Re: the basis of relativity

Source: http://sci.tech−archive.net/Archive/sci.physics.relativity/2005−06/msg00136.html

- *From*: "Ken S. Tucker" <dynamics@xxxxxxxxxxxx>
- *Date*: 1 Jun 2005 12:31:09 −0700

Tom Roberts wrote:
> Ken S. Tucker wrote:
> > I think you'll find this fun, see Weinberg's
> > "The Gravitational Action" pg 364.
> >
> > IMO, there is a clear geometric definition of
> > the g−field, characterized by the gravitational
> > action invariant.
> > Please see Weinberg's "Grav & Cosmo", Eq.(12.4.2).
> > Therein we see the Curvature Scalar "R".
> >
> > I understand a non−zero "R" at (x) denoted R(x)
> > means a g−field exists at (x) that cannot be
> > transformed away, due of course to the invariance
> > of "R".
>
> The actual value of the Action does not matter −− one can add an
> arbitrary constant to it without changing any physics.

I find no evidence to support your statement, check
Weinberg pg 360−1, it's not there, provide a ref please.

> Indeed, there is a much larger group of functions one
> can add without changing any physics....

Yes, but action is not *usually* considered in that
group. Just examine adding an arbituary constant to
Plancks "h", such as −h, the physics will change :−).

> And, as the previous posts pointed out repeatedly: R^a_bcd can be
> nonzero but R is zero (because the terms in the contractions sum to
> zero), and this _ALWAYS_ happens in a vacuum region.

The problem is: If R=0 then constant g_uv's may be
used to describe that field over a finite region.
Hence R=0 means R^a_bcd=0, that's a fact.

> The nonvanishing of
> R^a_bcd (the Riemann curvature tensor) is what indicates the manifold is

> not flat; whether or not that indicates the presence of a "g field"
> depends in detail on what you mean by "g field".

In our framework, that means we have spacetime defined
by light paths in which g_uv are not constant. Baring
classical EM interactions, like refraction, we're in
a g−field.

> But yes, if R is nonzero at a given point that nonzeroness cannot be
> transformed away.

agreed

> > Ok, in view of the above let me summarize my
> > understanding of the discussion.
> > The R_uv=0 has TWO solutions,
> > 1) g_uv = constants
> > or
> > 2) g_uv = Schwarz Solution.
>
> No. The eqution R_uv=0 has an infinite number of solutions, of which you
> named 2 (assumeng you means the Schwarzschild solution for (2)). That's
> why one needs boundary conditions (like any other set of PDEs)....

The point is, R_uv=0 has two solutions, and you maybe
correct it has more, but for our purposes we agree
those two exist, coincident with R_uv=0, ok?

> > However R^a_bcd =/=0 requires the g_uv are NOT
> > constants, and that *implies* to me R=/=0, [...]
>
> See above. You keep getting the implication backwards.

Study metrics where R=0, i.e. No Curvature, in that
case we can surely use constant g_uv's right?

> > IMO, the use of G_uv=T_uv=0 is a non−physical
> > *approximation* of "empty space".
>
> It's no "approximation", it is _exact_ −− that is what we mean by "empty
> space" (aka "vacuum"). This may not correspond to any region of the
> world we inhabit, but that's a different issue....

> > In fact the
> > space is NOT empty, as it contains the gravitating
> > body.
>
> What "gravitating body"???? −− if T_uv=0 in some region, there is
> nothing in that region. Period.

> This, of course, says nothing about
> other regions of the manifold. If there is matter in other regions, then
> even though T_uv=0 in the region in question[#], almost certainly
> R^a_bcd will be nonzero −− gravitational attraction exists in vacuum
> regions.
>
> [#} Hence R_ab=0 and R=0 in that region.
>
>
> The Riemann (components R^a_bcd) curvature tensor can be separated into
> two tensors: the Ricci tensor (components R_ab) and the Weyl tensor
> (components C^a_bcd); at each point Ricci is related to matter/energy at
> that point while Weyl is related to matter/energy elsewhere.

IMO we're analysing AE's Law, I think we may be
digressing by beginning an analysis of the Weyl.

> > The definition of a vacuum can then depend
> > upon the arbituary volume one chooses, certainly
> > that's not a good definition.
>
> You are confused. See above. There is no such indefiniteness about what
> "vacuum" means −− it means T_uv=0 at any point in the vacuum region.

I'm not confused at all, but I do recognize ambiguity
in the definition of a vacuum. Tell us what volume we
should use to calculate the density and hence vacuum
using mass/volume=density and why.

> > I prepose the definition of a vacuum in GR to be
> > defined by the effect of the spacetime field G_uv
> > on light propagation, such as deflection, Shapiro,
> > Pound−Rebka which differs from one that an inter−
> > galatic "empty space" would be.
>
> Don't "prepose" anything, just use the standard meanings of words, or
> you will get hopelessly confused (as if you aren't already (:−().

No Tom, you're drifting to insult. Please define
vacuum (aka density) or ref as we should use it in GR.

> > Hence in the presence of the Sun a particle like
> > Mercury would *strictly* require T_uv>0 to calculate
> > it's precession, though retain G_uv=0 as an
> > approximation, but not truly physical because of the
> > two possible solutions above that are permitted.
>
> You are confused.

Tom, your trying our patience, answer the questions.

> The usual approximation

Yes, we agree to approximation...

> used for computing the
> precession of Mercury's perihelion is that the region of its orbit is
> truly vacuum, and the sun is spherically−symmetric and not rotating, so
> the Schwarzschild metric holds in that region. Hence in this
> approximation G_uv=0 and T_uv=0 and R_uv=0 in the region of its orbit.
> One can then calculate its precession using the Schw. metric. One can
> show that the error in assuming that region is vacuum is negligible.

Negigable is vastly different than zero in theory.
I can tweek Newton's gravity and get GR's results,
does that make it right?

> > So I suggest recognizing Gravitation as an *Action*
> > (not a field) as Weinberg describes in the ref.
> > (Perhaps the field concept is a Newtonian hang−over).
>
> Again you are confused.

Tom, answer the questions, if you can.
If I'm confused and you aren't then it
should be easy for you, just point to
the exact equations.

> While indeed the notion "gravitational field" is
> quite ambiguous in GR,

Why is it ambiguous, why do you think that?
How would you remove that ambiguity?

> the action does not come close to meeting what
> people expect from that concept.

What people? Who said that? Do you have a ref?
Regards
Ken S. Tucker

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- ***Follow−Ups***:
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    - *From:* Tom Roberts
- ***References***:
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◊ *From:* Tom Roberts

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