Unfolding the space of theories

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Abstract

It is argued that physics necessarily is in terms of a prior flat space, which can be addressed as phase space. Spacetime itself is the conjugate variable to the gravitational field, what results in corresponding uncertainty relations.

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As from 1905, there have been left two fundamental dimensionful concepts: Spacetime and energymomentum. Planck mentioned his constant h in union with Newton's constant G as quite obvious candidates for conversion factors to pure numbers. However, the role of fundamental units has remained miracolous [1].

The paper [2] reflects the state of knowledge. If it is assumed that all measurements factually are in terms of spacetime quantities, then only one fundamental unit is needed to measure energymomentum as well. In concrete terms, the authors present the G-protocol and the h-protocol as alternatives: A mass m can either be estimated in terms of its Schwarzschild radius r_s or in terms of its de Broglie wavelength λ. The redundancy is obvious from the relation $r_s\lambda = 2Gh$ (I set the velocity of light unity). This implies that the space of theories spanned by G and h collapses as is shown in Figure 1 of [2].

This pretty clear analysis demonstrates that physics does not yet perceive facts correctly. Finally, any dimensionful physical concept must appear in terms of information [3] which is a pure number, hence two fundamental units have to enter the game. The residence for the concept of information is phase space. Quantum physics brilliantly teaches that not an n-dimensional Lagrangian submanifold is sufficient to describe physics, rather the full $2n$-dimensional volume of phase space is relevant. This can be formulated in terms of uncertainty relations or equally in terms of a commutator algebra. Consequently, in place of the above redundancy relation should come an uncertainty relation of the kind $\delta? \ \delta? \geq const \cdot Gh$, where the constant is a pure number of order of magnitude unity. I put question marks in place of the relevant quantities to reflect the fundamental difficulty: On the r.h.s. stands the square of a length, while two lengths can never be a pair of conjungate variables. Fixing this problem means unfolding the space of theories: The gravitational scale must be rearranged in phase space in a direction orthogonal to spacetime.

In the limiting case where gravitational effects are neglected, λ can easily be understood in terms of an uncertainty. Without loss of generality the massive particle shall be at rest relative to the observer, so the wave only oscillates along time x^0, while it is constant all over space. It makes no sense to have an object living shorter than for the duration of one oscillation, so $\lambda = \delta x^0$. In contrast, for the other limiting case where only gravitational effects are regarded, r_s does not appear in any uncertainty relation.

The point of view that spacetime is what we primarily observe exactly manifests itself in the Riemann-Einsteinian approach to gravitation. It has proven to be a good approximation at scales of stellar and planetary systems for yet unknown reasons, while it is rotten at the core. Bearing in mind that information is the universal currency of physics, spacetime and energymomentum have to be treated at an equal footing diametrally against General Relativity. A clear symptom of the current mistreatment is the strange way Newton's constant appears in the relations, while the roles of the velocity of light and of Planck's constant are widely transparent. Concedetly, the factual configuration of nature looks asymetric, but breaking of symmetries is a quite familiar phenomenon.

A phase space - in a somewhat extended sense - can be constructed by treating the gravitational field as energymomentum of gravitation itself. The principle shall be demonstrated by introducing $z^\mu = x^\mu + \imath \ell A^\mu$ together with the hermitian metric $g = \eta \otimes \mathbf{d}z \otimes \mathbf{d}z^*$, where the x are the 4 macroscopic spacetime degrees of freedom, ℓ essentially is the Planck length, A is the gravitational field and η is the Minkowski metric. As the crucial point, this phase space has prior flat geometry as the one with least information content. There is quite a pile of evidence that the postulate of background-independence in union with the assumed dynamic nature of metrics is the central misconception causing all the severe problems of current theoretical physics.

If this is accepted, it is quite straightforward to derive the classical gravitational field equations from an embedded extremal phase manifold varied in terms of the embedding space coordinates and their derivatives. How this can work in detail based on an appropriate coupling to the sources shall be discussed elsewhere. The only particular aspect needed here is the static isotropic solution. In place of the Newtonian $\frac{\mathrm{d}A^0}{\mathrm{d}r} = \frac{Gm}{r^2}$ comes the obvious modification $\frac{\mathrm{d}A^0}{\mathrm{d}r} = \frac{Gm}{\sqrt{r^4+\ell^4}}$, where r is the distance from the source. This makes the field finite at the source point, hence $\delta A^0 = A^0(\infty) - A^0(0) = const \cdot \frac{m}{m_{pl}}$, where m_{pl} is the Planck mass and the constant is a pure number of order of magnitude unity.

To sum up, in the pure quantum limit the uncertainty in time was brought in connection with the length of the wave, while in the gravitational limit the uncertainty in the potential was understood to originate from its variation over the radius. For the general case, as the central conclusion *spacetime itself is conjungate to the gravitational field*. In their terms, the uncertainty relations read $\delta A^\mu \ \delta x^\mu \geq const \cdot \ell$ for any $\mu = 0, 1, 2, 3$. I leave for a later discussion any technical aspect of minor importance, like dynamic constraints comparable to those in electrodynamics.

It is very instructive to see how the prior existence of a flat embedding space reopens the case of the velocity of light. Even if General Relativity was the correct universal description of gravitation, such a prior space would exist due to a mathematical theorem: Any intrinsic curvature can be produced from embedding in a flat space of sufficient number of dimensions. In this embedding space, symmetries are global with the translations trivial as is necessary to gauge information. From the above, in place of spacetime one primarily has to deal with embedded phase mainfolds, embedded phase trajectories and so on. However, irrespective of the interpretation, the slopes of singular straight lines have to be set global unity in embedding space, else the connection to the concept of information is wrong. Consequently, embedded intrinsically curved manifolds show what one can call a "variable speed of light" - a pure number - at the sufficient level of abstraction.

References

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[2] Matsas GEA et.al. 2007 arXiv:physics.class-ph/0711.4276

[3] As representative of a vast literature:
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