Abstract

We present a quantum theory of gravity which is in agreement with observation in the relativistic domain. The theory is not relativistic, but a Galilean invariant generalization of Lorentz-Poincare ether theory to quantum gravity.

If we apply the methodological rule that the best available theory has to be preferred, we have to reject the relativistic paradigm and return to Galilean invariant ether theory.

Generalization Of Lorentz-Poincare Ether Theory To Quantum Gravity

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... die bloße Berufung auf künftig zu entdeckende Ableitungen bedeutet uns nichts. Karl Popper

In quantum gravity, as we shall see, the space-time manifold ceases to exist as an objective physical reality; geometry becomes relational and contextual; and the foundational conceptual categories of prior science – among them, existence itself – become problematized and relativized. Alan Sokal

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1 The Problem Of Quantum Gravity

We believe that there exists a unique physical theory which allows to describe the entire universe. That means, there exists a theory — quantum gravity — which allows to describe quantum effects as well as relativistic effects of strong gravitational fields.

The simplest strategy would be to search for a theory which is in agreement with the metaphysical principles in above limits — a relativistic quantum theory of gravity. This theory

- allows to derive the experimental predictions of general relativity in $\hbar \to 0$ and Schrdinger theory in $c \to \infty$;
- is a quantum theory;
- is in agreement with the relativistic paradigm.

The strategy seems to fail. After a lot of research we have, instead of a theory, a list of serious problems: problem of time, topological foam, non-renormalizability, information loss problem. The consequences of relativistic quantum gravity seem close to Sokal's parody [19].

What if this strategy really fails? In this case, at least one of the two paradigms of modern science has to be wrong. This makes quantum gravity — a theory we possibly never need to predict real experimental results — very interesting for current science.

But, if one of the principles is wrong, how can we find out which? To find the answer, we can apply standard scientific methodology (following Popper [14]). All we need is the following methodological rule: We always have to prefer the best available theory, to refer to possible results of future research is not allowed. What we have to do is to present one of the following theories:

- post-relativistic quantum theories (non-relativistic theories which predict relativistic effects in some limit);
- post-quantum relativistic theories (non-quantum theories which but predict quantum effects in some limit).

Until relativistic quantum gravity has not been found, the principle which is not valid in this theory is the wrong one. Indeed, in this case we have a theory which fulfils our first condition. We have to prefer this theory as the best available theory, and reference to the future success of relativistic quantum gravity is not allowed. qed.

The rejected paradigm may be revived by the results of future research. But this is a trivial remark — it is correct for every invalid paradigm. Thus, this paradigm is as dead as possible for a scientific paradigm.

This result depends on some methodological rules we have to accept. We have to make a decision to apply a certain methodology of empirical science. We need:

- The rule that we have to prefer the best available theory and to ignore the hope for future success of alternative approaches;
- A rule which allow to prefer a unified theory of quantum gravity compared with theories which do not allow to describe quantum effects of strong gravitational fields;

Our decision was to accept the methodology of Popper [14]. It contains the rule that we have to prefer the best available theory. Popper's criterion of potential predictive power obviously prefers a unified theory of quantum gravity.

2 Introduction

The aim of this paper is to present a post-relativistic quantum theory of gravity — that means, a non-relativistic theory which nonetheless describes relativistic effects correctly.

Our strategy may be described as the simplest search strategy after the search for relativistic quantum gravity. We have to omit at least one of the guiding principles — the relativity principle or quantum theory. As guiding principles, we use the other principle and an available competitor of the rejected principle.

For quantum theory we have no appropriate known competitor — Bohm's hidden variable theory seems to be even less compatible with relativity. For the relativity principle the best known non-relativistic theory is Lorentz-Poincare ether theory. It is Galilean invariant, thus, we have obviously no "problem of time". We have a fixed, flat space, thus, no topological foam. Thus, to replace relativity by the Lorentz-Poincare ether paradigm solves at least two of the quantization problems.

Thus, we try to use the pre-relativistic ether paradigm as the replacement of the relativity principle and search for a theory of gravity which

- is a quantum theory,
- is Galilean invariant,
- allows to describe relativistic time dilation as caused by interaction with a physical field — the "ether".

We already know how we have to describe special-relativistic effects, thus, what we have to do is to generalize this scheme to gravity and to quantize the resulting theory in the simplest possible way — with canonical quantization.

To realize this concept is surprisingly simple.

We know that general relativity is tested for a wide range, thus, the simplest idea is to remain as close as possible to general relativity. Thus, it would be the simplest case if we have a Lorentz metric $g_ij(x,t)$ in our theory and this metric fulfills the Einstein equations. What we have to include is a preferred Newtonian frame. The simplest idea is to choose harmonic coordinates to define this frame.

We obtain a theory — post-relativistic gravity — which is slightly different from general relativity, with a natural ether interpretation: we can identify a "density" ρ, a "velocity" v^i, and a "stress tensor" σ^{ij} with correct transformational behaviour and the usual conservation laws. The simplest way to incorporate the harmonic equation into the Lagrange formalism requires to break the covariance. This makes the ether observable in principle — as some type of dark matter, with two cosmological constants which have to be fitted by observation.

Once we have an ether theory, the question if this ether has an atomic structure is natural. Is our continuous ether theory valid for arbitrary distances or is it only the large scale approximation of some atomic ether theory for distances below some ϵ? The first hypothesis leads to problems already in classical theory, but in the quantum case we obtain ultraviolet problems.

That's why we assume that the atomic hypothesis is true. This obviously solves the ultraviolet problems. We show this for a simple example theory with discrete structure — standard regular lattice theory. For this theory, standard canonical quantization may be applied without problem. This suggests that for better atomic theories canonical quantization works too.

Our lattice theory is not the ideal atomic ether theory. But this is already a Galilean invariant quantum theory of gravity, and it works in the relativistic domain. Thus, it already solves the problem of quantum gravity. In other words, the solution of the "problem of quantum gravity" can be described in a single sentence:

Classical canonical Weyl quantization of a lattice theory (standard first order finite elements on a regular rectangular lattice in space) of a classical Galilean invariant theory for an "ether" g_{ij} and matter fields ϕ with Lagrangian

$$L = L_{Rosen}(g_{ij}) + L_{matter}(g_{ij}, \phi) + \lambda_1 g^{00} + \lambda_2 g^{aa}$$

Note that to remove the regularization, that means to solve the ultraviolet problem by some sort of renormalization, is necessary only in a relativistic theory. The point is that the regularization is not relativistic invariant. That's why this theory is far away from being "relativistic quantum gravity".

But Galilean invariant regularization is not problematic, and that's why this simple theory already solves the problem of Galilean invariant, non-relativistic quantization of gravity, even for the relativistic domain.

3 Generalization Of Lorentz-Poincare Ether Theory To Gravity

In this section, we present the details of the definition of our ether theory. We present a slightly more general scheme, which shows that our approach is not very much related with the details of the theory of gravity.

Definition 1 *Assume, we have a classical relativistic theory with the following variables: the Lorentz metric g_{ij} and some matter fields ϕ^m, with a relativistic Lagrangian*

$$L_{rel} = L_{rel}(g_{ij}, g_{ij,k}, \phi^m, \phi^m_{,k})$$

In this case, the "related ether theory" is defined in the following way:

The theory is defined on Newtonian space-time $R^3 \times R$. The independent variables are:

- *a positive scalar field $\rho(x,t)$ named "density of the ether",*
- *a vector field $v^a(x,t), 1 \le a \le 3$ named "velocity of the ether",*
- *a positive-definite symmetrical tensor field $\sigma^{ab}(x,t), 1 \le a,b \le 3$ named "stress tensor of the ether",*
- *and one field $\phi^m(x,t)$ for every "matter field" of the original relativistic theory named "inner step of freedom of the ether".*

The Lagrange functional is

$$L = L_{rel}(g_{ij}, g_{ij,k}, \phi^m, \phi^m_{,k}) + \lambda_1 g^{00} + \lambda_2 g^{aa}$$

where the "ether metric" $g_{ij}(x,t)$ is defined by the following formulas:

$$\hat{g}^{00} = g^{00}\sqrt{-g} = \rho \tag{1}$$

$$\hat{g}^{a0} = g^{a0}\sqrt{-g} = \rho v^a \tag{2}$$

$$\hat{g}^{ab} = g^{ab}\sqrt{-g} = \rho v^a v^b - \sigma^{ab} \tag{3}$$

$$\tag{4}$$

The most interesting example is of course general relativity. The related ether theory we have named post-relativistic gravity or simply post-relativity. In the following we restrict ourself to this theory. Nonetheless, the previous scheme may be applied to other metrical theories of gravity too. That means, the question of existence of an ether does not depend on the details of the theory of gravity.

3.1 Elementary Properties Of Post-Relativistic Gravity

The "ether metric" in post-relativistic gravity identifies the ether with the gravitational field. It is in general inhomogeneous and instationary. Only in the Minkowski limit the ether becomes homogeneous and stationary, and obviously coincides with the ether of Lorentz-Poincare ether theory. Because of our assumptions about ρ and σ^{ab}, g_{ij} is really of signature $(1,3)$.

The ether influences all matter fields only via minimal interaction with the ether metric, thus, in the same way. Thus, we have no ether for the electromagnetic field only, but a common ether for all matter fields. Especially, all clocks — which have to be described by matter fields — are time-dilated in the same way and show general-relativistic proper time τ. But this "proper time" does not have the metaphysical status of time. It is only a parameter for the speed of clocks, which depends on the state of the ether and the relative velocity of the clock and the ether.

Our Lagrange density is not covariant. To compare it with relativistic theory, it is useful to introduce the preferred coordinates as independent functions T, X^a. This allows to make the Lagrange density covariant:

$$L = L_{rel}(g_{ij}, g_{ij,k}, \phi^m, \phi^m_{,k}) + \lambda_1 g^{ij} T_{,i} T_{,j} + \lambda_2 g^{ij} X^a_{,i} X^a_{,j}$$

Now we see that the relativistic field equations are fulfilled, with a small modification — an additional term has to be added to the energy-momentum tensor. In the preferred coordinates T, X^a, the additional energy term is

$$(T_{full})^0_0 = (T_{rel})^0_0 + \lambda_1 g^{00} - \lambda_2 g^{aa}.$$

For the absolute coordinates, we obtain the usual harmonic wave equation

$$\Box T = 0; \quad \Box X^a = 0$$

Translated into the original variables, these are simply conservation laws for the ether:

$$\partial_t \rho + \partial_i (\rho v^i) = 0$$

$$\partial_t (\rho v^j) + \partial_i (\rho v^i v^j - \sigma^{ij}) = 0$$

3.2 The Cosmological Constants

Thus, the only immediately observable difference between general relativity and post-relativistic gravity are two unknown constants λ_1, λ_2. To observe them we have to compare the energy-momentum tensor of observable matter with the observable Einstein tensor in harmonic coordinates. The observed difference should have the form $\lambda_1 g^{00} - \lambda_2 g^{aa}$. These parameters may be considered as cosmological constants of post-relativistic gravity.

This does not mean that this observation immediately falsifies relativity. We can explain the same observation inside the relativistic paradigm too. Indeed, we can interpret the fields T, X^a as some new matter fields. They obviously fulfil a relativistic equation. The fields T, X^a are defined only modulo a constant, thus, describe only some potential, only the derivatives $\hat{g}^{ij}T_{,j}, \hat{g}^{ij}X^a_{,j}$ are physical fields. These fields do not interact with other matter. Thus, all what we observe from relativistic point of view is more or less standard dark matter.

3.2.1 The Observation Of The Cosmological Constants

To observe the cosmological constant seems possible for the global homogeneous universe solution. In post-relativistic gravity, only the flat universe is homogeneous — a preference of the flat universe which is supported by observation. Now, let's look how dark matter of the form $\lambda_1 g^{00} - \lambda_2 g^{aa}$ in harmonic coordinates modifies the flat Friedman solution (c=1)

$$ds^2 = d\tau^2 - b^2(\tau)(dx^2 + dy^2 + dz^2).$$

The harmonic coordinates are x, y, z and $t = \int b^{-3}(\tau)d\tau$, thus, we have

$$ds^2 = b(t)^6 dt^2 - b^2(t)(dx^2 + dy^2 + dz^2).$$

The first part $\lambda_1 g^{00}\sqrt{-g} = \lambda_1$ is a fixed density — something like invisible dust in rest.

The second part $-\lambda_2 g^{aa}\sqrt{-g} = -3\lambda_2 b^4(t)$ has a different behaviour. The parameter λ_2 obviously influences the observable (proper time) age of the universe.

In other words, if the cosmological constants are non-trivial and have observable effects, we will observe:

- a missing mass — a difference between observed mass and mass necessary to explain the current Hubble coefficient in general relativity.
- a wrong age of the universe — a difference between the observable age of the universe and the age which follows from general relativity and the current Hubble coefficient.

The observations may be described in general relativity as more or less standard dark matter.

3.2.2 The Necessity Of Cosmological Constants

We know that there are problems with missing mass and the age of the universe. We have to admit that this knowledge has influenced our decision to incorporate these cosmological constants into post-relativistic gravity. But, remember the history of the cosmological constant in general relativity. Is it possible that the introduction of these constants is an error in post-relativity too?

For an ether interpretation of g^{ij} we need conservation laws — the harmonic condition. To incorporate the harmonic condition into general relativity without cosmological constants we have some possibilities: we can use penalty terms like $g_{ij}\Gamma^i\Gamma^j$, or Lagrange multipliers like $\lambda_i\Gamma^i$. We can also consider the harmonic equation as an external constraint, which does not have to be derived with the Lagrange formalism. Indeed, non-harmonic configurations violate conservation laws, thus, are simply meaningless, not part of the physical configuration space. Variation in these directions is meaningless.

Comparing these possibilities, we nonetheless tend to prefer the variant with cosmological constants, because of the following arguments:

- They seem to be the simplest way to incorporate the harmonic equation into the theory.
- The related terms ρ and $\rho v^2 - \sigma^{aa}$ look much more natural from point of view of an ether interpretation, if we compare them with the other possibilities like $g_{ij}\Gamma^i\Gamma^j$.
- They break relativistic symmetry and make the "hidden preferred frame" observable. This allows to avoid classical positivistic argumentation

against hidden variables.[1]

Thus, there are some independent reasons to prefer the theory with cosmological constants.

In the following, we ignore the questions related with the cosmological constants. That means, we consider the theory in the domain with $\lambda_1, \lambda_2 \approx 0$, in other words, we consider solutions of general relativity in harmonic coordinates as solutions of post-relativistic gravity. In this domain, we have relativistic symmetry for all observables, the "preferred frame" is a hidden variable.

3.3 The Global Universe

Let's consider now what happens with the global universe. For this purpose, we have to consider homogeneous solutions of post-relativistic gravity.

In the case without cosmological constants, we have to use homogeneous solutions of general relativity and to introduce homogeneous harmonic coordinates. This is possible only for the flat universe. Thus, that the universe is flat is a consequence of the assumption that it is homogeneous in the large scale.

For the standard Friedman solution

$$ds^2 = d\tau^2 - \tau^{4/3}(dx^2 + dy^2 + dz^2)$$

we obtain the absolute (harmonic) coordinates x, y, z and $t = -\tau^{-1}$. This leads to the following interpretation:

- All galaxies remain on it's true place, the ether density remains constant.
- The observed expansion is explained by distortion of rulers. All our rulers become smaller.
- The limit $\tau \to \infty$ may be reached in finite absolute time.

[1] I have to remark that I consider this argumentation, as well as positivism, as invalid. Moreover, there are two other domains where the hidden variables become observable: for small distances it follows from the atomic hypothesis, and in the quantum domain space-time points have an invariant meaning, which also violates relativistic symmetry requirements.

Thus, instead of the big bang singularity in the past, we have now a singularity in future. We don't know yet if this future singularity is only a property of this particular solution or a general problem. In the following, we assume the worst case — that this singularity is as unavoidable as the big bang and black hole singularity in general relativity.

An interesting property of this singularity is that our rulers become infinitely small in absolute distances and constant ether density. This suggests a simple solution of this problem — an atomic hypothesis. If the ether has some atomic structure, in some future the rulers become small enough to observe these atoms. At this moment, the application of continuous theory is no longer justified, we have to use the atomic theory to understand what happens with our rulers. Thus, before the singularity $\tau \to \infty$ happens, continuous theory breaks down and has to be replaced by an atomic theory.

3.4 Gravitational Collapse

For the consideration of solutions with special symmetries, like spherical symmetry, we also have no problem of choice of the harmonic coordinates — we require that they have to be symmetric too. For example, for the solution of a spherical static star we have the following harmonic coordinates:

$$ds^2 = (1 - \frac{mm'}{r})(\frac{r-m}{r+m}dt^2 - \frac{r+m}{r-m}dr^2) - (r+m)^2 d\Omega^2$$

Here $m = m(r) = GM(r)/c^2$, $M(r)$ is the mass inside the sphere of radius r. For a collapsing star the situation is a little bit more complicate, nonetheless we have a unique choice — no incoming waves. This has been found already by Fock [8]. A spherical symmetric collapse or explosion leads to outgoing ether density waves.

A remarkable property of post-relativistic gravity is that the part behind the horizon is not part of the complete solution. In the ether interpretation, the time dilation for a falling observer becomes infinite, in a way that the limit of observed, distorted, time remains finite in infinite absolute time. Thus, in post-relativity we have no "black hole" in the general-relativistic sense. The part behind the horizon is not physical. The old notion "frozen star", which is also in agreement with the temperature of Hawking radiation, seems more appropriate.

Note that ether density is greater near the surface, and reaches infinity at the horizon. The collapse leads to a flow of ether into the black hole. This suggests that the theory may break down already some time before horizon formation. Probably, once the ether has reached some critical density, the collapse stops.

This leads to a theoretical possibility to test the theory: fall into a great black hole like the center of the galaxy. In general relativity, we will reach the region behind the horizon and die in the singularity. In post-relativistic gravity, we stop falling before the horizon, and survive there up to the time of the breakdown of the continuous approximation we have found for the global universe.

This is of course far away from realization. In the domain where we have experimental data, post-relativistic gravity coincides with general relativity. This includes not only tests of the PPN parameters in the solar system, but also tests for strong gravitational fields like black holes outside the horizon.

3.5 A Post-Relativistic Lattice Theory

We have observed internal problems of the continuous theory which may be interpreted as a breakdown for small distances — a solution which leads to infinite values in finite time. We also have similar evidence from quantum theory: the ultraviolet problems of general relativity in harmonic gauge are well-known, highly probable they appear in post-relativity too. That's why we make the following "atomic hypothesis":

Post-relativistic gravity is only the large scale approximation of a different, atomic ether theory.

Note that this atomic hypothesis destroys the relativistic symmetry of post-relativity in the domain $\lambda_1, \lambda_2 \approx 0$. The atomic theory has a completely different symmetry group compared with the large scale approximation. Relativistic time dilation is only a large scale effect. The atomic theory should be Galilean invariant, but there will be no local Lorentz invariance. Thus, for distances where the atomic structure of the ether becomes observable, relativistic symmetry becomes invalid, the hidden "preferred frame" becomes observable.

There are a lot of different possibilities for "atomic models". All what follows from the internal problems of continuous theory is a breakdown of this theory for absolute distances below some $\epsilon > 0$. But even this $\epsilon > 0$ is unknown yet.

To find out if the atomic hypothesis allows to solve these internal problems, the details of the atomic model seem to be not interesting. For this purpose, a simple example theory should be sufficient. Let's define now such a theory. Note that the purpose of this theory is not so much to describe a nice atomic model, but to have a simple example theory for computations.

Definition 2 *Assume we have a Galilean invariant classical field theory with a Lagrange density L_c which does not depend on higher than first derivatives of the fields ϕ.*

The "related lattice theory" is defined by the following steps of freedom:

- *a regular rectangular 3D lattice with distance ϵ between the nodes, with N nodes in each direction;*
- *for every field $\phi(x)$ of the continuous theory one step of freedom ϕ_x for every node x of the lattice;*

and it's Lagrange density

$$L = L_{lattice} + L_c(i(\phi_x))$$

Here $L_{lattice}$ denotes the Newtonian Lagrangian of a rigid body for the position of the lattice as a whole, and $i(\phi_x)$ denotes the standard (tri-linear) first order finite element embedding.

The finite element embedding $i(\phi_x)$ is a function with $(i(\phi_x))(y) = \phi_y$ for every node y, interpolated for the other points. It is a continuous function with discontinuous first order derivatives. That's why we include the condition that L_c does not depend on higher than first derivatives.

The movement of the lattice as a whole may be ignored. The only purpose of this construction was to make the lattice theory Galilean invariant.

The most interesting example is post-relativistic gravity. The related lattice theory we name post-relativistic lattice theory. To fit into the scheme, we have to use the Rosen Lagrangian instead of the curvature as the relativistic Lagrangian L_{rel}. This well-known Lagrangian

$$L_{Rosen} = g^{ik}(\Gamma^m_{il}\Gamma^l_{km} - \Gamma^l_{ik}\Gamma^m_{lm})$$

does not depend on second order derivatives, but leads to the same relativistic equations like scalar curvature R.

Thus, we have defined a simple example theory with a finite number of steps of freedom. It fulfills the necessary requirements of our approach: Galilean invariance and agreement with experiment.

3.6 Better Atomic Ether Theories

Post-relativistic lattice theory is only one example theory with a microscopic structure. It fulfils the necessary requirements — Galilean invariance and agreement with experiment. From mathematical point of view, lattice theory seems to be the simplest discrete theory.

But there is an interesting class of theories which has to be preferred because of higher predictive power — theories which really justify the notion "atomic models".

Indeed, the steps of freedom of the ether highly remember classical matter, and we have classical conservation laws. These properties have not been used in lattice theory. Better atomic models with the following properties:

- Galilean invariance,
- atoms as particles with a certain position as steps of freedom,
- the ether density ρ and velocity v^i of continuous ether theory as particle density and average velocity of these particles.

automatically explain these properties. Some other ideas for atomic theories:

- There may be a crystal structure. The axes may be described by a triad formalism. This is a natural modification of the relativistic tetrad formalism. We already have a predefined splitting into space and time direction, thus, we need only three vector fields in space.
- Visible fermions may be interstitials, their anti-particles vacancies. That's a variant of Dirac's original idea.
- Gauge fields describe different types of deformations related with these crystal defects. It is known that gauge formalism may be used to describe crystal defects.

Thus, even without experimental support, further improvement of the atomic ether models is possible. The ideal final result may be something like a qualitative crystal model of the ether which explains the observed particles and gauge fields as some types of crystal defects. This will be the ether-theoretical replacement of a unified field theory. But, of course, even in this ideal picture we have a lot of unexplained remaining parameters, like the masses of the different sorts of ether atoms.

4 Canonical Quantization

Now, let's show that the hypothesis of a different microscopic structure really allows to solve the quantization problem. For this purpose, it is sufficient to show the existence of a quantum theory with the necessary properties: Galilean invariance and agreement with experiment. Moreover, it is sufficient to do this for our simple example theory — post-relativistic lattice theory.

Theorem 1 *Assume we have a classical Galilean invariant theory with Lagrange formulation so that the Lagrangian does not depend on higher than first derivatives of the variables.*

In this case, there exists a quantum theory with this theory as some classical approximation.

This is straightforward: we can apply classical canonical quantization to our theory. Indeed, we have a theory with a finite number of steps of freedom, and a classical Lagrange mechanism with a Lagrange density which does not depend on higher than first derivatives of these steps of freedom.

This is already sufficient to derive the Hamilton formulation in the canonical way. Constraints we remove by small regularization terms like $\epsilon\dot{\lambda}^2$ for a Lagrange multiplier λ.

Once we have found a Hamilton formulation, the only remaining quantization problem is the definition of the Hamilton operator $\hat{h}$ for the classical Hamilton function $h(p,q)$. But the existence can be proven for arbitrary L^∞-functions. If Weyl quantization (which works for L^2) fails we can use anti-normal quantization (which works for L^∞). If even this scheme fails because $h(p,q)$ is not bounded, we regularize it using some large enough energy H_0 for cutting. This does not change Galilean invariance and agreement with experiment. qed.

Note that the regularizations we have allowed in this general scheme are modifications of the classical Hamilton formalism. The quantization itself is pure, standard, canonical quantization.

Now we can apply this scheme to post-relativistic lattice theory and obtain the main result:

Theorem 2 *There exists a Galilean invariant quantum theory of gravity, obtained by classical canonical quantization, which is in agreement with experiment in the relativistic domain, even for strong gravitational fields.*

Of course, there may be better variants. Instead of a regularization of the constraints, we will obviously prefer the generalized Hamilton formalism introduced by Dirac. But all we need for the purpose of this paper is to show the existence of such a quantum theory.

5 Discussion

This shows that special and general relativistic effects are compatible with Galilean invariance, the metaphysics of Lorentz-Poincare ether theory and canonical quantization.

Our argumentation is very simple. The mathematical part of theory we have presented is trivial — de-facto a single sentence. We apply a methodological rule which is also a single sentence: we have to choose the best available theory. The conclusion is very non-trivial: we have to choose this non-relativistic theory as the best available theory of quantum gravity. That means, the relativistic paradigm has to be rejected. Instead, we have to use pre-relativistic ether-theoretical metaphysics.

It seems, the simplicity of our argumentation is essential. Only a very simple argumentation which does not leave place for loopholes and immunization has the power to destroy such a fundamental paradigm like relativity.

We have to remark that it is not our simple theory which invalidates relativity. What we have done was to prove that there is no compatibility problem between gravity, Lorentz-Poincare ether theory and canonical quantization. Relativity has to be rejected because it is incompatible with quantum gravity. There is enough support for the incompatibility hypothesis: the problem of time [11], topological foam, the information loss problem, non-renormalizability. It's time to draw the conclusions and to reject relativity.

Moreover, this is not the only reason to reject relativity. The other is an experimental result — the violation of Bell's inequality by Aspect's experiment [3]. If we accept the EPR argumentation [7], it is a clear experimental violation of Einstein causality. Bell's conclusion was (cited by [15]):

"the cheapest resolution is something like going back to relativity as it was before Einstein, when people like Lorentz and Poincare thought that there was an aether — a preferred frame of reference — but that our measuring instruments were distorted by motion in such a way that we could no detect motion through the aether. Now, in that way you can imagine that there is a preferred frame of reference, and in this preferred frame of reference things go faster than light."

At this time, there was a strong counter-argument: to go back to the Lorentz ether means to throw away general relativity — one of the most successful theories of our century. Indeed, in general relativity we have solutions with non-trivial topology, but this is incompatible with Lorentz ether theory. In other words, Lorentz ether theory was much more wrong than general relativity, because it was unable to describe gravity.

Now, by the way, this counter-argument is removed. We have an ether theory of gravity which is compatible with relativistic experiment. Thus, Bell's conclusion is now much stronger, we have de-facto no costs if we "go back to relativity as it was before Einstein".

This independent argument against relativity remains valid even if a relativistic quantum theory of gravity will be found in future following one of the many research directions ([1], [2], [4], [6], [12], [11], [9], [10], [20]). This theory should not only solve all of the well-known problems, but it should present obvious advantages to overweight their problem with the violation of Bell's inequality. From this point of view, the relativistic paradigm is as dead as possible for a scientific paradigm.

5.1 Conclusion

According to our argumentation, the relativistic paradigm has to be rejected. We have two independent reasons for this rejection: The non-existence of a relativistic quantum theory of gravity, and the violation of Bell's inequality.

We have to replace relativity by a generalization of Lorentz-Poincare ether theory to gravity which does not have these faults. It follows that:

- Our universe is Galilean invariant. There exists an absolute space and absolute time. The space is filled with an ether — another word for the gravitational field.
- Our clocks and rulers are distorted by interaction with the ether.
- Our universe is flat and not expanding. Only our rulers become smaller. There is no big bang in the past in absolute time.
- Black holes do not exist, instead we have "frozen stars". In absolute time, the collapse stops immediately before horizon formation. The part "behind the horizon" is not physical.

The assumption that our current continuous ether theory remains valid at arbitrary small distances has to be rejected. The ether probably has a yet unknown atomic structure.

For this atomic theory we can apply canonical quantization. This has been shown for a simple discrete example theory, and there is no reason to doubt that it works for other atomic ether theories too.

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