Contact: lkcl@lkcl.net Date: 04 Jan 2017
Ref: Revision: v1

Abstract

Colour (R,G,B) seems to be fashionable in particle physics theories, where it may be interpreted to be phase. In the context of the Extended Rishon Model, where we interpret particles to comprise photons in phase-harmonic braid-ordered inter-dependence, Colour takes on a very specific relevance and meaning, not least because Maxwell's equations have to be obeyed literally and undeniably, and phase is an absolutely critical part of Maxwell's equations.

A number of potential candidate layouts are explored, including taking Sundance O Bilson-Thompson's topological braid-order [8] literally [12]. Ultimately though, the only thing that worked out that still respected the rules of the Extended Rishon Model [4] was to place the Rishons on a mobius strip, mirroring Williamson's [13] toroidal pattern, which, with its back-to-back two-cycle rotation, reminds us of Qiu-Hong Hu's Hubius Helix [6]. The layout of the 2nd level I-Frame is therefore explored, using the proton as a candidate.

Contents

1 Introduction

In a prior discourse [1] I mentioned that adding in colour into the phase-transform (aka "decay") diagrams was so fantastically and stupidly laborious, that I temporarily abandoned it for the sake of my sanity. In returning recently to the Extended Rishon Model in order to document the insights of Rishons being somehow related to phase and braiding order if particles are considered to comprise photons, re-reading Piotr Zenczykowski's paper [5], section 8, reminded me that colour is really rather important.

Harari in a later collaboration [3] states that "hypercolour" is an inherent part of the model.Over the years in which I've explored the Rishon Model I also attached colour to Rishons, and endeavoured also to gain some relevance from their position. For no reason that I can fathom I came up with is this:

$$\begin{pmatrix} \color{red}{T} \\ \color{green}{\overline{V}} \\ \color{blue}{T} \end{pmatrix} (\color{green}{V}\color{blue}{\overline{T}}\color{red}{V}) \begin{pmatrix} \color{blue}{T} \\ \color{red}{\overline{V}} \\ \color{green}{T} \end{pmatrix} \tag{1}$$

I think the reason why is because it's symmetrical. Each triplet I surmise represents 120 degree phases in "something" (position in a 3-entry circular buffer, to use computing terminology), but note two things: firstly, that the order is preserved (modulo 3 arithmetic starting from a different point in each), but also, if you recall the I-Frame "rules", where the outer Rishons of the middle triplet have to match the type and the opposing sign of the middle of the outer triplets, we notice that hey cool, the colours happen to match as well.

Assuming that this isn't just a total coincidence, but is really rather important information, I use "colour preservation proximity" as an additional guide when exploring different dynamic schemes and layouts. First, trying triple-braiding and recursive braiding (triple braids of triple braids), then triple braids in a Trefoil knot, and finally returning to the scheme I came up with in 1986, but this time placing it on a Mobius strip.

2 Bilson-Thompson-inspired braiding

I quickly abandoned this approach despite writing out half a dozen different diagrams, but it is worthwhile going over in order to eliminate it from enquiries. I started with a Rishon triplet, using my daughter's "Magic Pens", not realising that "Blue" would change spontaneously - without the "magic marker" - some thirty minutes later:

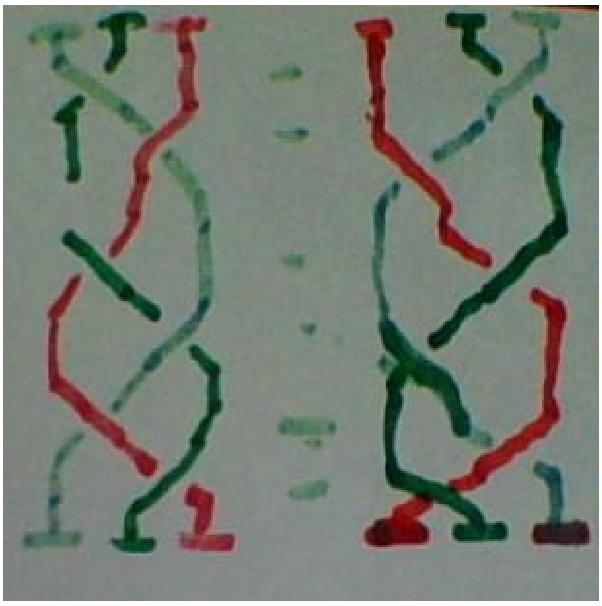

Figure 1: 3 Rishons, 6 twists, cyclic

The (now lighter green) blue line returns to its original (first) position after performing an under-left, over-right, under-right and over-left. The other two - green and red - (actual green and red) end up similarly in their original starting positions after six twists are carried out: four on each colour. All of this is totally familiar to anyone who's created a braid over the millenia: only recently however have scientists realised that the technique can be applied to light, and that in doing so there *really is* a difference in the end result if you change the braiding order and/or phase: *information is preserved* [12] and not only that but we have a reasonable representation of "spin half" characteristics.

Hence I figured it may be important to try this out at the 9 Rishon level. Bear in mind, though, that I have no explanation as to why the photons (if they are photons) would go clockwise in one twist followed by anti-clockwise immediately after. Bear in mind also that we've (arbitrarily) assigned different types (phases) of matter to each "strand", where "T" represents a phase peak in the real numberplane and "V" represents a phase peak in the complex numberplane.

I then took the proton, with the three sets of triplets, and laid it out as a series of "braids of braids":

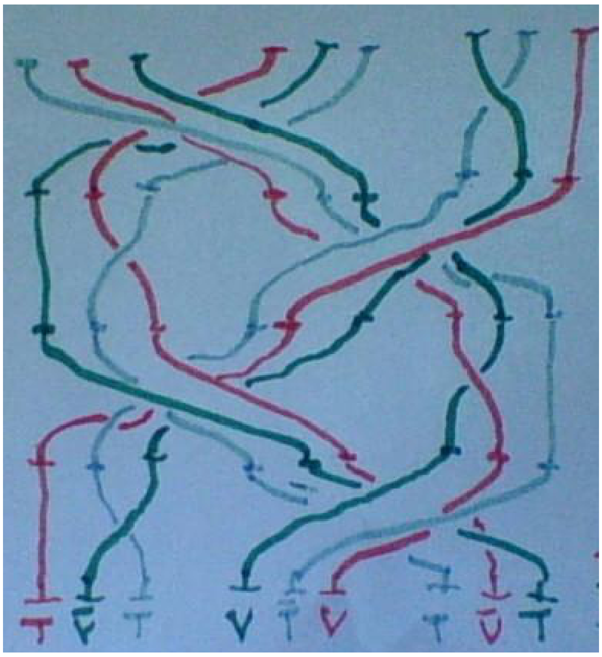

Figure 2: I-Frame as a "braids of braids"

My notes contain a full six twists of these triple sets, but the problem is immediately apparent on close inspection of the ordering of the Rishons as they "twist". In the first layer (at the bottom of the picture), all the triplets undergo a single twist (middle with right), and also the two right-most braids *simultaneously* undergo a twist. Note that $\overline{T}V$ of the middle triplet (aka "down quark") undergoes a *simultaneous* twist alongside the $\overline{V}T$ of the right ("up") quark. From experience of dealing with phase transforms (observing that $V\overline{T}0$ transforms occur in pairs), ignoring the fact that the starting colours are laid out according to equation 1 above, all seems well.

The next twist is where it all goes pear-shaped. We now have to "twist" the two up quarks... which means "twisting" TT from the left quark with TT from the right. Sorry, but this offends my sense of style. Where's the symmetry? If it one was $\overline{T}\overline{T}$ (i.e. inverted sign) I could accept it, but I honestly don't see how this could work, if T and V represent photon phases. There's no correlation, here, between the actual "twisting" and the colours, signs and types: bear in mind that T and V we are assuming to mark twelve phase points in the complex numberplane. I tried a whole range of tricks including shifting one quark up a braid-level: it just didn't work.

3 Braided Trefoil knots

The trefoil knot is particularly popular in the alternative particle physics community, as well as in String Theory. I thought it was therefore definitely worth trying, so, again, taking a triplet and laying it out according to the 6-twists of a braid then putting *that* into a trefoil knot, I came up with a beautiful pattern that really, really reminds me of a Russian Wedding Ring:

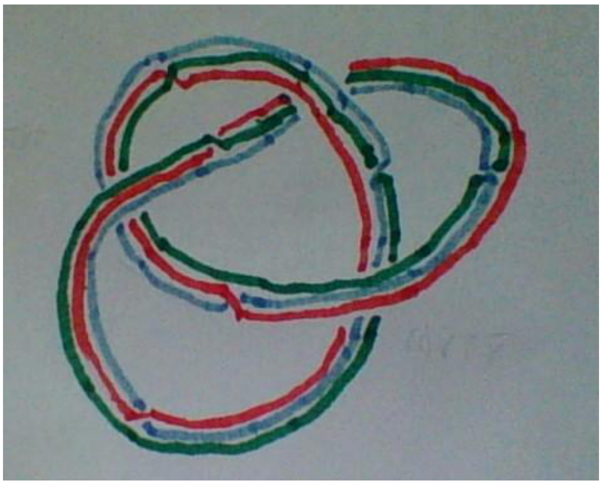

Figure 3: Triple braid that's then "trefoiled"

The first thing I did after celebrating the completion of this diagram, was wonder, "okay... so how does apply to the I-Frame?" which prevented me from noticing something really rather spectacular and beautiful for at least an hour. Look closely at the orientation (and colour) of the inner and outer "twists" in each of the three nodes. The first thing: it's always the same two colours that cross over. The second: they're the opposing rotation as well (one clockwise, one counter). The third: the twist that's on the inner track of the node is on the outside whilst the twist that's on the outer track of the node is on the inside. This is totally fascinating and worthy of further study in its own right... "But Does It Blend?".

The short answer is no. Once again it boils down to the same thing as happened with the Braids-of-braids. Let's go over it. First I had to come up with a scheme where the trefoil would be relevant to the 9 Rishon I-Frame. I opted to use the trefoil as a "race track", starting each of the three triplets (up, down and up quarks) equidistantly spaced from each other. I then traced each of the Rishon triplets to see where they went. Unfortunately, exactly as happened with the Braid-of-braids: TT tried crossing at the same time as TT. No correlation: no dice.

4 Rotating triplets

Thinking back thirty years to 1986 is all a bit vague, but I do recall that I'd laid out the I-Frame of the Extended Rishon Model even back then. I also recall that I'd thought that the triplets might "spin" around each other, like gears. I remember actually checking that, by drawing out the triplets and spinning them. outer quarks clockwise, middle quark anti-clockwise (for no particular reason). By 90 degrees something very interesting happened: on each outer quark the T of the up quark "lined up" with the $\overline{T}$ in the middle of the down quark, whilst all V particles moved conveniently some distance away.

What i *hadn't* done was applied "colour" to this mixture, and it seemed like a good idea to try. So, I drew 9 diagrams, rotating the I-Frame's triplets about their central Rishon by 22.5 degrees each time, starting from the original layout as shown in equation 1, marked "(1)".

Ignoring colour temporarily in figure 4, and looking closely at the Rishon's type and sign, we see the central $\overline{V}$ of the left-most up quark in close proximity (assumed to be attraction) to the left-most V of the middle (down) quark's Rishon, and likewise on the right (except in red). The T Rishons are *not* in close proximity. Now watch what happens when you rotate by 22.5 degrees: the two blue T Rishons begin to move towards the central (same-coloured) $\overline{T}$ anti-T Rishon. By stage (5) a 90 degree rotation has occurred, and the T Rishons are now at their closest proximity to each other whilst the V Rishons of the down quark are now correspondingly at their furthest extent away from the central anti-V of both up quarks. All is well.

The "fly in the ointment" starts from (6) to (9). By the time a 180 has occurred (which we assume for no particular reason, which may bite us later, to be the half-way point i.e. "spin half" of the proton's "Hubius Helical" style orbit), $\overline{V}$ is in close proximity to V and correspondingly on the other side, sign and type are fine, but colour is not.

In 1986 (and again in 2014) this "colour mismatching" wasn't somehthing that bothered me, because I hadn't followed through to step (9). whoops.

So now I felt a need to resolve this, somehow. I therefore wondered if laying out Rishons in a circle would resolve the issue. Bear in mind that I envisage the triplets to somehow *be* a circular loop of some kind.

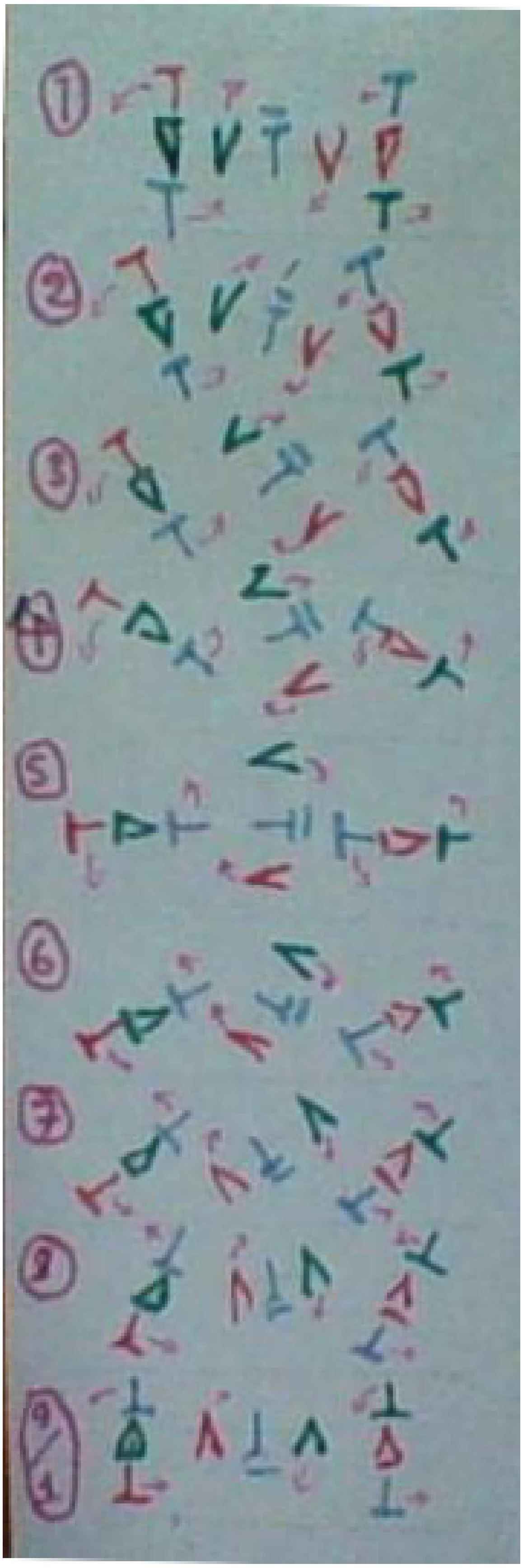

Figure 4: Triplets rotating, linear layout

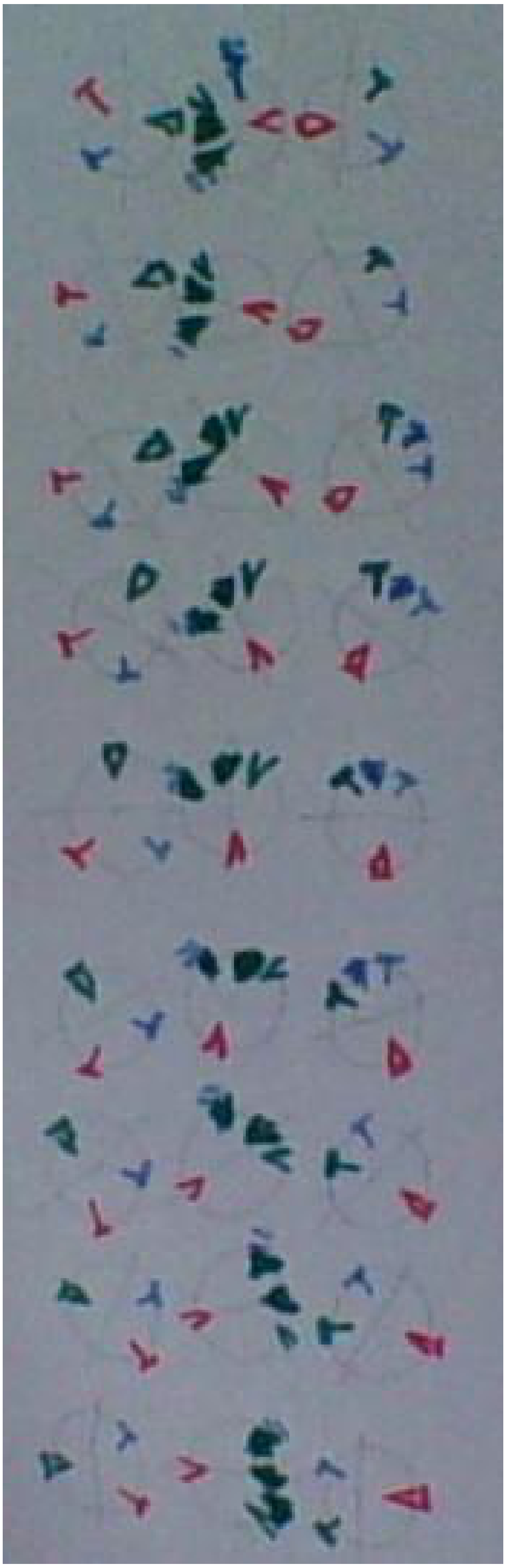

Figure 5: Triplets rotating, circular layout

4.1 Circular rotating triplets

So, as can be seen in figure 5, I laid out the triplets in circles, still keeping them rotating in the same corresponding directions as the linear-rotating triplets. The general thinking behind this was: if the $\overline{V}$ for example was furthest away, and the other two quarks were equidistantly spaced such that their "combined" colour was in effect "anti-green", somehow magically it would... you get the general idea: it didn't work.

I tried imagining the layout of the three quarks in a similar fashion to that of a water molecule (a shallow V-angle of say 120 degrees): that also didn't work. I considered equidistantly spaced equilateral triangle (placing one down quark next to the up and right-most down), that didn't work (not least because the "gears" won't "mesh"). Throughout all of these thought-experiments, the simple guiding principle was: colours need to match, same-typed opposing-signed Rishons attract, same-typed same-signed Rishons repel, and all hell breaks loose if differing-typed Rishons come into proximity.

Also, the $VT0$ rule (symmetrical proximity) I felt was equally important to consider, especially given that in effect it represents "gluon exchange" aka "ultra-short-lived pions", and we respect the rule that $VT0$s have to occur in opposing pairs... now there's colour to take into consideration *as well*.

4.2 Introducing the mobius strip

The breakthrough was to consider what would happen if the (linearly-arranged) Rishon triplets were circling on the path of a mobius strip:

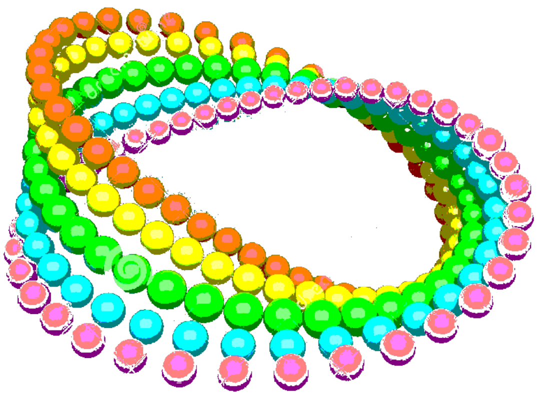

Figure 6: Coloured (sort-of) mobius strip

Although this isn't strictly a mobius (it has two twists) it serves our purposes very well by having coloured rings. Let's say that the orange ring represents the track covered by the left Rishon triplet (one up quark), the green ring represents the middle (down quark) and the pink track the rightmost (up) quark. The next bit is quite hard to draw in two dimensions so requires a bit of imagination and explanation.

Let's take the piece of paper on which figure 4 was drawn, complete it up all the way up to step (16) and then *literally* put it into a mobius strip. Now cut away (erase) the middle quark's track and *put it back in place but this time in a straight ring*, right smack in the middle of where the two down quarks are suspended in space if you had enough hands and patience to hold two mobius strips in mid-air. With me so far?

If not: this is where the (erroneous) sort-of-mobius comes in handy, because the "green" track we envisage to be the up quark on a straight "ring" (no mobius), and the "pink" and "orange" tracks *are* on a mobius track... you may be getting an inkling here of what happens already. Look again at the linear-rotating triplets. Imagine that as the left quark is progressing from stage (1) through to stage (9) it's *also rotating about the z-axis down the centre of the up quark*, such that by the time it reaches stage (9) it's **on the right-hand side of the paper**. Correspondingly, the right-most quark has also swapped places. Note that the middle quark, because it's in the middle, we *assume* that it's not undergone some weird rotational magic which puts the green Rishon on the left side.

If it's safe to make that assumption, then, as if by magic, the green $\overline{V}$ of the (formerly left) up quark is now on the right, happily matching up with the right Rishon of the middle-most (down) quark (whew).

If it's not safe to make that assumption, we do feel that there will exist some other configurations that would still allow for the possibility of the colours to line up. at stage (9) and at stage (1), which would apply to all three quarks. One where they would exhibit "spin half" characteristics that turned them upside-down after going through half of their full cycle... this should all be sounding extremely familiar: the key here being that the two up quarks, if they *did* undergo inversion at the half-way point it *wouldn't matter* because it's the *central* Rishon that has to line up (and consequently colour-match) with the two Rishons of the middle (up) quark. Thus I feel that (in some form) the "mobius" configuration actually works.

5 Discussion

The overal purpose of this paper is to firm up the rules under which Rishons can be demonstrated to represent phase, position and braiding order of photons within (all) particles, so that the application of Maxwell's equations (if or when they are ever applied) has some sound basis that actually make sense, and, crucially, narrow down the layouts that need to be tried out so that mathematicians who make the effort aren't wasting their time.

I therefore consider it quite important to make the effort to apply "colour" (or hypercolour as Harari puts it) to the Extended Rishon Model (ERM), as a way to represent something (most likely position, potentially something else if we move to a multi-dimensional space such as Williamson's [13] or Poelz's [7]), and to guage if the ERM's "rules" can be augmented to incorporate colour.

I explored the idea put forward in my prior paper [1] that Sundance's topological braids [9] might be taken literally, without success. Likewise with the Trefoil knot / Russian Wedding Ring. The I-Frame, however, proved amenable, so it is worthwhile checking to see if there is theoretical work that has anything like a toroid, mobius strip or hubius helix out there: turns out that there is.

In Williamson's paper "On the nature of the photon and the electron" [13] he provides an artist's impression of what looks remarkably like a mobius strip (or Hubius Helix):

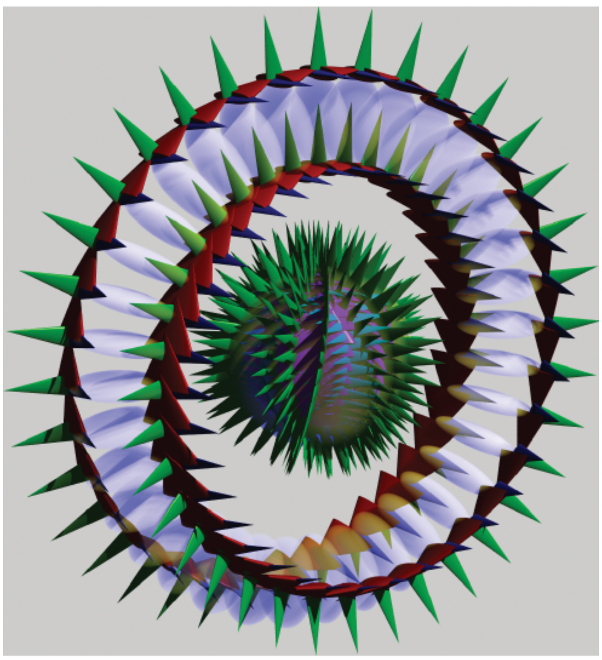

Figure 7: Toroidal field (Williamson)

I therefore wondered if it would be possible to arrange three Rishons to go in similar loops, and from there if it would be possible to arrange for nine whilst *at the same time* preserving the (now coloured) I-Frame characteristics. With a bit of fudging and fussing, the answer tentatively appears to be, for the second level I-Frame: yes.

What I *haven't* provided though is a reasonable explanation as to why the *triplets* would remain in a linear arrangement, either in the original first level (electron, neutrino) or when part of higher-order levels. That remains as a puzzle to be solved, particularly in the context of Maxwell's equations. No theoretical work that I've yet encountered to date in this highly-experimental arena combines Maxwell's equations with the Rishon Model. Mills [10] assumes a sphere and charge being uniformly distributed (as does Williamson after back-mapping from six down to three dimensional space).

Perhaps, though, it may turn out to be simpler than I expect, and there is nothing to fuss about: Kaminer et al's team showed that nondiffracting beams can be formed that rotate in phase by half the angle that they curve through on a circular trajectory, and that they can even go full circle [11], whilst still obeying Maxwell's equations.

Also still to be explored is the 15-Rishon (third level) and before that the pion. The pion I surmise may be trivial, but the 15-Rishon arrangement (which has only ultra-up and ultra-down), even though it is a hybrid of both the pion and the 9-Rishon I-Frame, less so. One thing we do expect though: the two 15-Rishon ultra-quarks are zero-spin, so we *do not* expect the "Mobius" trick to be necessary (or, more specifically, to work). Here, in light of what went wrong on the proton without the "Mobius" trick, I may already have an intuitive suspicion as to why the W and Z Bosons are unstable. Luckily the W and Z Bosons only need to hold together long enough to be part of a phase-transform ("decay").

It is worth emphasising that the proton was only used as an illustration for the exercise involving the I-Frame: careful re-reading should show that the I-Frame construction rules are involved, *not* the actual types of the Rishons themselves. In other words, if I'd done the demonstration with a neutron or even a muon it would still work. The last key question, then, is: why is the muon (and neutron to some degree) unstable?

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