# Space is open but Time is closed-topologically

**The Topology of Spacetime is open but fields defined on open spcaetime are closed in the sense of differential geomtery.**

Or that fields exist only on the surfaces of the quantum of spacetime.

Wikipedia cites three topologies on spacetime. Path or Zeeman topology is Hausdorff, spearable but not localy compact. and by Lemma in topology( that says: a compact subspace of a Hausdorff space is closed), spacetime with the Path or Zeeman topology is not closed. This could have very interesting direct implications, for example Gauss's magnetic flux equation from the Maxwell's equations says that you cannot enclose a magnetic monopole in a closed spacetime, but in an open spacetime one could possibly do that. Now back to not-locally compact.spacetime is not compact (locally) would mean that there do not exist finite sets whose arbitrary union gives spacetime (no finite subcover), so spacetime is covered by infinite sets. And so the smaller we zoom in, the more "spread" spacetime is and so we cannot find space and time precisely. This could be described by the Heisenberg's uncertainty relation after defining the metric on spacetime.

What I would think Feynman tried to do by saying there's virtual particles there and calculating the weights of the possible interactions is to apply the non-compact property to the interacting cross section ~ the spacetime with interaction is spread out to all possible interactions. And what the amplituhedron perspective is trying to say by using that fundamentally on two particles interact and excluding creation and annihilation is to add causal description to the picture as: 1. Two particles in a fundamental collision describing that of the infinite subcover of spcaetime, the intersection of two basis elements is not empty. 2. There is no creation and annihilation adding a constraint that "these infinite subsets can not grow arbitrarily", with perhaps some relation to Lebesgue covering dimension.

The idea that is really interesting is that: even though spacetime is open, because of the causal relation, spacetime with the Path or Zeeman topology is metrizable; and I think that is reflected in the idea that some volume measured in the partition of the amplituhedron is real and measurable (number theory permutation pictures). So, if one were to try to tweak around with causality, one could perhaps look to explore this feature in the Path or Zeeman topology in spacetime.

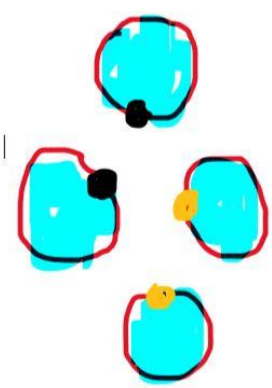
**Main idea: Spacetime is open but something is closed.**

Note: Open here does not mean hyperbolic. I haven't used a precise metric and so have not described anything to do with differentiable manifolds. That would be interesting to explore and we'd have to be precise with the metric (perhaps the Einstien metric of some exotic metric).

I like to think that there is some sort of tension between describing spacetime as Hausdorff but not locally compact. General relativity says: Yes space is Hausdorff and the metric is defined for arbitrarily close points giving black holes and singularities in solutions. But there's uncertainty relation that says: But space is Compact and that it's kind of spread out into non-finite subcovering and so you can't define arbitrarily close points in spacetime. I think this perspective is influenced by the first impression that spacetime should be closed (again topology only, not differential geometry) because we are always trying to resolve infinities trying to understand large numbers and regulating them. But if we were to think of spacetime as open from the first principles, I think this could lead us to explore other ways to resolve infinities. For example, this might be absolutely incorrect but here goes a creative attempt: 1. A finite dimensional open topological space(in the Lebesgue covering dimension, sense) is homomorphic to an infinite dimensional closed topological space. 2. One step further, now to differential geometry: A differentiable manifold defined by an infinite dimensional manifold is an infinite dimensional manifold (now in the general dimension sense like in General relativity), and that an infinite dimensional manifold is closed but has no interior, meaning its interior is diffeomorphic to the surface. 1 and 2 are indeed in the same spirit. They do however look like they could make a good topic of exploration, despite perhaps proving to be incorrect.

Spacetime is open but following the proposition: "A finite dimensional open space is homomorphic to an infinite dimensional closed space", is a discussion that this infinite dimensional closed space can "contain" a finite dimensional closed field, or a finite dimensional closed field can be defined on an infinite dimensional closed space. The structure is topological and dimensions describe ideas like the Lebesgue covering dimension or perhaps something similar. The idea is that even though spacetime is open, it can contain closed fields defined on finite dimensions.

Before we take this topological construction to a manifold, let's try to describe its subtleties. Perhaps they can be better illustrated with pictures.



The green balls are supposed to represent the quanta of spacetime (from the topological perspective). Since each quantum is open, the red boundary is not part of spacetime. However a finite dimensional closed field as represented by the red can be contained in the homeomorphism of spacetime that is an infinite dimensional closed spacetime.

But we believe that potentials are more fundamental than fields.
And so what potentials describe are how two "positions" in two quanta Of fields are identified. In the diagram, the yellow "positions" are Identified together and so are the black "positions".

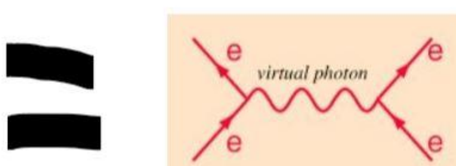
With that perhaps, we can get started on a bit of differential Geometry.

Now we play with the idea that spacetime is not locally compact.
In the figure on the right, all green dots together represent a single quantum
Of spacetime, and so do all red dots together and all the yellow dots together.
But the identifications that potentials carry preserves the field structure
From topological construction. In this picture, the field may not look closed
at all, given that spacetime is locally not compact. But the idea is that:
"Spacetime is open but fields are closed."

Now we get either too creative or very silly and introduce the following notion.
Traditionally, if there is only one charge entity (one quantum) in the entire universe
, there is no charge in the universe, because that charge can't feel itself; only other
Charges can feel its field and it can only feel somebody else's charge (field). 1 charge =
0 charge. But now we have the above topological discussion that might help us get a
Bit more creative.

We use the description of the Banach Tarski paradox. A closed loop of field (because its on the surface of open spacetime) is equivalent to (can be reassembled into) two of those loops.
But since potentials are more fundamental, the two loops can "identical" (also from the paradox) identifications described by the potentials and prevent a single loop generating infinite or even two Loops. The idea is that to the outside world (as described by identifications), the loop is a single quantity. But in a sense to itself, it doesn't make sense to distinguish between 1 and 2 (or 7).
But it does make a difference to distinguish between 0 and 1. In a sense, a field can feel itself (or more intuitively a charge can feel its own charge). Now this one thing is even more weird, but This could provide a constructive meaning for consciousness. But I'll just stop there on that one.

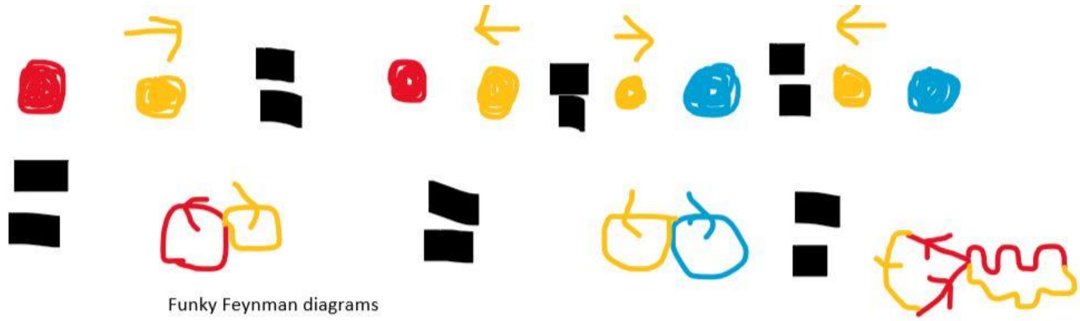
Let's see an example with two electrons interacting via photons.




Feynman diagram for the electromagnetic force between two charges.

http://hyperphysics.phy-astr.gsu.edu/hbase/Particles/expar.html
Just this one Feynman diagram

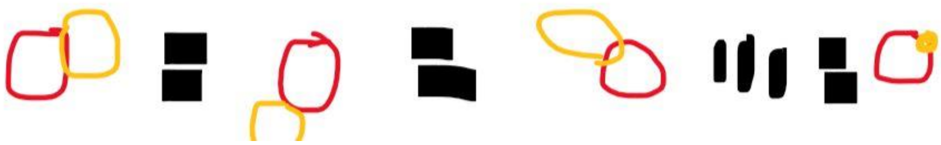
Now let's take away half of the picture:



Funky Feynman diagrams

The yellow part completes
The half version to a meaningful
version

Adding what we just said about using the Banach Tarski paradox:



The above figures represent that the idea that the direction of the photon doesn't carry information, the fields are closed , we come back to the idea that vector potentials (identifications ) are fundamental and so an example of what we just discussed.

A Perspective on String theory

From the above discussions(assumptions), fields exist on surfaces as fields are closed. But because space (probably just space here) is open the quantum of the field is not static, which can be described by the homomorphic relationship between an infinite dimensional closed surface (on which the fields exist), and a finite dimensional topologically open space. And so this means even without any outside interference a quantum of a field is dynamic and not static and there comes the notion of time. Which more intuitively means that it can feel itself, its changing without any other influence, it is evolving on its own. And so by this sense time (the dynamics) is contained in space, implying **That Space is open but Time is closed.** So topologically, time is a component of space- a maximally connected partition of space. It is perhaps **because time is closed, that there seems to be an arrow of time.** And even though space is open, since time is closed solutions don’t blow up and can make sense.

From this perspective, the main idea in String theory is that particles (and hence quantum of fields) are not points, but rather dynamic as conveyed by the idea of vibrating strings. And so what string theory appreciates is that quantum of fields are dynamic and not static, and hence space is open but time is closed. And this should probably be the main idea of any theory that tries to unify Gravity and Quantum Mechanics- That the quantum of space-time contain not static but dynamic quantum of fields.