Re: Download a new book on quantum mechanics and relativity.

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From: bernard.chaverondier (*bernard.chaverondier_at_wanadoo.fr*)
Date: 10/05/04

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Date: Tue, 5 Oct 2004 19:12:50 +0200
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"Eugene Stefanovich" <eugenev@synopsys.com> a écrit dans le message de
news:41622565.7080302@synopsys.com...

bernard.chaverondier
> >>> If all symmetries of relativity are satisfied, then, there can be
> >>> only one speed c at which interactions propagate at a speed
> >>> independent on the motion of their source. If this speed
> >>> of propagation is infinite you get the Galilean Relativity

Eugene Stefanovich
> >>Why? Prove it!

Chaverondier
> > Presently, in the framework of _your_ theory, I can't.
> > My assertion could be proven (or disproved) if we had a
> > common basis. So, tell me the geometrical basics you would
> > agree with. 1 What mathematical structure do you accept
> > for the set of all events ?

Eugene Stefanovich
> First I choose one inertial observer.

Chaverondier
You can't. It's too soon. Your theory tosses in some way
Special Relativity because right from the beginning, you claim
that equivalence of physics laws in all inertial frames is not the same
than Lorentz covariance and claim this assertion to be an additional
axiom. You cannot support such claims without providing a precise
mathematical model of what is an inertial frame in your theory.

If you disagree that inertial frames are an inertial system
of coordinates (I will tell what it is below) you have
to define _mathematically_ what is an inertial frame.

It is not to harass you with tiny details. This inertial frame

mathematical definition is a central concept in your theory
because, if our discussion progresses how I think that it
may, I will probably be up to prove you that you have
* either to suppress Faster Than Light
interactions in your theory
* or to discard the principle of relativity of motion
(the impossibility to detect absolute motion) as
suggests the CJS theorem proving the incompatibility
of interaction of particles with the principle of relativity
in a non quantum context.

Eugene Stefanovich
> *Assume that this observer can erect*
> *three mutually perpendicular axes, that*
> *he has all necessary measuring rods,*

Chaverondier
>*From a mathematical point of view, you have first to*
introduce the for real numbers that are needed to locate all
events, that's to say a 4D manifold. Indeed, you can't define the
measuring rods and perpendicularity conditions (that's to say a
rank 3 spatial metric) and the measuring clocks (that's to say
a rank 1 time metric) as far as you have not a 4D manifold
where these geometrical tools can take place.

* So as to get a picture deprived of space−time curvature,
because you don't bother to account for gravity presently
so as to satisfy the Keep It SImple point of view, you have
to assume the constancy of these two metrics in any of the
cards mapping your 4D manifold (your set of events).

Now, for the sake of convenience, let us call it a space−time.
Up to now we have introduced only geometrical tools you
agree to pour in, so that they don't conflict with your views
of physics.

* these two metrics provide your space−time
(your set of events) with a foliated manifold structure.
* the foliation of your space−time into motionless
1D world lines which form the characteristic foliation of your
rank 3 space metrics (indeed, we haven't so far introduced
the tools that are necessary to define inertial observers
foliating the space−time into moving 1D worldlines)
* the foliation of your space−time into 3D slices
of simultaneity which form the characteristic foliation
of your rank 1 time metric.

* then you can introduce Orthonormalized systems of coordinates
(t0,x0,0,z0) (Aristotle frames R0) which are such that
* the space metrics dL0^2 writes as
dL0^2 = dx0^2+dy0^2+dz0^2

* the time metrics dT0^2 writes as
dT0^2 = dt0^2

* Then you can introduce canonical transformations of this metric space−time as transformations preserving these two metrics (hence their characteristic foliation, ie any leaf transforms into an other leaf)
* the time translations are transformations that let our time leaves unchanged (a 1D motionless world line transforms into the same 1D motionless world line)
* the space translations let our space leaves unchanged (a 3D simultaneity slice transforms into the same 3D simultaneity slice)
* the space rotations let your 3D space slices of simultaneity unchanged (a 3D simultaneity slice transforms into the same 3D simultaneity slice) and at least one motionless world line is unchanged.

Hence our space−time is now equipped with the Aristotle group structure encompassing the space−time translations and the space rotations. The Aristotle frames transform into each other in accordance with actions of the Aristotle group SE(1)xSE(3) (group product of the time Euclidean group of time translations by the space Euclidean group of space isometries)

Of course, we may pretend that all that is a geometrical model of what takes place in a given inertial frame, but, as this concept of inertial frame has not be given an appropriate mathematical model up to here, it is an assertion which would be deprived of any mathematical content (even if some heuristic meaning can be attached to such an idea, this isn't a relevant feature in the verification process of mathematical consistency of your theory you are engaged now)

Eugene Stefanovich
> He also has a clock which assigns to each measurement
> a real number − the time of the measurement.

Chaverondier
I have introduced above the time metrics that provides you with the minimal mathematical content you require to be up to use it.

Eugene Stefanovich
> Then I assume that this observer can register events and
> measure their positions in space. So, he can assign three
> real numbers (x, y, and z) to each event. So, events are
> characterized by at least 4 real numbers (position and time).

Chaverondier
>From a mathematical point of view, these 4 numbers picture
of space−time location of events has to be set right form the
beginning. It is so in my above proposal thanks to the introduction
of a 4D manifold. Indeed you can't define durations and lengths
without a 4D manifold where the time and space metrics that
model such things can take place.

Chaverondier
> > how do you define space translations (as we have not
> > defined what is an inertial frame and can't as far as space
> > and time themselves have not been defined first) ?

Eugene Stefanovich
> I think that you don't need to know anything about space and
> time in order to define inertial frame. Inertial frame (or observer)
> is self−evident and does not require definition.

Chaverondier
I strongly disagree about this point. Your theory drastically
requires a precise mathematical model of what you name
an inertial frame. This is a pivotal concept in your theory.
You cannot prove anything if you don't define what it is
mathematically.

Eugene Stefanovich
> You have your inertial frame, I have mine.

Chaverondier
Up to here, you have no inertial frame. You
haven't defined what it is mathematically.

As far as I can see, the best mathematical definition of an
inertial frame is to consider it as a system of space and time
coordinates endowed with appropriate properties about the
way they transform into each other. Indeed, each observer
in its inertial frame will ascribe a time and a space coordinate
to any event, so that any inertial frame will necessarily be
ascribed a system of space−time coordinates locating events.

Now, as we have now introduced space, time as well as time
and space metrics, we can now ascribe a time measurement
and a position measurement to any event in a given Aristotle
frame. We are now up to define inertial frames as systems
of coordinates stemming from appropriate space−time
transformations (called boosts) of Aristotle frames.

Theses boosts will be derived on the basis of the
mathematical hypotheses expressing the physics properties
we consider to be required (noteworthy an appropriate
expression of the principle of relativity of motion).

In these inertial frames, you can define mathematically,
a time metric and a space metric stemming from these
boosts. You need these metrics so as to be able to speak
of durations and distances measurements in a given frame.
Hence you have to define them in such a manner that
they satisfy the principle of relativity. Consequently,

If R0 is an Aristotle frame and R an inertial one,
(ie a boosted one)
* the "same" rod in R or in R0 have to be seen as
having the same length in R as in R0
* the "same" clock in R or in R0 has to be seen as
ticking at same rate in R as in R0

Hence, if coordinates (t0, x0, y0, z0) in an Aristotle
frame R0 transforms to coordinates (t,x,y,z) thanks to
a boost, you must have a covariant definition of the
time and space metrics in the inertial frame R.
* if in R0 you have
dL0^2 = dx0^2+dy0^2+dz0^2
dT0^2 = dt0^2
* then, in R you must have
dL^2 = dx^2 + dy^2 + dz^2
dT^2 = dt^2

Notice that this is not a complete expression of the
principle of relativity. The symmetry of point of view
between an observer standing in R and an observer
standing in R0 has also to be accounted for (as well
as some other physics requirements that are needed
to define what is a boost in an unique manner).

Then, given these physics assumptions we can derive
the expression of boosts. I don't go further into these
details so as to try to keep this post a decent length.
That's what I did in
http://perso.wanadoo.fr/lebigbang/epr.htm and
http://perso.wanadoo.fr/lebigbang/transformation.htm

Chaverondier
> > 5 What do you define as an inertial frame ?

Eugene Stefanovich
> Easy. This is observer (it could be a person or a Pioneer
> spacecraft, doesn't matter) which has necessary measuring
> equipment (like measuring rods, clocks, etc.)

Chaverondier
So that an inertial frame can be associated with the possibility
to ascribe any event with 1 time and 3 space coordinates because
the observer has the measuring tools that allow him for such

a space−time parameterization associated with his inertial frame.

Hence, form a mathematical point of view, we can define
an inertial frame as a system of space and time coordinates
and these systems have to transform in an appropriate
manner thanks to the restricted Poincaré group actions
(which appear to be spanned by boosts together
with the restricted Aristotle group actions)

Indeed inertial systems of space−time coordinates
form the space time parameterization that enter all
your models, measurement results, equations and
so on, so that they have to be defined in a rigorous
mathematical manner.

Notice that I don't require you to assume that all laws
of physics satisfy the covariance with regard to the
transformations of your inertial frames
(ie inertial systems of coordinates)

I only need that you define the way these systems
of inertial frames of coordinates transforms into
each other when an inertial frame change is involved.

After that, you can decide if only free particles
or all laws of physics satisfies the covariance
with regard to these transformations.

That's an other matter and you are free of your choice
provided that your theory is self consistent (and of
course doesn't contradict known experimental results)
Your chapter 1 has to be enough mathematically detailed
so as to ensure that your theory doesn't discard at some
place an hypothesis that is taken for granted and used
implicitly or explicitly at some other place.

Eugene Stefanovich
> I am glad you raised this issue, because we
> really need to start our discussion from such
> basics as meaning of inertial observers.

Chaverondier
Fine, so that I think that our discussion should be
fruitful, even if it is a difficult one (don't imagine
that I underestimate its difficulty or the value of
your work whatever our present discrepancy of
point of view).

Eugene Stefanovich
> When you start to talk about Lorentz transforms
> you need to ask "Lorentz transforms of what?".

Chaverondier
Absolutely. As soon as you have defined your space−time
parameterization (and restricted your choice to inertial frames
of coordinates) you can define what are Lorentz transforms.
These are precisely the transformations of inertial system of
coordinates into each others.

Eugene Stefanovich
> *So far we described our inertial observers (e.g., astronauts*
> *moving in free space along all possible directions).*
> *We haven't introduced any physical system yet.*

Chaverondier
Yes we have. We have the measuring rods and clocks
(modeled as space and time metrics on a manifold) and
the inertial systems of coordinates without which you are
deprived of space−time parameterization up to characterize
the location and the moment when physics events occur
as well as lengths and durations.

Space−time parameterization and numerization of measurement
outcomes can't exist independently of measuring tools
satisfying symmetries requirements which are precisely
at the root of the geometry embedded in space−time and
implicitly used in your work. This has to be done explicitly
so as to prove that there is no inconsistency between an
implicit geometrical assumption and an explicit one.

Eugene Stefanovich
> *When astronauts (observers) look out of their windows they*
> *see nothing, just black cosmos, and probably other observers.*
> *Each observer can measure properties of other observers*
> *(position, angle, velocity, time).*

Chaverondier
These measurements are coded in accordance with a manner to
ascribe space and time coordinates to events as well as a length
to a given rod and a period to the ticking rate of a given clock.

Eugene Stefanovich
> *When these measurements are compared, observers may figure*
> *out that the set of transformations between them is a 10−parameter*
> *group called Poincare group. That's a big step forward. Now*
> *we not only know that there is some symmetry in nature...*

Chaverondier
We have to know of this symmetries and use them right from
the beginning of our mathematical construction. They are needed
to build the time metrics, space metrics and inertial frames concepts.
It's the basis to define the way you ascribe numerical values
to measurement outcomes and their location in the space−time

parameterization provided by an inertial frame of coordinates.

Eugene Stefanovich
> *Now suppose, there appears some object (physical system),*
> *let's say a meteorite. All observers start to measure its properties*
> *and conclude that the meteorite moves along straight line with*
> *constant velocity.*

Chaverondier
This is precisely one of the properties you need in order to define what is an inertial system of coordinates. As far as no other properties than its space−time trajectory is considered, a free particle is a straight worldline. An inertial frame of coordinates has to satisfy to the requirement that a free particle in an Aristotle frame is again a free particle (a straight worldline) when observed in an inertial frame (ie a boosted Aristotle frame). This contrives boosts to be 4D diffeomorphisms transforming straight lines into straight lines. This requires them to be affine transformations of Aristotle space−time (which proves the linearity of inertial system of coordinates transforms, ie Lorentz transforms).

Eugene Stefanovich
> *The same Lorentz formulas will be applicable*
> *for events related to systems of such non−interacting rocks*
> *(e.g. to collisions of such rocks). See my derivation of*
> *Lorentz transformations in subsection 2.3.3.*

Chaverondier
Hence, you agree that an inertial frames can be defined as systems of coordinates transforming into each other thanks to the Lorentz transforms.

Eugene Stefanovich
> *Now comes the difficult part. Suppose that all meteorites*
> *in the system bear a non−zero charge. It is easy to find out*
> *how positions and velocities of interacting meteorites will*
> *change with respect to translations and rotations. These*
> *transformations are kinematical.*

> *To find out how time translations affect positions and*
> *velocities is difficult : these transformations are dynamical.*
> *For each meteorite, the change of its position in time depends*
> *on positions and velocities of other meteorites in the system*
> *and forces acting between them. To figure out the result of*
> *boost transformation is as difficult as for time translation.*
> *Boosts are dynamical as well.*

Chaverondier
Agreed

Eugene Stefanovich
> The principle of relativity is:
> 1) all inertial observers are physically equivalent.

Chaverondier
1/ provided that an inertial observer be defined as an inertial
system of coordinates. If not, you have to define what is an inertial
observer and not misrepresent the inertial frame with a dynamical
system, encompassing interacting particles, space−time parameterized
in that inertial frame.

Eugene Stefanovich
> Then you need another postulate:
> 2) the group of transformations between
> inertial observers is the Poincare group.

Chaverondier
In my proposal, this postulate was not stated a priori.
I gathered any requirements and any required symmetries
from physics considerations and derived as a consequence
the restrited Poincaré group as the symmetry group
transforming inertial systems of coordinates into each
others. System of coordinates, whatever they are, don't
exist independently of physics phenomena ruling the
symmetries satisfied by the measuring apparatuses
of the observer (noteworthy rods ans clocks).

Eugene Stefanovich
> The third important postulate defines the space of states
> of the physical system. This can be a Hilbert space for
> quantum system or phase space for classical system. It then
> follows from postulates 1) and 2) that inertial transformations
> of observers are represented in the state space by unitary
> operators (in the quantum case) or canonical transformations
> (in the classical case). Let's take quantum case for definiteness.
> The generators of the representation of the Poincare group are
> denoted by P (space translations), J (rotations), H (time
> translations), and K (boosts). The dynamical character of time
> translations is expressed by the form H = H_0 +V of the Hamiltonian.
> V is interaction, H_0 is free−particle Hamiltonian. The dynamical
> character of boosts is expressed by the form K = K_0 + Z.
> Z is boost interaction and K_0 is boost operator for the system of
> non−interacting particles. When you consider the Poincare group,
> it is impossible to have non−zero V and zero Z. This would
> contradict Poincare commutation relations. Therefore, each interaction
> in the Hamiltonian V is accompanied by interaction in the boost
> operator Z. Boosts are dynamical, and boost transformations of
> trajectories of interacting particles are different from Lorentz
> transformations.

Chaverondier
Agreed. I know you doubt it, but I consider your above
statement as an extension of the CJS theorem proving
that the principle of relativity of motion doesn't apply to
interacting particles.

I don't know exactly what should be thought of the required
gauge transformation that Bilge is strongly arguing about but
I think you should investigate that matter with some scrutiny.
If gauge transformations requirement provide you with a wrong
Hamiltonian, you have to know exactly what goes wrong in this
picture. It wouldn't be to much a surprise to me if that were
connected to the fact that quantum diffusion begins with free
particles and ends with free particles so that some conditions
that are physically correct at the beginning and at the end of
the dynamical phenomenon are not anymore so during the
quantum interaction.

I don't believe the quantum dynamics to be a Lorentz covariant
process. That's one of the strong reasons why I am interested
in your theory which sems to fill a gap, as it seems provides a
dynamical model of quantum diffusion and solve ultraviolet
Quantum Field Theory divergences. All that is really appealing
whatever our present discrepancy of point of view.

Eugene Stefanovich
> *Instantaneous interactions and causality and the*
> *principle of relativity can peacefully coexist together.*

Chaverondier
I think that this discrepancy should be cleared up when we will
agree on the geometrical basics grounding your mathematical
model of space, time, rod lengths, clock ticking rates, inertial
frames and boosts.

Eugene Stefanovich
> *OK, I probably do have what you call geometry, but I prefer*
> *to use terms "measuring rods", "clocks", "distances" etc,*
> *instead of "geometry". That's because I am afraid that you'll*
> *drag me into the 4D Minkowski space−time, which I don't*
> *like at all.*

Chaverondier
You are right to be afraid. If you define the geometrical tools you
need in a rigorous manner, I don't believe that you may find a way
out to preserve the principle of relativity of motion. In such a case,
your work should be considered as encompassing, at his heart, a quantum
extension of the no−interaction CJS theorem proving the incompatibility
of the dynamics of interacting particles with the principle of relativity.

Bernard Chaverondier
http://perso.wanadoo.fr/lebigbang/transformation.htm
Derivation of Lorentz transforms and "canonical" inertial
frames in the framework of Aristotle space−time.
http://perso.wanadoo.fr/lebigbang/epr.htm
Quantum determinism or Relativist locality ?