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A cheap, rational and testable refinement of special and general relativity

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Abstract

1.) The main testable idea of this contribution is quite a new explanation of the light flash of gamma bursts. As will be shown, a free falling particle converts its rest mass partly into wave energy. This is freed when the particle hits the surface of a star. Such an effect during the collapse to a neutron star might be seen as a gamma burst – unexplained by classical general relativity up to now.
2.) The central theoretical idea: In general relativity, there is not a curved space-time in a philosophical sense. $U < 2\pi r$ or $U > 2\pi r$ follow if measuring rods contract in gravitational fields and this different in radial and tangential directions of a circle.

Content

1 Refinement of special relativity and possible tests

The refinement of special relativity is well known to us, it is the so called Lorentzian interpretation of special relativity. For details and literature see [1]-[3] and for the newest one see [4]. The two principles of special relativity

constancy of velocity of light

relativity principle (version of Einstein)

are interchanged by

relativity principle (version of Galilei and Lorentz) stating that an absolute velocity (through space and ether) is not measurable. A simple consequence: The **measuring value** of light velocity is 'c' in all inertial systems but it's one-way velocity becomes different. This is possible only if moving measuring devices change their properties. More concrete, the following three assumptions

(a) length contraction $dx = ds\left(1 - \beta^2\right)^{1/2}$

(b) time dilation $dt = d\tau\left(1 - \beta^2\right)^{-1/2}$

(c) synchronisation with light signals

allow derivation of Lorentz transformation formula, [2]. Within such inertial systems all physical laws have the same form. It is no need to postulate a four dimensional space-time in a philosophical sense but instead some form of ether such as the non-empty space of quantum mechanics or the Higgs field hypothesis [5] or the others discussed by Duffy [6] or [7] this conference.

Possible tests are related to the Ehrenfest paradox and discussed in [2]. Even more convincing are gedanken experiments concerning the relativistic paradoxes, especially the twin paradox [8].

2 Falsifiable refinements of general relativity: Reshaping black holes into active supermassive stars and conversion of rest mass into wave energy.

2.1 New assumptions

Curved space-time is regarded as caused by length contraction and clock retardation which is not a totally new idea [11], [12], [13]. Though contradicting the philosophical findings of general relativity (GR) this is not rejected up to now [2]. The here discussed variation **fulfils two demands: No contradiction with general relativity as far as experimentally proven as well as new and testable consequences**. Therefore, if true, it is justified to call it a refinement of general relativity. Its name: Lorentzian interpretation of general relativity.

There are other, partly similar efforts improving GR. In [14] GR is derived with Euclidean space, [15] gets rid off black holes by introducing grava-stars, and new developments in quantum gravity restrict the equivalence principle - with the consequence that curved space-time looses its philosophical meaning concerning space and time [16]. Both, the aim of [15] and the restriction of [16], and certainly [14] are closer related to parts of this refinement than to GR.

The following four assumptions are made:

rods of length ds put into radial direction at position r within SM contract to dr_{rad} by

(1) $$dr_{rad} = ds\left(1 - r_{SM}/r\right)^{1/2},$$

rods put into tangential direction are contracted to

(2) $$dr_{\tan} = ds\left(1 - r_{SM}/r\right),$$

clocks resting at r in SM with proper time τ are slowed down

(3) $$dt = d\tau\left(1 - r_{SM}/r\right)^{-1/2},$$

masses *dm* resting at *r* in SM (e.g. a particle on the surface of a star) are reduced to

(4) $$dm_r = dm\left(1 - r_{SM}/r\right)^{1/2}.$$

r_{SM} : Schwarzschild radius.

(3) is proven experimentally [17]. (1) and (2) are motivated by geometrical [2] and (4) by energy conservation considerations, see below. (1) and (3) are read off from SM, too. None of (1) to (4) are testable within local inertial frames where the equivalence principle holds.

The above assumptions illustrate a **deeper concept of refined general relativity: the difference between measurable (or proper) and real value of a physical quantity**. Measurable values are ds, $d\tau$, dm, dr (difference of near lines of constant altitude) as well as s, τ, r (line of constant altitude/2π), t (far away clocks). Real values are dr (radial projection of ds), dr_{tan} , dm_r , r_r (see (7)) , dt, t. Some of them are both depending on context (the others are indexed by r).

General relativity is the theory of measurable values in gravitational fields or in other words the relativistic formulas connect measurable quantities. Physically this would be enough but real values become necessary on two reasons: **some relativistic formulas are obscure though correct (e.g. (8))** and well known laws (e.g. energy conservation (f)) are only to be formulated using real values.

2.2 Consequences

With the assumptions (1) to (4) it is possible to show:

(a) SM no longer predicts black holes,

(b) Oppenheimer Volkoff (OV) equation with constant density is no longer singular if

$$r_{star} < 9/8\, r_{SM} ,$$

(c) super-massive stars become stable.

(d) formula (8) of gravitational mass of Einstein's field equations becomes self explaining,

(e) infinite fall times of radial free fall become rational,

(f) radial free fall exhibits an energy conservation law missing without assumption (4).

2.3 Proof of consequences

To (a). Calculating $\oint dr_{\tan}$ with assumption (2) along some line of constant altitude of SM one gets

(6) $$2\pi r_r = 2\pi r\left(1 - r_{SM}/r\right)$$

(7) $$r_r = r - r_{SM}$$

Inserting into SM no singularity arises since $r_r \geq 0$ and $r \geq r_{SM}$. Black holes become a limiting case of theoretical value only. Assumption (2) looks arbitrarily but if there is radial contraction assuming a tangential one is nearby. If black holes are a limiting case the same is true for infinite fall times (s. Fig.1) which is rational and also justifies (2). Details [2].

Observational refute of black holes does not mean observation of super-massive stars with $r_{star} < r_{SM}$ but radiating ones with $r_{star} > r_{SM}$ just as is observed in our galactic centre [19]. ($r_{star} < r_{SM}$ is excluded since $r_r > 0$ though possibly $r_r \approx 0$.) s. Fig. 2 and Fig.3.

To (b). Insertion of (7) into OV for constant density OV has no singularity if $r_{star} < 9/8\, r_{SM}$. Details [19].

To (c).

gravitational pressure at the centre of stars calculated with Oppenheimer Volkoff equation is less than Fermi pressure of degenerate stars. Super-massive stars become stable. They possibly emanate jets, UHECR (ultra high energy cosmic rays) and spiral shock waves. Fermi pressure $p_{Fermi} \sim \rho^{4/3}$, ρ: density, gravitational pressure $p \sim \rho$ in OV **together with (7)**. At least if $r_r \approx 0$ and $\rho \to \infty$ then $p_{Fermi} > p$. Details [18]. This remains true in the radiation limit $p = \frac{1}{3}\rho$, ([20], p.617).

To (d). **Gravitating mass *m* is given by**

(8) $$m = \int 4\pi r^2 \rho dr \text{ . [20]}$$

Evaluation leads to (11):

(9) $$m = \int 4\pi r^2 \rho ds \frac{dr}{ds}$$

(10) $$m = \int dm_{measured} \left(1 - r_{SM}/r\right)^{1/2} \text{ (using (1))}$$

(11) $$m = \int dm_r \qquad \text{(using (4))}$$

$m = \int dm_{measured}$ would be understandable – it is a measuring result - but is wrong, $m = \int dm_r$ **becomes clear by applying the concept of measured and real values.**

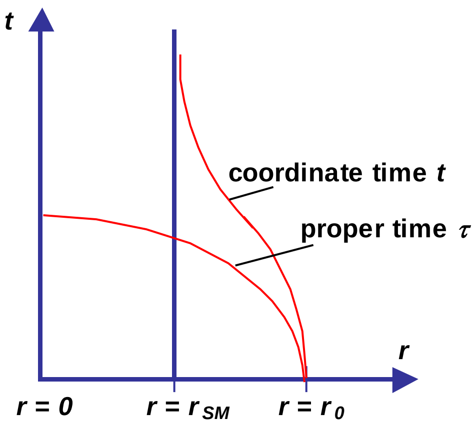

Fig.1 Coordinate time *t* and proper time τ as function of radius *r* for radial free fall, [20].

To (e) and (f): Infinite fall time, energy conservation

Fig. 1 shows two fundamental new features of refined general relativity against general relativity and Newton's theory: (I) The infinite fall time and (II) decreasing fall velocity of a free falling particle. The formulas are relativistic correct but not to understand. The energy of a free falling particle remains constant, its potential energy decreases and therefore its velocity should increase but instead it decreases. The finite distance to the surface of a black hole should be traversed in a finite time.

Since *t* is **more** than part of a coordinate system – it describes except a constant factor the time of a resting clock – one cannot attribute these findings to a peculiar choice of some coordinate system as done normally in general relativity [20].

(I) The infinite fall time is rational since it belongs to a theoretical limit – a point mass. In reality all massive objects possess a finite radius and therefore a finite fall time.

(II) From (4) one concludes that the mass of a free falling particle shrinks but its total energy remains constant as the following relativistic formula of free fall proves:

(12) $$k = m_0 c^2 (1 - \frac{r_{SM}}{r}) \dot{t}$$ k=constant

Therefore **energy conservation** leads to following **new assumption**:

(13) $$k = m_0 c^2 (1 - \frac{r_{SM}}{r})^{\frac{1}{2}} + k_{kin} + k_{wave}$$

Rest mass and kinetic energy k_{kin} become zero but wave energy k_{wave} increases. This explains the decreasing velocity of a 'particle'. The particle mass disappears and instead wave energy is created. A wave moving in an optical dense medium – the gravitational field – has a lower velocity than outside but its frequency and therefore its energy remains constant. If the free falling particle hits the surface of a star it keeps its rest mass, its kinetic and wave energy are freed. Within a collapse to a neutron star many of these particles are stopped at equal time and this is seen as the light flash of a gamma burst or of a supernova explosion.

A gedanken experiment proving (4): Pull a mass $m(r)$ from $r = r_A$ till $r \to \infty$. The energy input k_G becomes

(14) $$k_G = \int_{r=\infty}^{r=r_A} \frac{d\phi}{dr} m_G c^2 dr$$

On account of $\varphi = \frac{c^2}{2} \ln(1 - \frac{r_{SM}}{r})$ one gets $\frac{d\phi}{dr} = \frac{GMc^4}{r^2} \frac{1}{1 - \frac{r_{SM}}{r}}$

Inserted into (14) and integrated the result is:

$$k_G = m_0 c^2 (1 - (1 - \frac{r_{SM}}{r})^{\frac{1}{2}})$$

in agreement with $$k = k_G + m(r_A) = m_0 c^2$$

Numerical example: Free fall from a large distance onto a neutron star (1 mass of sun, R = 16 km, r_{SM} = 3 km)

$$m_0 (1 - r_{SM}/R)^{1/2} = 0.90\ m_0$$

$$k_{wave} = 0.09\, m_0 c^2$$

$$k_{kin} = 0.01\, m_0 c^2$$

When hitting the surface the rest mass of the particle is 90%, 9% is wave energy. This part might be freed as a light flash during a gamma burst or a supernova event. These ideas rest on Lorentzian interpretation. Especially the refinement of OV algorithm and the considerations of energy conversion during free fall was encouraged by [21] claiming difficulties in simulation of supernova explosions as well as by open questions in gamma bursts.

3 Comments on 'non-uniqueness' of general relativity

The here proposed refinement of general relativity heavily rests on uniqueness of its main formulas, especially the Schwarzschild metric (SM). In two papers "Non-uniqueness of predictions in the general theory of relativity" is stated, [9]. My counterarguments are recapitulated in this last chapter.

Following [9] the Schwarzschild metric (SM)

$$(15)\quad ds^2 = \left(1 - \frac{2GM}{r_S}\right)^{-1} dr_S^{\,2} + r_S^{\,2}(d\theta^2 + \sin^2\theta d\varphi^2) - \left(1 - \frac{2GM}{r_S}\right) c^2 dt^2$$

and the Fock metric (FM) – derived by V. Fock, a well-known Russian physicist -

$$(16)\quad ds^2 = \left(\frac{r_F + GM}{r_F - GM}\right) dr_F^{\,2} + r_F^{\,2}\left(1 + \frac{GM}{r_F}\right)^2 (d\theta^2 + \sin^2\theta\, d\varphi^2) - \left(\frac{r_F - GM}{r_F + GM}\right) c^2 dt^2$$

predict different values of gravitational red-shift. This results from the questionable statement, that in both of the formulas r_S and r_F are the same. But r_S and r_F are different as will be shown now.

Assumptions.

In agreement with Logunov and Loskutov φ and θ are identical for SM an FM, and **both of the formulas are in equal rights.** Further, Logunov and Loskutov are right when stating: The possible transformation $r_F + GM = r_S$ does not prove that both of the formulas are identical and it does not prove that they only differ in their coordinate systems. Certainly, this is what has to be proven.

Proof.

1.) Take some arbitrarily point $P = P(r_{S0}, \theta_{S0}, \varphi_{S0}) = P(r_{F0}, \theta_{F0}, \varphi_{F0})$ in a central symmetrical gravitational field.

2.) Construct all the points lying on the same sphere as point *P* does. You can achieve this in two different ways.

a.) Take a rigid stick of length *P* to *C*, where *C* is the centre of the field. Change the direction of the stick keeping one endpoint fixed at the centre *C*. The other endpoint gives all the points of the sphere to be constructed.

b.) Take all the points with the same gravitational red-shift as *P*. (This is not a circularity since it is not asked for the predicted values of *P*.)

3.) Construct the equator of the sphere - e.g. in the following way. Take some arbitrarily point as north pole. Its opposite, the south pole, has the largest distance from the north pole. Take all the points with half of this distance. Shorter: Take $\theta = 90^\circ$ - it has the same meaning for SM and FM.

4.) Measure the circumference U_0 of the equator using a meter stick. You will get $U_0 = N_0 \times 1\text{meter}$. ($N_0$ times your meter stick can be put near each other and you will be back at the starting point.)

5.) Calculate the coordinates r_S and r_F using SM and FM respectively by setting

$dr_S = dr_F = 0$, $\theta = 90^\circ$. You will get

$$(17)\quad \begin{aligned} U_0 &= N_0 ds_S \\ &= N_0 r_{S0} d\varphi \end{aligned}$$

from SM and

(18) $$U_0 = N_0 ds_F = N_0 r_{F0}\left(1+\frac{GM}{r_{F0}}\right)d\varphi$$

from FM. Since (17) = (18) - the same U_0 - you will get

(19) $$r_F + GM = r_S$$

This means r_S and r_F are different.

6.) Introduce (19) into SM and you will get FM. Especially in the case $dr_S = dr_F = 0$, $d\theta = d\varphi = 0$ you will yield the same formula for the gravitational red-shift.

(20) $$c^2 d\tau_{S0}{}^2 = \left(1-\frac{2GM}{r_{S0}}\right)c^2 dt^2$$

(21) $$c^2 d\tau_{F0}{}^2 = \left(\frac{r_F - GM}{r_F + GM}\right)c^2 dt^2$$

(20) and (21) are the same when introducing (19).

Conclusion

It is **not** correct to demand $r_F = r_S$. Application of SM and FM to free chosen points of radial symmetrical gravitational fields yields $r_F + GM = r_S$. Within general relativity *r* is some arbitrary coordinate.

Lorentzian interpretation of general relativity introduces absolute space and time into general relativity. Therefore Lorentzian interpretation makes the assumption

$$r_{real} = r_S - 2GM \quad or \quad r_{real} = r_F - GM$$

giving the same result for both metrics. (r_{real}: real radius.) By this, black holes become some theoretical limiting case with radius zero similar to electrical point charges for both of the metrics. This would be impossible if $r_S = r_F$.

4 Summary: Main results in pictures

Black holes of general relativity, fig. 2, change to super-massive objects, fig. 3. Looking at our galactic centre with improved telescopes one will see a black hole, fig. 2, or a radiating object similar to Fig. 3.

Fig. 4 illustrates a new hypothesis about the origin of the light flash of gamma bursts. This gets a first evidence by failing simulations of supernova events [21].

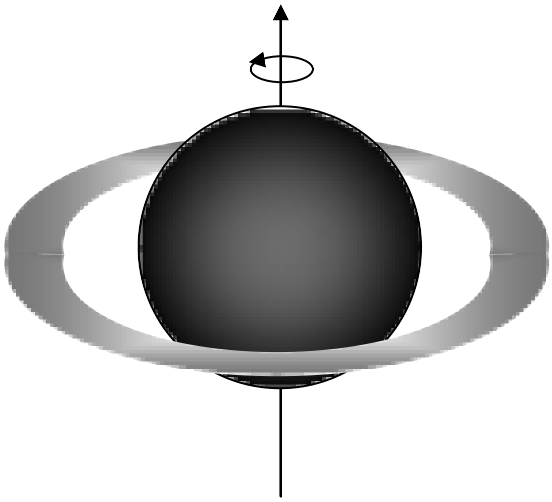

Fig. 2 Black hole with accretion disk and angular momentum

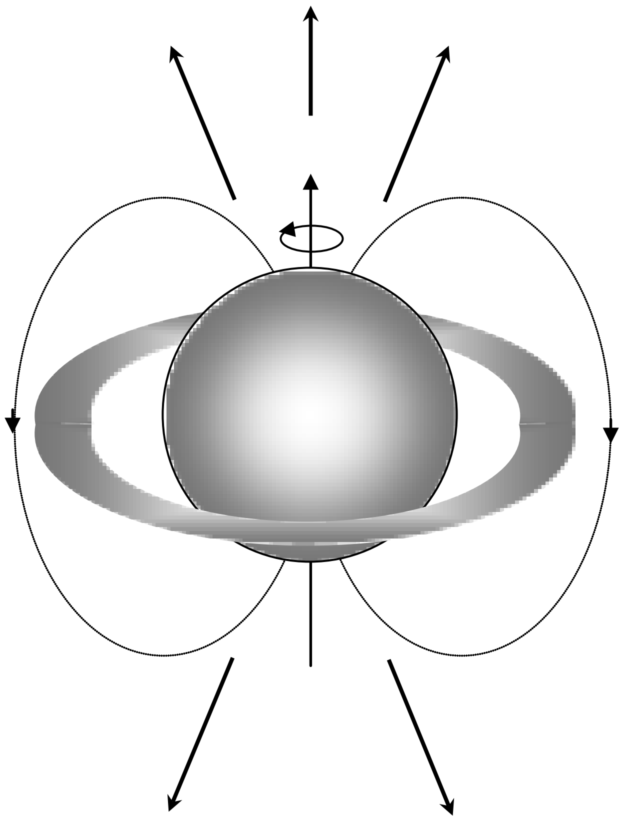

Fig. 3 Super-massive stellar object, additionally to black hole of fig.2 it's radiating, owns magnetic fields and possibly emanates jets.

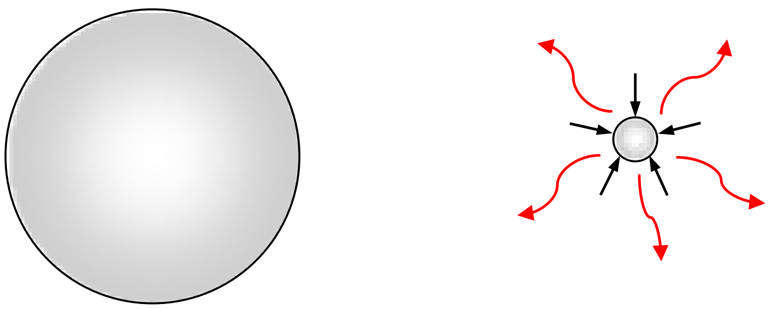

Fig. 4 Gamma burst: A massive star collapses to a neutron star. Part of the rest mass of all its particles is converted into wave energy, see (4), (13). This energy is freed as a light flash when the particles are stopped creating a neutron star.

5 Literature

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