The Future of Physics and the World

Source: http://sci.tech−archive.net/Archive/sci.astro/2005−04/msg00037.html

- *From*: whopkins@xxxxxxxxxxx
- *Date*: 2 Apr 2005 15:37:24 −0800

Over the following months a new archive, the Federation Archive −− temporarily set to be located at a free web site that is currently also the home site of the Federation Series:
http://www.federation.g3z.com/Federation.htm
shall be opening, including numerous informal papers, expositories and other writings, perhaps numbering ultimately up to 1000 or more, from myself in a diversity of fields including Physics, Mathematics, (some of
which have been previously mentioned in articles here over the last few days) as well as numerous other areas ... and, in addition, a select range of similar writings, many edited and upgraded, from a wide diversity of other people.

A watershed event in history, whose full significance shall only become apparent with the hindsight of future historians, has just taken place. And it is with this opportunity, granted the permission of the moderators, that I'd like to make a few remarks lending perspective on the event, on the future world, and on the progeny of Physics, including
an account, given somewhat in depth on the new Physics, as yet unseen, of that world.

The change in orientation is a legacy of the post−War time of the 1950's
that saw the likes of Oppenheimer, Einstein, Dyson, etc. shifting their focus onto larger events. In more recent times, it has seen the Russian
Physicist Sergey Kapitza tackling the larger issues from the perspective
of physics applied to large−scale systems, like the human race, itself; or the emergence of physical economics based on gauge theory via the intimate correspondence between arbitrage and curvature; or the recent shift in focus onto the large−scale issues by no less than the former moderator, John Baez, himself.

And now, this includes me, with a vision no less than one of Alexandrian
proportions. Much of what's seen here will ultimately find its way into

the 2nd and 3rd volumes of the Federation Series: the Fourth Wave and Progeny.

Only part 1 of the following will be presented here, the other sections listed only for reference. The rest may eventually be found at the archive, or elsewhere on the USENET under articles with the same subject
header.

An early preview of some of the material in part 2 can be found under the Fourth Wave presentation,
http://www.federation.g3z.com/TV04/Index.htm
originally given at Transvision 2004 in Toronto in August, 2004.

Full Contents
−−−−−−−−−−−−−

1. Progeny

1.1. The End of an Era

1.1.1. The Last Will be the First

"... many now first will be the last, and the last will be the first".

The man who ACTUALLY brought down Communism, reconciled with modern science and with the various faiths of the world has just died. Today, the Vatican is a major contributor to research and conferences in Biology and Astronomy, having closed its dispute with modern science, apologizing for its actions during the time of Galileo. The spirit of reconciliation has been extended not just to the sciences, but to other religious bodies of the world: Judiasm, Islam, Protestantism.

The world left behind is a de facto confederation, united in a single body that encompasses every nation on Earth, but for the Vatican and Taiwan. Taiwan, pending the peaceful resolution of its dispute with China that will arise after China's ruling party splits into 2 and accommodates the Taiwanese government in its newfound diversity, has indirect representation through some Pacific nations.

The Vatican stands alone as the piece that does not fit the puzzle, working in close association with the UN as a kind of world conscience, but standing apart from it as a clear testament of the inability of the world body −− that even in the words of its own leader is no longer suited to these times −− to fully accommodate the diversity not only of its nations, but of the TYPES of all its institutions that are housed on this world.

The last Pope, as the Malachian tradition ascribes to, but for 2 is

gone. An ancient order is, in many ways, a continuation of Rome, itself.
Gregory the Great, 590−604 was from a family in the Roman senate, which continued to function all the way up to 609. He restored the imperial grain distribution, made reparative restorations to Rome, itself, carried on the leadership of the defense forces, etc. The modern institution will continue on, going on to greater heights in the pursuit of the spirit of reconciliation on its own behalf and, in a mediative role, on the behalf of others as the next bishop of Rome emerges.

It will be one of the catalysts, and one of the guiding consciences, of the future world to come.

1.1.2. Galileo, Reconciliation and the Origin of Relativity

Despite the Vatican's advocacy of the modern sciences, with a solid presence in the Astonomy community, its history is marred by the shortsightedness of its intransigence in its dispute with astronomy and the natural sciences.

But there's plenty of blame to go around, and, even today, the lesson of the history of that time STILL has not been fully assimilated −− not even by those who claim to be the most ardent supporters of the Galilean stance that now underlies modern science.

Galileo was interred challenging the authority of the time. Though his advocacy of Copernicus was not branded a heresy, his attack of the Church's position was treated as such. And for this, Galileo truly was wrong. His wrong, which mirrored the intransigence he was mocking, was to insist on the dichotomy of the two positions. The very fallacy that both sides tacitly endorsed was, itself, the false pretext of their pseudo−debate.

It was his inability to dislodge the traditional stand (which was largely founded on the fact that the stars show no observable parallax that one would expect for a moving frame), and his inability to draw the necessary and correct conclusions that made him equally the subject of the condemnation of hindsight that sees the pettiness of the debate of the time.

Even as modern science holds to: it is not enough to prove your side right. Advancement is only made by also explaining WHY and HOW the other side is wrong −− or else, finding an accommodation that subsumes everything.

The psychological effect of being forced, under pain of torture or worse, to utter the words "I was wrong" is undeniable: you begin to

take
seriously the notion of playing devil's advocate (an ironic use of
terms
here) and thinking through the issues more clearly. When two people in good conscience, consistent with the facts on hand, hold to opposite positions, then there is clearly something in between that both have
not
yet taken into account that divides them.

This lesson, for instance, has not been fully assimilated by many in the string and loop QG community.

It was only during his confinement that the steadfastness of both sides of the debate finally began to register on Galileo. And it was only because of this that during this time the Earth−shaking idea finally dawned upon him:
Motion is relative. ALL frames of reference are equivalent.

Thus it was that Galileo, the actual discoverer of the Principle of Relativity finally came onto the insight. And it is Relativity that excuses and reconciles the conflict in the two points of view. It is only from this that one can proceed to investigate natural phenomena, not only in the terrestial frame where the ground is fixed, but also from the celestial frame, where nothing is fixed, but where the order intrinsic in the motions of the planets suddenly becomes clearer.

Relativity is actually what unites the terrestial world with that of outer space. The Copernician Revolution only provided order for the celestial domain, and was an incomplete revolution.

An ancient book can be excused for describing an event in the
terrestial
frame of reference, since it was intended for an earthly readership.
It
could have equally well argued −− even back during Galileo −− in a way acceptable to all sides that had there been anyone on the moon to deliver the stories to the most natural mode of description would have been to render it in the frame they resided in: the lunar frame. But
in
this frame, the Earth rotates once a day. Indeed, all parties to the medieval debate accepted without question that whatever lay in the sky would go about the Earth once a day. So ANYTHING that managed to find its way all the way up into the sky would have to participate in this universal motion. From its perspective, the Earth would be rotating.

The view opens up more revealing questions that were never asked: at which altitude does the transition to the celestial daily motion initiate? Is there a transition region where a part of this motion is imbued onto matter? For instance, does the passage of storm fronts have anything to do with the relative rotation of the Earth and sky?

The general mode of thought was easily available to all parties even at that time. For, despite impressions to the contrary, the notion of travel to the moon or life on the moon or elsewhere is not a modern idea at all. In fact, the first bona fide Science Fiction story about travel to the moon is not from H.G. Wells from the 19th century, but from ancient Rome, in 160 AD by the Greek satirist, Lucien of Samosata.

It was translated in the 17th century by no less than Kepler, himself, who proceeded to write his own Science Fiction story on space travel. Undoubtedly, it also had an impact on the development of Kepler's Laws.

Unfortunately, the lesson of history has not yet been fully assimilated.

1.1.3. The Return of Plato versus Copernicus

Though people in their heads think of the world as modern science does; ALMOST NOBODY actually believes this picture −− even when they think they do and claim to. To this day people will still be shocked if you point downward in the precise direction of their favorite religious holy site −− as if "down" meant hell. If you point down and say the sky is that way, you still get a blank stare. Nobody knows where they actually are. They still tacitly think of the world as being a gigantic Cosmic Floor over which (for some) might sit the abode of a really, really old man (and His angels); and under which sits the hot lava−like abode of his former accomplice gone bad.

You literally have to stand on your head while outdoors to see things as they actually are. The first time doing so can be rather disorienting: you get the impression that your feet are dangling in the middle of an infinite void and that a giant planet is resting heavily upon your shoulders.

A little thought reveals that the impression is not the illusion and the "real world" real, but quite the opposite: the everyday perception is the illusion and the world seen upside down is the reality.

But nobody stuck in an Earthlubbing civilization will ever clearly see this.

The Platonistic view of the world, with the Earth at the center, has still not been relinquished. The prevailing mode of thought is still on what to do in THIS world, as if that were all of reality. It still treats the prospect of exterrestial civilizations as taboo, when the

principle of modern science, which holds to the premise that nothing
over the sun or under the sun is extraordinary −− demands that the
premise be no less than the null hypothesis, and the possible absence
of
other civilizations the "extraordinary fact requiring extraordinary
explanation".

The shift in viewpoint spawned by the Copernician revolution will not
be
fully consummated until the world has taken the next step into becoming
a spacefaring civilization. Until then, it will remain cooped up in an
increasingly claustrophobic world where, even now, the hallmarks of the
destructive syndrome of Cabin Fever (otherwise known as the Rapa Nui
Syndrome) are have started to take root.

1.2. The Outline of Future Physics

1.2.1. Light Cone Tunnelling, Black Holes and Hawking's Self−Admitted Error

Nothing stays in a black hole.

Early on, it was thought that objects stayed at the event horizon for
all eternity and never fell in. In particular, in the Russian school,
one saw the term "frozen star" for Black Hole. At a later stage in
thought this was clearly recognized to be wrong, as the proper time for
an object falling into a classical black hole remained finite all the
way to the singularity.

Unfortunately, the very pointing out of the fallacy was, itself, based
on an even larger fallacy that went largely unnoticed until I raised
the
issue here in 2000 and 2003, and Hawking shortly later in 2004.

It was remarkable display of intransigence that even in the process of
replying to the repudiation, presented here, of the mistaken notion
borne of the classical model of the black hole, that a moderator ended
up reiterating the very point repudiated, repeating the fallacy and
then
compounding the error by pointing out the first generation fallacy the
2nd generation of thought superseded −− thus being 2 steps behind the
game!

However, this pertains to the classical Black Hole. There is no such
thing as a classical black hole, if we are to believe Quantum Gravity.
All black holes radiate, and eventually radiate away.

What is the consequence of that? Technically, an "event horizon" is
the
surface bounding a causal trapped region in space time. For a black

hole that radiates away, there is no trapped region, at all. What is commonly construed as the "event horizon" is actually only a transient local causal horizon. It does not bound a trapped region. The black hole −− a' la Hawking −− has no clearly defined event horizon.

The "Information Paradox" is based on fallacy and is no paradox at all.

Thus, by June of 2004, no less than Hawking himself (apparently) taking up the lead, admitted that after 30 years of through on this matter that
he (and by extension the rest of the Physics community) was simply wrong.

As Hawking now (belatedly) agrees, black holes, do not have well−defined
event horizons, and nothing stays (or even goes) in. By the time it gets there, the black hole is already gone.

The reason in retrospect is clear. In a quantum theory of gravity, the metric is also subject to a non−zero dispersion borne of the uncertainty
principle. The light cone, whose very definition involves the metric, is therefore likewise subject to a smearing. What in one state may be within the light cone, on the edge, in another state may lie outside; or
vice versa. With the superposition principle, one also has the possibility that a quantum state can be the superposition of two such states so that the very question of what lies inside the light cone and what lies outside is ill−defined.

The event horizon of the classical black hole is the light cone. More precisely, it is the outer envelope of all the light cones on the sphere
of symmetry surrounding the black hole. In a quantum setting, its precise definition is subject to the uncertainty principle and what may lie in some states in the "inside" will be seen in others as "outside". The very definition and position of the horizon becomes observer dependent.

The ill−definedness of the horizon −− a special case of the ill−definedness of the light cone −− is a corollary of a feature unique to a quantum theory of gravity: light−cone tunelling. Radiation of the Hawking black hole, in effect, is tunelling through the light cone that comprises the event horizon.

For a radially infalling observer, assuming the Stefan law for radiation, in the observer frame what will happen is that during the infalling the horizon will slowly recede as the Black Hole is radiating away. Eventually, with the time compression taking full effect, there will be a point where the distance between the observer and the horizon will actually be at a minimum after which the receding of the horizon outruns the observer and the black hole evaporates before the observer reaches the singularity.

At no point will the observer ever fall within the horizon.

>>From their frame of reference there is no actual horizon. In contrast from a frame of reference at asymptotic infinity, a horizon persists as long as the black hole is there. For other stationary observers closer to the black hole, they will see a different location with the horizon further in. For those infalling, there is no horizon at all.

Thus, the notion of local causal horizon assumes primacy in a prospective quantum theory of gravity.

Causal horizons give us local Rindler states, associated with which are thermal vacuum states. Thus, at the center of any theory of quantum gravity are the laws of thermodynamics.

1.2.2. Local Horizons, Quantum Theory in Acausal Universes and the Thermal Vacuum

Quantum Field Theory is generally ill−defined, even when pursued in a classical background spacetime. By "generally", what we mean is over the most general classical spacetime which not be globally hyperbolic. Though I pose it as a conjucture here, it seems intuitively obvious that
with respect to any reasonable measure one can come up with, almost all Lorentzian spacetimes are globally non−hyperbolic so that, technically, Quantum Field Theory is ill−defined about 100% of the time.

Clearly there is something wrong here. What we are saying is that the portion of the universe which lies outside the causal horizon −− which could literally be anything −− has a relevant bearing on the very question of whether the quantum field theory formed on the clasical background of the part within the horizon even exists! This violates in
the worst possible way both the principle and spirit of locality.

It should be possible to formulate a theory in a way that ignores the fine details of what goes on outside the scope of the observable part of
the domain under investigation (here: the universe within the causal horizon) and accommodate by other generic means the part on the outside.
If that principle sounds familiar, then we don't have to go very far to understand why: it's the premise behind the idea of coarse−graining.

In a classical background, the spacetime can be thought of as covered by
a set of compact locally hyperbolic regions. Each region R is bounded

by two spacelike surfaces Boundary(R) = (R+) − (R−), each region (R+), (R−) having a common boundary: d(R+) = A = d(R−), which provides an "anchor" to the region.

The anchor takes on the analogous role of asymptotic infinity, except here it lies on the outer periphery of the compact region R.

The region, R, itself is generated by a homotopy which connects the two bounding surfaces:
R = { R_t: 0 <= t <= 1 }
with
R− = R_0, R+ = R_1, Boundary(R_t) = A.
In this way, we have the desired framework for formulating a suitable action principle:
S = Integral L_t dt
L_t = Integral_{R_t} (L(x) d^{n−1} x)
n = dimension of the spacetime
The homotopy parameter plays the role of the "t" coordinate
prerequisite
to formulating a quantum theory.

But now what about consistency?

First, suppose the region is embedded within a larger globally hyperbolic spacetime R*. Then one may take a spacelike surface A*,
such
which lies in R* − R, such that
d(A*) = A;
A* union R_t = C_t is a Cauchy surface.

In the local quantum theory, the state space is that corresponding to the subsurface R_t. When embedded within the larger spacetime, the state space for R_t is derived from that for C_t by integrating out all the modes associated with the external surface A*.

Thus, we implement coarse−graining.

The end result is a local spacetime region with a local causal horizon. The integration of the external modes yields a Rindler horizon and a Rindler vacuum state.

Second, suppose now we're in the more general situation where the
region
R may not be embedded within a globally hyperbolic spacetime. If we
are
to hold to the general principle of locality, then we should require that the same description of the local physics continues to apply, even in this case.

Consequently, one of the central axioms of the Wightman formalism −− that of a pure Poincare' vacuum state −− must be relinquished. In the

most general case, where spacetime may be globally non−hyperbolic, there
need not be a universal configuration space, nor a universal quantum
pure state. Instead, one can only talk about LOCAL configuraton spaces,
and LOCAL (thermal) states. Thus, thermodynamics and statistical
mechanics becomes an essential part of the foundation of the quantum
theory of gravity.

But, now what about consistency, itself? What is required for
compatibility to hold for the overlapping parts of locally hyperbolic
regions? As was first discovered by Jacobson in 1995

Thermodynamics of Spacetime: The Einstein Equaton of State
gr−qc/9504004 v2

the requirement of compatibility (proportionality of entropy and the
area of a local causal horizon, following the famous Hawking formula)
implies a lensing effect which, itself, leads as a corollary to
Einstein's equation in the classical limit!

Hence, one recovers General Relativity for free. Here, however, we're
dealing with a more general context where the spacetime need not be
globally hyperbolic, and where compatibility is between the overlapping
portions of locally hyperbolic regions. Thus, the Jacobson result in
this more general context is being posed as a conjecture.

If it holds true, then Quantum Gravity suddenly appears through the back
door: a quantum theory established on locally hyperbolic spacetime
regions, with a requirement for compatibility between regions includes
as a corollary Einstein's field equations.

1.2.3. Strings and Helical Worldlines. The Particle−String Duality of
−−−
Thiess
−−−−−−

In the 1930's Einstein and Infeld established that the geodesic law of
motion was actually derivable from the field equations of General
Relativity. The simplest way to pose the argument is to just take the
stress energy tensor, itself, for a point source, given by:
|g|^{1/2} T^{mn} = M dx^m/ds dx^n/ds delta^{3}(x−x(s))
and apply the Bianchi identities, themselves, which under the field
equations implies conservation law for the stress tensor:

d_m (|g|^{1/2} T^{mn}) + |g|^{1/2} Gamma^n_{ms} T^{ms} = 0

where d_m is the ordinary derivative d/dx^m. After substitution, we get
using the abbreviations
x^m' = d(x^m)/ds

$D = \delta^{3}(x - x(s))$
the result
$M x^{n\prime} x^{m\prime} d_m D + \Gamma^n_{ms} M x^{m\prime} x^{s\prime} D = 0$
and after a little delta function manipulation
$x^{m\prime} d_m D = -D'$
and finally
$M x^{n\prime} x^{m\prime} d_m D = -M x^{n\prime} D' = (M x^{n\prime})' D.$
Thus, after integrating:
$(M x^{n\prime})' + \Gamma^n_{ms} M x^{m\prime} x^{s\prime} = 0.$

Now ... what happens if we start out more generally with an N−dimensional singularity for $N > 1$. The general result is a similar set of equations, this time the coordinates being functions of several parameters, which we won't produce here. The resulting surface, generated by a map:
$X: S \to M$
where S is an N−dimensional surface, is called a Harmonic Map. If we substitute the analogous (singular) stress tensor in the field equation and apply the conservation law as before, the result will be the corresponding equations of motion. These, too, are thus derivable from the gravitatonal field equations.

In an approximately Minkowski spacetime, for $N = 2$, one has a string on a flat spacetime background. The solution to the harmonic law, which generalizes the geodesic law, produces something quite interesting for the classical solution −− as first found by Thiess.

The 2−surface for an open string is closely related to a single point−like singularity following a helical worldline. In particular, the surface is generated by the midpoints of all pairs of points (with spacelike separation in the 2−surface, under a particular local coordinate gauge) from the helix.

Conversely, given the classical string, one recovers the helix that generates it. The generator of the helix −− which represents the averaged motion of the string −− also gives us the total momentum of the
string.

The classical fermion, as has been known since the time of Dirac, undergoes a helical motion, with the velocity having only light−like eigenvalues. Here, too the generator of the helix yields the momentum, averaged over a period, of the fermion.

It's quite possible that there is a deep−seated equivalence between the two pictures, with the smearing implicit in the transformation from the helix to the string, in the particle picture actually being attributed to a smearing of the underlying spacetime.

In particular, as shown in Arcos and Pereira
"Kerr−Newman Solution as a Dirac Particle"

the Dirac particle, itself, can be represented in classical General Relativity as the ring singularity with the corresponding angular momentum, mass and charge parameters of the particle.

Hence, there may be a deep−seated duality between the particle and string picture, which has not been fully exploited.

.

- Prev by Date: ***Re: An apology to everyone from DJM***
- Next by Date: ***Re: BREAKING NEWS: The Galaxy's newest satellite***
- Previous by thread: ***Re: An apology to everyone from DJM***
- Next by thread: ***dark energy stars?***
- Index(es):
    - ***Date***
    - ***Thread***