathbf{x},t)\right]}{4\pi\varphi_o\sqrt{1-\beta^2}}$$

- Volume integrals of the moving elementary charge

$$\int \rho(\mathbf{x},t,q)d^3x \; = \; \int \rho'(r',q)d^3x' = q = const$$

$$\int n(\mathbf{x},t,q)d^3x = \int \frac{[E^2(\mathbf{x},t) - H^2(\mathbf{x},t)]}{4\pi q\varphi_o}\gamma d^3x$$

$$= \int \frac{r_q\gamma dxdydz}{4\pi[\gamma^2(x-vt)^2+y^2+z^2](\sqrt{\gamma^2(x-vt)^2+y^2+z^2}+r_q)^2} \equiv 1,$$

This Cartesian equality follows directly from the exact solutions for strong charged fields

Compensated action for Cartesian electrodynamics of charged (material) fields

$$S_q \equiv \int \Lambda dt = -\int \left(\frac{f_{\mu\nu} f^{\mu\nu}}{16\pi} + \frac{A_\mu j^\mu}{2c} \right) d^3x dt,$$

Lagrange function of matter-extension nullifies the real path action

$$\Lambda \equiv -\int \frac{(H^2 - E^2 + 4\pi\varphi'\rho' u_\mu u^\mu)}{8\pi} d^3x$$

$$= \int \frac{q^2\varphi_o^2}{8\pi r'^2(\varphi_o r' + q)^2} \left[1 - ln\left(1 + \frac{q}{\varphi_o r'}\right)\right] \frac{4\pi r'^2 dr'}{\gamma} \equiv 0,$$

$$T_\mu^\nu = \frac{\delta_\mu^\nu f_{\lambda\rho} f^{\lambda\rho} - 4 f^{\nu\lambda} f_{\mu\lambda}}{16\pi} + \frac{\delta_\mu^\nu A_\lambda j^\lambda - 2A_\mu j^\nu}{2c} + P_\mu^\nu$$

$$P_\mu^\nu \equiv p_q(u_\mu u^\nu - \delta_\mu^\nu)$$

$$\begin{cases} T_0^0 = \frac{E^2 + H^2}{8\pi} - \gamma^2 \left[\frac{\rho'\varphi'}{2} + \beta^2 \left(\frac{\rho'\varphi'}{2} - p_q \right) \right] \\ T_0^i = \frac{[\mathbf{E}\times\mathbf{H}]^i}{4\pi} - \gamma(\rho'\varphi' - p_q) u^i \end{cases}$$

Poincare's internal pressure

$$p_q = \frac{\rho'(r')\varphi'(r')}{3} = \frac{q^2\varphi_o^2}{12\pi r'^2(\varphi_o r' + q)^2} ln\left(1 + \frac{q}{\varphi_o r'}\right)$$

$$T_\mu^\mu = (A_\mu j^\mu / c) - 3p_q = 0$$

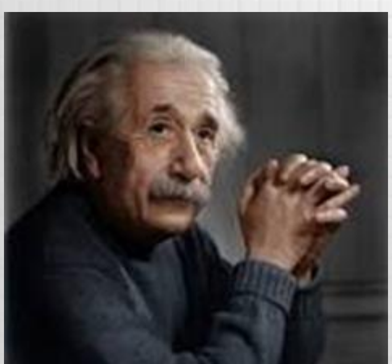
Drawing by Rea Irvin; 1929 The New Yorker Magazine, Inc.

A 1929 cartoon:

"People slowly accustomed themselves to the idea that the physical states of space itself were the final physical reality."

Professor

Albert Einstein



- “A coherent field theory requires that all elements be continuous… And from this requirement arises the fact that the material particle has no place as a basic concept in a field theory. Thus, even apart from the fact that it does not include gravitation, Maxwell’s theory cannot be considered as a complete theory.”

A.Einstein and L.Infeld. Evolution of Physics. 1938.

Int J Theor Phys (2008) 47: 1261–1269
DOI 10.1007/s10773-007-9559-z

Full similarity of extended energy-charges in the Cartesian reading of GR and EM theories with nonempty space

Einstein's Gravitation for Machian Relativism of Nonlocal Energy-Charges

$$\mu_p(r) \equiv \mu_a(r) = m\frac{r_o}{4\pi r^2(r_o+r)^2} = \frac{c^2}{4\pi G r^2}\frac{1}{[1+(rc^2/Gm)]^2},$$

$$Gm_o/c^2 = 7\times 10^{-58} m$$

$$e \equiv \int_o^\infty 4\pi r^2 \rho(r) dr = -e_o$$

$$\mathrm{E}^2/4\pi = (e/r_e)\nabla\mathrm{E} = (e/r_e)\rho(r)$$

$$\begin{cases} \mu(r) = Mr_o/4\pi r^2(r+r_o)^2 = \mathbf{w}^2/4\pi G c^2 \\ \mathbf{w}(r) = -\nabla W(r) = -GM\hat{\mathbf{r}}/r(r+r_o) \\ W(r) = -c^2 ln[(r+r_o)/r] \\ E_M = \int \mu c^2 d^3x \equiv r_o c^2/G = Mc^2. \end{cases}$$

$$\begin{cases} 4\pi\rho(r) = er_e/r^2(r+r_e)^2 = \nabla\mathrm{E}(r) = \mathrm{E}^2/(e/r_e) \\ \mathrm{E}(r) \equiv -\nabla W_e(r) = e\hat{\mathrm{r}}/r(r+r_e) \\ W_e(r) = (e/r_e) ln[(r+r_e)/r] \\ E_e = \int d^3x \rho W_e = \int d^3x \rho e/r_e = \int d^3x \mathrm{E}^2/4\pi = e^2/r_e \end{cases}$$

Mass-energy unification with electric charge-energy

$$E = (\sqrt{G}m + q)\varphi_o = mc^2 + ieG^{-1/2}c^2$$

50th Rencontres de Moriond | March 21–28

GRAVITATION | GRAM 2015

I. Bulyzhenkov, *Pure field physics of continuous charges without singularities*, Proceedings of “Gravitation: 100 years after GR”, p.317, Recontres de Moriond 2015, La Thuile, Italy http://moriond.in2p3.fr/Proceedings/2015/Moriond_Grav_2015.pdf

Complex Charge Densities Unify Particles with Fields and Gravitation with Electricity,
Bulletin of Lebedev Physics Inst, v4, N4 (2016) p.140;

Pure field electrodynamics of continuous complex charges,
Tutorial of the 4th year course, MIPT, Moscow 2015
ISBN 978-5-7417-0554-4. Physics in Higher Education (in Russian) v22 (2016) p.59, http://pinhe.lebedev.ru/;

MINISTRY OF EDUCATION AND SCIENCE OF THE RUSSIAN FEDERATION
MOSCOW INSTITUTE OF PHYSICS AND TECHNOLOGY
(STATE UNIVERSITY)

Faculty of General and Applied Physics
Department of Quantum Physics Problems

Igor E. Bulyzhenkov

PURE FIELD ELECTRODYNAMICS OF CONTINUOUS COMPLEX CHARGES

MOSCOW
MIPT
2015

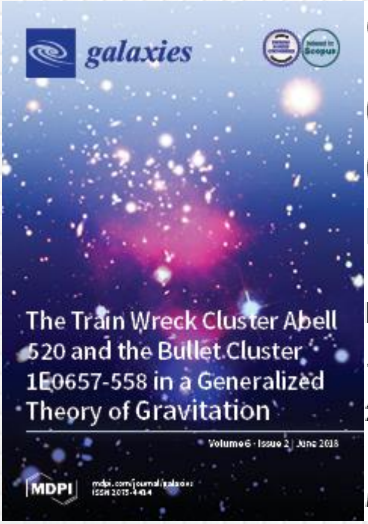
Tutorial for the 4th year course
"Nonlinear Electrodynamics"

MIPT and many other top universities enroll graduate students in courses taught at the leading laboratories where the cutting edge science of currently unresolved problems is explored. Suggested learning through brainstorming of continuous charges instead of customary localized carriers of mass and electricity can open a new vision of the nonlocal material world, which is invisible to superficial human perception. Well-established Euclidean electrodynamics and Sommerfeld relativistic quantization together require us to turn our attention back to the nonempty space plenum of the Ancient Greeks. Modern researchers should reject the conventional paradigm of curved empty space, which does not exist in physical reality. Contemporary empty space physics is overloaded with controversial energy problems, sophisticated metric constructions and unphysical singularities. By accustoming nonempty space and continuous charges under this tutorial (which tends to resolve radiation self-acceleration, Coulomb energy divergence and many other failures of Classical Electrodynamics), a reader on his own may renew the Einstein mass-energy formula by electric terms, may relate the physical meaning of the Ricci scalar of material metric space to its scalar mass density, etc. Nonempty space Euclidean electrodynamics is a prerequisite to new interpretations in General Relativity and to a better reading of the Einstein Equation, where conventional point masses at the Equation right-hand side should be moved to the pure field (left-hand) side as continuous Ricci curvatures.

ISBN 978-5-7417-0554-4

My semester courses:

1. *1st year - "Introductory Electromagnetism and Wave Motion" PHYS 1004, Carleton University, Ottawa*
2. *1st year - "Kinematics and Mechanics" PHY2210, Algonquin College, Ottawa*
3. *2d year - "Electricity and Magnetism" PHY 2307, U of Ottawa*
4. *3d year – "Elements of Quantum Mechanics" PHYS 3701, Carleton University, Ottawa*
5. *4th year – "General Relativity" PHY 4346, U of Ottawa*
6. *4th year – "Nonlinear Electrodynamics", MIPT*
7. *5th year – "Microwave plasma", MIPT*
8. *5th year – "Electromagnetic waves in the Ionosphere", MIPT*
9. *5th year – "Fundamental interactions and principle experiments", MIPT*
10. *PhD – "Fundamentals of Nanoengineering" CHG8145, U of Ottawa*
11. *PhD – "Advanced Magnetism", PHY 5922, U of Ottawa*



Galaxies **2018**, *6*(2), 60; https://doi.org/10.3390/galaxies6020060

Open Access Article

Cartesian Material Space with Active-Passive Densities of Complex Charges and Yin-Yang Compensation of Energy Integrals

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Received: 9 April 2018 / Revised: 21 May 2018 / Accepted: 29 May 2018 / Published: 5 June 2018

$$\nabla^2 W = 4\pi\rho \Rightarrow \varphi_0^{-1}(\nabla W)^2$$

$$\frac{\partial_r[r^2\partial_r W(r)]}{4\pi r^2} \equiv \frac{[\partial_r W(r)]^2}{4\pi\varphi_o} = \frac{q r_q}{4\pi r^2(r+r_q)^2}$$

$$W(r) = -\frac{q}{r_q} ln\left(1+\frac{r_q}{r}\right) \equiv -\varphi_0 ln\left(1+\frac{q}{\varphi_0 r}\right)$$

Cartesian charge potential W corresponds to the Shannon information rate

$$W_{sys}(\mathbf{x}) = -\frac{c^2}{\sqrt{G}} ln\left(1+\frac{z_1}{|\mathbf{x}-\mathbf{a}_1|}+\frac{z_2}{|\mathbf{x}-\mathbf{a}_2|}+...+\frac{z_n}{|\mathbf{x}-\mathbf{a}_n|}\right)$$

Multi-pole potential of material space

$$Q_k = \sqrt{G}m_k + ie_k \equiv \varphi_0 z_k \equiv \mathcal{E}_k/\varphi_0$$

Metric densities of multi-pole inertial systems

$$W(\mathbf{x}) \equiv -c^2 ln \frac{1}{\sqrt{g_{oo}(\mathbf{x})}} = -c^2 ln \left(1 + \frac{r_1}{|\mathbf{x}-\mathbf{a}_1|} + \frac{r_2}{|\mathbf{x}-\mathbf{a}_2|} + ... + \frac{r_n}{|\mathbf{x}-\mathbf{a}_n|}\right)$$

$$r_i \equiv GE_i/c^4 = Gm_i/c^2$$

$$\mu_p(\mathbf{x}) \equiv \frac{[\nabla W(\mathbf{x})]^2}{4\pi G c^2} = \frac{\nabla^2 W(\mathbf{x})}{4\pi G} \equiv \mu_a(\mathbf{x})$$

This is the GR Principle of Equivalence for equilibrium (static) densities of active and passive masses

$$\int d^3x \mu_p c^2 = \int d^3x \mu_a c^2 = E_{metric}$$

$$E_{metric} \equiv \frac{c^4}{4\pi G} \int d^3x \left(\frac{\frac{(\mathbf{x}-\mathbf{a}_1)r_1}{|\mathbf{x}-\mathbf{a}_1|^3} + \frac{(\mathbf{x}-\mathbf{a}_2)r_2}{|\mathbf{x}-\mathbf{a}_2|^3} + ... + \frac{(\mathbf{x}-\mathbf{a}_n)r_n}{|\mathbf{x}-\mathbf{a}_n|^3}}{1 + \frac{r_1}{|\mathbf{x}-\mathbf{a}_1|} + \frac{r_2}{|\mathbf{x}-\mathbf{a}_2|} + ... + \frac{r_n}{|\mathbf{x}-\mathbf{a}_n|}} \right)^2$$

$$= (m_1 + m_2 + ... + m_n)c^2 = const$$

Inertial energy conservation for the global overlap of elementary matter

Multi-pole mechanical system of inertial fields

$$\rho_a(\mathbf{x}) \equiv \frac{[-\nabla W_{sys}(\mathbf{x})]^2}{4\pi\varphi_o} = \frac{\nabla^2 W_{sys}(\mathbf{x})}{4\pi} \equiv \rho_p(\mathbf{x})$$

Local equivalence of active and passive charges in equilibrium systems

Active energy conservation

$$\mathcal{E}_{sys} \equiv \int \rho_a(\mathbf{x})\varphi_o d^3x = \frac{\varphi_0^2}{4\pi}\int\left(\frac{\frac{(\mathbf{x}-\mathbf{a}_1)z_1}{|\mathbf{x}-\mathbf{a}_1|^3}+\frac{(\mathbf{x}-\mathbf{a}_2)z_2}{|\mathbf{x}-\mathbf{a}_2|^3}+\dots+\frac{(\mathbf{x}-\mathbf{a}_n)z_n}{|\mathbf{x}-\mathbf{a}_n|^3}}{1+\frac{z_1}{|\mathbf{x}-\mathbf{a}_1|}+\frac{z_2}{|\mathbf{x}-\mathbf{a}_2|}+\dots+\frac{z_n}{|\mathbf{x}-\mathbf{a}_n|}}\right)^2 d^3x \equiv \varphi_0^2\sum_{k=1}^{n} z_k \equiv \sum_{k=1}^{n}\mathcal{E}_k$$

Yin-Yang compensation of active (kinetic) and passive (potential) energies

$$\int\left(\frac{\frac{(\mathbf{x}-\mathbf{a}_1)z_1}{|\mathbf{x}-\mathbf{a}_1|^3}+\frac{(\mathbf{x}-\mathbf{a}_2)z_2}{|\mathbf{x}-\mathbf{a}_2|^3}+\dots+\frac{(\mathbf{x}-\mathbf{a}_n)z_n}{|\mathbf{x}-\mathbf{a}_n|^3}}{1+\frac{z_1}{|\mathbf{x}-\mathbf{a}_1|}+\frac{z_2}{|\mathbf{x}-\mathbf{a}_2|}+\dots+\frac{z_n}{|\mathbf{x}-\mathbf{a}_n|}}\right)^2 \frac{\varphi_o^2 d^3x}{4\pi}$$

$$-\int\left(\frac{\frac{(\mathbf{x}-\mathbf{a}_1)z_1}{|\mathbf{x}-\mathbf{a}_1|^3}+\frac{(\mathbf{x}-\mathbf{a}_2)z_2}{|\mathbf{x}-\mathbf{a}_2|^3}+\dots+\frac{(\mathbf{x}-\mathbf{a}_n)z_n}{|\mathbf{x}-\mathbf{a}_n|^3}}{1+\frac{z_1}{|\mathbf{x}-\mathbf{a}_1|}+\frac{z_2}{|\mathbf{x}-\mathbf{a}_2|}+\dots+\frac{z_n}{|\mathbf{x}-\mathbf{a}_n|}}\right)^2 ln\left(1+\sum_{k=1}^{n}\frac{z_k}{|\mathbf{x}-\mathbf{a}_k|}\right)\frac{\varphi_o^2 d^3x}{4\pi} \equiv 0$$

The 100 meters long Matter-wave Atomic Gradiometer Interferometric Sensor (MAGIS-100, arxiv.org/pdf/1812.00482.pdf) – “will be the world’s largest atom interferometer and push the boundaries of how far an atom can be driven apart from itself”.

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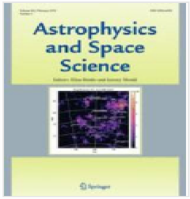

Astrophysics and Space Science
February 2018, 363:39 | Cite as

Gravitational attraction until relativistic equipartition of internal and translational kinetic energies

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A closed relativistic system tends to the equipartition of relativistic kinetic energies on available degrees of freedom, including the inside mass-energy variable. This tendency leads to mutual oscillations between the translational order and internal chaos for multi-polar self-aggregations.

Dynamical deceleration by strong fields in General Relativity

$$E(r,t) \equiv \frac{Q_o\sqrt{g_{oo}(r,t)}}{\sqrt{1-\beta^2(r,t)}} \equiv Q_o\sqrt{1-\beta^2(r,t)} + \left[\frac{Q_o\beta^2(r,t)}{\sqrt{1-\beta^2(r,t)}} - \frac{Q_o(1-\sqrt{g_{oo}(r,t)})}{\sqrt{1-\beta^2(r,t)}}\right]$$

Einstein's kinetic energy is balanced by the negative external potential or Newtonian yin-yang scheme of motion in external gravitational fields

$$\frac{g_{00}(r)}{g_{00}(R)} = 1 - \frac{v^2(r)}{c^2} = 1 - \frac{1}{g_{00}(r)c^2}\left(\frac{dr}{dt}\right)^2$$

$$\frac{d\mathbf{r}(t)}{dt} = \pm\hat{\mathbf{r}}c\sqrt{g_{oo}(r)\left[1-\frac{g_{oo}(r)}{g_{oo}(R)}\right]}$$

Exact prescriptions of Einstein's General Relativity

$$\frac{d^2\mathbf{r}[t]}{dt^2} = \hat{\mathbf{r}}c^2\left(\frac{1}{2} - \frac{g_{00}(r)}{g_{00}(R)}\right)\frac{dg_{00}(r)}{dr} \Rightarrow -\frac{c^2 r_0 \mathbf{r}(r^2-2r_0 r - r_0^2)}{(r+r_0)^5}, \quad g_{00}^{2008} = \frac{r^2}{(r+r_0)^2}$$

Newtonian acceleration becomes deceleration in strong metric fields of Einstein's GR.

Why does GR admit the free-fall self-pulsation in steady metric potentials?

Self-organization of kinetic energies toward their equipartition drives the physical reality of only positive energies. Newton's pulls with negative energies exist only in mathematics but not in Cartesian material space.

$$mc^2 u^\nu \nabla_\nu^{ext} u_\mu = 0$$

the free fall of the system mass-energy integral in external fields - Lagrange dynamics

$$\mu' c^2 u^\nu \nabla_\nu^{self} u_\mu = F_\mu^{in}$$

inertial self-organization of the extended system - post-Lagrange dynamics

$$Q(r_{eq}) \equiv Q_o\sqrt{1-\beta_{eq}^2} = \frac{Q_o\beta_{eq}^2}{\sqrt{1-\beta_{eq}^2}} \equiv T(r_{eq})$$

equilibrium of internal chaos and translation order for the Hamilton kinetic energy

$$\{F_j^{gr} + F_j^{in}\}_{eq} = 0$$

or

$$\mu_{in}' c^2 u^\nu \nabla_\nu(-u_\mu) = \mu_{in}' c^2 u^o(\Gamma_{o\mu}^o u_o) = \{0; \mu_{in}' c^2 [x_i r_m / r'^2 (r' + r_m)]\}$$

$$\frac{\varphi_Q R(r')}{8\pi} = \frac{\varphi_Q R_o^o(r')}{4\pi} = \frac{w_i(r')w^i(r')}{4\pi\varphi_Q} - \frac{\partial_i w^i(r')}{4\pi} \equiv \sqrt{G}\mu_{in}(r') + \sqrt{G}\mu_{gr}(r')$$

$$w^i(r') \equiv -\delta^{ij}\partial_j W(r') = \Gamma_{i\nu}^\nu, \; W(r') = -\varphi_Q ln(1 + r_m/r'), \; r_m \equiv \sqrt{G}m/\varphi_Q$$

$$u_\mu = \{r'/(r' + r_m); 0\}$$

$$\sqrt{G}\mu_{in}' = \sqrt{G}m r_m / 4\pi r'^2 (r' + r_m)^2 = \sqrt{G}\mu_{gr}'$$

$$\partial_o u_\mu = 0$$

Thermo-mechanics of adaptive energy flows in warm material space with Maxwell-type tensor tensions of inertia

$$\rho'\left[\partial_t V_i + \partial_i\left(\frac{V^2}{2}\right) - V^j M_{ji}\right] = -\frac{c}{4\pi G}\partial_t(M_{ij}M^{oj}) - \frac{c^2}{4\pi G}\partial_m(M_{ij}M^{mj})$$

$$+\frac{c^2}{16\pi G}\partial_i(M_{jo}M^{jo} + M_{jm}M^{jm}) + \eta\rho'\partial_j\partial^j V_i + \left(\xi + \frac{\eta}{3}\right)\rho'\partial_i\partial_j V^j + F_i^{ext}.$$

$$cM_{io}(x) \approx \partial_t V_i + \partial_i(V^2/2),\ M_{ij}(x) \approx \partial_j V_i - \partial_i V_j$$

the ensemble inertial 4-current $\rho'_{in}(x')cu^{\nu}_{en}(x) \equiv \sum_{k=1}^{K}\mu'_{in}(x'_k)cu^{\nu}_{en}(x_k)$

$$M_{\nu\mu} \equiv c(\partial_\nu u^{en}_\mu - \partial_\mu u^{en}_\nu)$$

$$cu^{en}_\mu \Rightarrow \{c, -V_i\}/\sqrt{1 - c^{-2}V^2}$$

$$dl^2 = \delta_{ij}dx^i dx^j = \gamma^k_{ij}dx^i_k dx^j_k = dl^2_k$$

Laboratory material space x^i also keeps Euclidean geometry as elementary x^i_k

High-order derivatives for inertial self-organization of Navier-Stokes streams


рахмат
danke
謝謝
ngiyabonga
teşekkür ederim
Баярлалаа
mersi
kia ora
barka
welalin
tack
spas
mahalo
tapadh leat
спасибо
faafetai lava
vinaka
спасибі
blagodaram
dank je
misaotra
matondo
paldies
grazzi
thank you
gracias
хвала
kiitos
dankie
nanni
nandri
dhanyavad
maururu
köszönöm
asante
manana
bedankt
bayarlalaa
gràcie
hvala
akun
dankon
ačiū
obrigada
tenki
murakoze
enkosi
djiere dieuf
tau
mochchakkeram
mamnun
дякую
dziękuję
chnorakaloutioun
gratias ago
gràcies
sulpáy
go raibh maith agat
chokrane
sobodi
dĕkuji
taiku
obrigado
sagolun
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ありがとう
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kam sah hamnida
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তোমাকে ধন্যবাদ
감사합니다
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