# New Light on Old Light - Reinterpreting the Cosmological Redshift as a Rotation at the Observer's Matter - Signalwave Interface*

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**Abstract**

The universe and the cosmological redshift are modeled from the perspective of a local observer in one dimension communicating via Lorentz transformation to a non-local, perpendicular observer. Applying the Maxwell-Faraday transformation laws shows that the non-local observer is in the midst of curls and has to adjust by rotations to the increasingly flat wavefront of the redshifted light in order to restore the shape that the wavefront had when emitted. These ideas are applied to the so called 'Hubble tension' and it is found that if the signal residing in the non-local wavefront is absorbed by a non-local observer (in the electron cloud, that is) then the discrepant numerical values obtained for the Hubble constant may be compatible and the 'Hubble tension' may be resolved. These results are based on astrophysical measurements of the Hubble constant at a redshift of 1.49 in a configuration that is independent of cosmological model. In the present theory, however, the apparent local cosmological expansion rate is calculated from the Bohr atom and regarded as a constant of nature.

## 1 Introduction

As for the entanglements, superpositions, teleportations and apparent nonlocality determined by probability measurements, which recently have come into the focus of physics research it will be interesting to see if these discoveries from now on merely will revitalize investigations into such probabilities leading to a separate physics niche or if their impact on already established physics will be critically evaluated. Namely, since these discoveries involve light signals it is immediately obvious that something is lacking in both Maxwell's equations (ME) and relativity theory (RT). ME does not at all describe the probability facets of the light signal and RT is founded on the concept of a maximal

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speed of light in a world where everything has precise space and time coordinates. Instead of just trotting along these century-old paths of ME and RT why not replace them with a solid theoretical framework which embodies the notion of 'non-locality'?

Certainly, information about an event can not precede the event itself as is often argued in favor of RT's founding speed of light, ignoring however, that the *anticipation* of an event can, and often does, precede the event proper. In addition to the various probability measures hinting that there must exist some kind of miraculous 'nonlocality' (faster than speed of light, that is) in the real physical world it is in fact possible to formulate it quantitatively. One approach, pursued by this author, is to accept the existence of one local dimension only, the linear momentum axis, straight or axial. This leads to the intuitively appealing and not too complicated notion that the other two spatial dimensions and time are nonlocal as judged from the local dimension. Probably all known physics can be rearranged according to this recipe [1] [2] [3] [4] . Another quantitative approach to nonlocality is *via* the Stokes' curl, which cancels in adjacent inner curl-cells but not at an outer boundary. This means that a vast region of space can be overcome by such curls. The significance of Stokes' curls in physics may be exemplified by the nodes of the electromagnetic radiation where the detectable fields are gone but theory, as in ME, indicates the electric and magnetic curls should be maximal since the curl of one is proportional to the rate of change of the other.

A trend that has emerged in theoretical physics in the past 100 years is to assign importance to the observer of physical processes. Previously, the world was regarded as an object whose properties and processes were to be described by exact mathematical language. The notion of 'invariance' in RT reflects these pre-20:th century views, the invariance constitutes a core in the midst of a geometry which allows the observer to measure different aspects of the object depending on relative velocity. In quantum physics there is the notion that the local measurement of part of a system changes the whole system. Both these scientific theories invoke a subjective, local world where the measurements are performed. This subjective, local world supercedes the objective outside world and turns it 'yonder', or 'non-local'.

It is the purpose of the present paper to develop and implement these ideas and to show that the concept of 'non-locality' has better justification than just providing a new academic niche; it changes physics and our world picture.

# 2 Physical Processes Emerging from Physical Units by Their "Frame Signatures".

In this world of one linear momentum axis and everything else non-local the usual (SI) physical units can be assigned uniquely to either a local or a non-local frame of observation [1] [3]. The discovery that time is perpendicular to the momentum axis provides the key to such an assignment [4] [5], once the assignment of momentum and time are known one can use the SI and SI-derived units as tabulated in standard textbooks, e.g. [6] for obtaining each unit's 'frame signature' in terms of local and/or non-local. Such compilations can be found in earlier papers, e.g. [1].

The reader may object here that the world is not at all one single dimension and throw this paper away. However, the author asserts that sufficient arguments will have been presented, in the end, that this view is tenable. It is reminded of how the magnetic charge was discovered by tracing the half-circle until it emerged along one dimension [7]. The 'monopole' has now been put in its originally conjectured context [2] (p. 830 in [7]).

Some physical units acquire composite frame signatures. Two such examples are 'pressure' and 'energy'.

In the case of 'pressure', its frame signature ˜/_ _, indicates momentum transfer from the local frame, _ , to the non-local frame, ˜, followed by a recoil back to the local frame, _. This interpretation by way of frame signature reveals the physical processes hidden in the unit 'Pascal', which otherwise is just a unit of experimental measure using a gauge. According to the frame signature in this case, the process of measuring pressure by way of recoil against (non-local) mass action puts the observer in the denominator.

Based on the concept of 'energy', with frame signature ¯ ¯/ ~ the non-local observer in the denominator ~ probes the local frame ( ¯) twice as in the case of an electron cloud jumping between atomic energy levels characterized by different atomic radii in one dimension. The 'energy' may be decomposed into a kinetic part ( ¯/ ~) and a momentum part ( ¯). Since time is perpendicular to momentum and length, the former represents a rotation while the latter represents a boost. A rotation and a boost are known to be inherent the Lorentz transformation which forms the basis of RT[1] [8]. This means that the frame signature of 'energy' accommodates relativistic effects and it is not necessary to speculate that the latter are embedded in the geometry. Instead they are managed at the level of the physical processes themselves, here the 'energy'. Furthermore, putting the observer in the non-local denominator (like in the case of pressure) allows him to account for multi-facetted aspects of 'energy' such as path integrals. The latter may possibly from now on be viewed, not as compounded lines of equations, but as real physical (non-local) processes taking place while tracing the circle until the process turns local along the momentum axis (perhaps as in [7]). Clearly, dissecting the local and non-local parts of the vague concept of 'energy' with the help of the frame signature herein provides a more 'nuanced' picture of the physical processes involved compared to just referring to the mute unit of 'Joule'.

Another advantage of tracking physical units in terms of local and non-local is that various 'descriptions' of 'measurements' or text-book theory can be analyzed and recast (the terms rearranged) such as to highlight real physical processes wherein the local and the non-local frame of observation (like in the two examples above) communicate. This has previously been applied to the black-body radiation [1] [9] [10] [11], Planck's constant [2] [1]; p. 8, the Schrödinger equation [4] and Maxwell's equations [12] [13].

Before proceeding with the latter it is instructive to pause and ponder on what one just now has done. One has squeezed out a lot of information about physical processes by contracting Nature's apparent 3+1 dimensions into one dimension only, recalling previous work [14]. In other words, simplifying the geometry allows Nature to communicate its inner workings. This is the opposite of the approach used in RT (and GR) where there are four dimensions on equal footing and important informative elements such as the velocity of light and Planck's constant are swept under the carpet by being incorporated in the geometry. The exciting question arises, are the examples above a penned artifact or are they evidence of how the real world is constructed? In other words, can 'nature' be

[1]RT = relativity theory, GR = general relativity theory

represented by a particle or an atom sensing (repeatedly) in one (arbitrary) dimension its *literally local* neighborhood while ceaselessly communicating with a non-local, yonder world?

# 3 Theory

Recall from previous work, e.g. [1], [4] [9] [15], this geometry of one spatial dimension *via* Lorentz transformations connected to a non-local, perpendicular observer[2],

$$(\widetilde{q}_0, \widetilde{t}_0) = \left(\frac{\sqrt{1-\frac{v^2}{c^2}}}{v}\frac{m^2}{s}, 0\right); \qquad (\overline{q}_0, \overline{t}_0) = \left(\frac{1}{v}\frac{m^2}{s}, -s\right) \tag{1}$$

$$(\widetilde{q}_r, \widetilde{t}_r) = \left(\frac{\sqrt{1-\frac{v^2}{c^2}}}{v}\frac{m^2}{s}, s\sqrt{1-\frac{v^2}{c^2}}\right); \qquad (\overline{q}_r, \overline{t}_r) = \left(\frac{1}{v}\frac{m^2}{s} - vs, 0\right) \tag{2}$$

$$\overline{\Delta q} = -vs\ , \qquad \overline{\Delta t} = \overline{t}_r - \overline{t}_0 = s \quad \Rightarrow \frac{\overline{\Delta q}}{\overline{\Delta t}} = -v \tag{3}$$

$$\widetilde{\Delta q} = 0\ , \qquad \widetilde{\Delta t} = \widetilde{t}_r - \widetilde{t}_0 = s\sqrt{1-\frac{v^2}{c^2}} \quad . \tag{4}$$

with

$$\overline{\Delta q} = \frac{-m^2}{\overline{q}} \quad . \tag{5}$$

and rearrange like before a Maxwell-Faraday equation, representing for instance the electric field, such as to identify local and non-local observers:

$$\widetilde{E_y} = \frac{1}{\sqrt{1-\beta^2}}\left(\overline{E_y} - \beta\overline{B_z}\right) \quad \Rightarrow \quad \frac{c}{v}\ \overline{E_y} + \overline{B_z} = \widetilde{E_y}\ \frac{c\ \sqrt{1-\beta^2}}{v} \tag{6}$$

Then, by comparison with Eqs. 1 or 2 the non-local observer appears in the node of the electromagnetic signal, turning local (suddenly exhibiting a field, that is) by a counter-rotation,

$$\overline{E_y} = \frac{c\sqrt{1-v^2/c^2}}{v}\underbrace{\left[\frac{v}{c\sqrt{1-v^2/c^2}}\ \overline{E_y}\right] - \frac{v}{c}\ \overline{B_z}}_{non-local\ observer,\ E} + \frac{v}{c}\ \overline{B_z}\ , \tag{7}$$

which simply says that the tangent and cotangent cancel around the angle $\pi/4$, the receiver of the signal thus adjusts to any relativistic distortions in the signal. Both the signal and the receiver (the electron) perform rotations, one described by the co-tangent and the other by the tangent of some angle. This idea can be supported graphically by letting the receiver of the signal rotate in order to correct a frequency mismatch along the momentum axis whereby both receding and approaching velocities cause time dilatations [16] [17]. Furthermore, the barred (local) field, $\overline{E}$, appearing from these rotations is equivalent of a Lorentz transformation since the local and non-local observers of Eqs. 1 - 2 are connected by such transformations. In other words, the non-local observer catches

[2]'m' is meter, 's' is geometrized second (non-standard notation) and c=m/s is the velocity of light.

the non-local part of the signal and turns it local by performing a Lorentz transformation comprising a boost and a rotation. Eq. 7 applies to the electric field but the Lorentz transformation of any measure, $A/\sqrt{1-v^2/c^2}$ can be compensated as

$$\frac{A}{\sqrt{1-\frac{v^2}{c^2}}} \quad \sqrt{1-\frac{v^2}{c^2}} \tag{8}$$

which can be written

$$\frac{vA}{c\sqrt{1-\frac{v^2}{c^2}}} \quad \frac{c\sqrt{1-\frac{v^2}{c^2}}}{v} \tag{9}$$

invoking the tangent and cotangent of an angle that the measure is seen delayed. This means that the distorted measure can be regarded as just an extension of an underlying rotation taking place naturally.

It is not necessary to speculate about the presence or absence of any 'photon-particle' since the momentum transfer is inherent in the mathematics [provided that 1) the Maxwell-Faraday equation is rearranged such as to highlight the non-local and local contributions of the signal and 2) the signal absorption starts at or near the node where the non-local Stokes' curls are maximal]. Actually, not even the wave-interpretation of the electromagnetic signal is needed since the signal is detected *via* the rotations that take place at the matter-signalwave front. This means that by focusing on this utterly local, 'subjective', and previously neglected process one can leave behind the century-old controversy of whether light is a particle or a wave, as will be further detailed on p. 7.

Then consider the problem of whether 'mass' is local or non-local: In contemporary physics with its roots in the 17:th century mass is 'the source of the gravitational field' around which space wraps in GR. This makes 'mass' appear very local. Little contemplation is needed, however, to be convinced that it may equally well be non-local: First, the 'gravitational field' is a resultant vector arising from several objects sharing their contributions non-locally. Then, there is the failure of contemporary cosmology to confirm the idea that mass is the 'source of the gravitational field' - its desperate search for the origin of the ubiquitous so called 'dark matter' in order to confirm the several hundred years' old speculation about mass is well-known. And, actually, in everyday life mass is measured on a balance by reference to a calibrating piece of mass located on the other arm of the balance - demonstrating beyond doubt that it is non-local, possibly refuting GR from the kitchen bench. While the complicated mathematics of RT and GR were developed at a more advanced level and the choices made which equations should be allowed to support the theories the early theoreticians settled for 'transverse' mass and rejected the 'longitudinal' mass [18] along the momentum axis. And, in the form of 'matterwaves' mass is indisputably non-local. Accepting that any mass may not be local removes a hurdle in accepting the possibility of a one-dimensional universe: If mass is everywhere non-local the observer is free to define its environment by the direction of its sensed linear momentum and calculate the rest of its universe from there on.

In the present geometry, the 'frame signature' approach can be applied to establish the non-locality of mass: The dimensionality on the left and right side of any equation must be the same, which yields the following rules for arbitrary physical units:

$$\widetilde{A}\ \widetilde{B} = \overline{C} \tag{10}$$

$$\frac{\overline{A}}{\widetilde{\overline{B}}} = \widetilde{C} \quad . \tag{11}$$

Applying this to the linear (or axial) 'momentum', $\overline{p}$ with $[t] = \widetilde{t}$ yields

$$\overline{p} = mv = m\frac{\overline{l}}{\widetilde{\overline{t}}} \Rightarrow [m] = \widetilde{\widetilde{m}} \tag{12}$$

When so much evidence can be obtained that mass is non-local, why does it behave like local matter in particle accelerators and in everyday life? The answer must be that its 'locality' is due either to its velocity or that it mostly is surrounded by a palpable exo-skeleton of electrons which makes it appear local. An observer 'co-moving' with a dark particle in an accelerator might not distinguish it so easily (most co-moving particles are *de facto* silent and do not interfere in the measured collisions). By plain logic, adding a velocity to a particle relative to a stationary background makes it 'stick out', so that it more easily can be judged to be 'local'. In the present geometry, velocity and 'force' have the same frame signatures, $^{-}/\sim$ so it is possible just by technical algebra that their interaction with 'mass' is shared by a local and a non-local frame. This has previously been evaluated in detail [2]. Whereas 'velocity' is a robust concept beyond doubt the notion of a 'force' has its roots in the mysticism of the era of the alchemists.

In order to proceed with the arguments herein remember the following about this 'one-dimensional universe': In Eqs. 1 - 4 only two observers are defined, the one at origo and the one at the circumference of a circle. The latter is capable of measuring the linear momentum of the geometry, $\overline{\Delta q}$, which is interpreted as the cosmological expansion rate, while the former is characterized by a velocity of rotation relative to (but not seen by) the local observer who just sees the linear momentum by definition. This rotation of the non-local origin around the local observer (purportedly, like the stationary electron's perspective on its orbiting atomic nucleus, cf. [17] or like a circle rotating about a point on its circumference) allows every local observer to see the universe from an apparent position at the origin. The radius of the circle defined by Eqs. 1 - 4, which is equal to $1/\overline{\Delta q}$, is interpreted as the radius of the universe. Since every unit length of the universe along the line of sight has the same geometry every unit length has the same line increment embedded and these line increments add (linearly) along the line of sight to one unit of length at the universe's relativistic horizon. At the horizon (seen from here), the universe's 'origin', that is, the 'non-locality' is maximal. By solving the line increment from[3]

$$\sqrt{\hbar} = \overline{\Delta q}\ 2\Big(\frac{ec}{2\alpha}\Big)\ \frac{1}{\pi\ Ampere}\ ; \qquad \overline{\Delta q} = 7.714 \times 10^{-27}\ s^{-1} \tag{13}$$

the universe is 13.7 billion years old, in fair agreement with the much more complicated cosmologies of today. The numerical value above corresponds in astronomical units to 71.36 $km/second/Mparsec$. At its extremely far away horizon nothing has even happened yet, as seen from here, this is substantial and different from the 'Big Bang' cosmologies: Since every point in the universe has an origin of its own the geometry allows an observer to identify with both 'local' and 'non-local' at the same time. This means that old elementary particles are allowed to still exist today and to dynamically contribute to the stability of present day particles (for example, as tentatively described in [2]). It should be emphasized that a mathematical object with *all* these properties is not yet known (at least

[3] $\hbar$ = Planck's reduced constant, $e$ = unit electrical charge, $c$=numerical value of the velocity of light in SI units, not being geometrized here because of the charge invariance of the magnetic charge, $ec/2\alpha$, $\alpha$ = fine structure constant $\approx 1/137$

to this author) but Eqs. 1 - 4 may be a good starting point to find one since they have constructively guided the development of this theory.

Contemplate now first how different this world-geometry is from the Cartesian (and Hilbert) space or its extension, RT's space-time. These are just mathematical constructs which have to be replenished with whatever physical process one wishes to describe. The present geometry, in contrast, has an inherent line increment and a radius like the real universe has and it inherently encodes for rotations which are so ubiquitous in micro- and macro-cosmos. Furthermore, it defines the concept of 'non-locality' quantitatively by distinguishing a non-local observer as being perpendicular to the local world in one single dimension and this definition can be applied to several equations describing concrete physical processes (examples above).

As discussed in the previous papers in this series 1) the form of Eq. 7 and 2) the graphical behavior of the signal recipient - the electron, when it compensates frequency shifts by tilting away from right angles indicate that the absorption of the signal starts at or near the node of the wave. This makes a big difference from prevailing ideas. In contemporary physics the signal is a head-on particle, the photon, and the wave front is of no interest since it turns almost flat within a few meters after leaving the source. In contrast, as illustrated in Fig. 1, a non-local observer has to make strenuous efforts in order to perceive a signal, the further away the source is, the more it has to compensate the increasingly flattened wave front in order to adjust the latter's curvature to the optimal shape it had when leaving the source. Such adjustments of the angle that the radius makes against adjacent segments of the arc are similar to phase adjustments (taking place with phase velocities).

In order to obtain some quantitative data, remember the numerical value of the *local* cosmological line increment in Eq. 14 and solve the relativistic Doppler velocity from the red-shift in the recent determination of Hubble's constant at $z \approx 1.5$ [19], which is said to be independent of cosmological model:

$$1 + z = \frac{1 + \frac{v}{c}}{\sqrt{1 - \frac{v^2}{c^2}}} \tag{14}$$

The velocity is 0.724. In the present linear cosmology this corresponds to a distance of 72.4% of the universe's radius. Then, let the non-local observer catch the signal, this means applying Eq. 7. The (absence of) torque in the wave front that has to be compensated by a rotation (cf. Fig. 1) is simply given by $\tan v$ and the angle is followed in the graph of Fig. 2 from zero at the universe's relativistic horizon to $\pi/4$ at the Terrestrial frame of observation (or *vice versa*), everything linearly proportional in this cosmology. By following the vertical line in Fig. 2 one concludes that the redshift at $z \approx 1.5$ causes the apparent Hubble rate to be 88.3% lower than the value calculated in Eq. 14, or 63 $km/second/Mparsec$, which agrees approximately with the observed value of $65 - 67 \pm\ 4km/second/Mparsec$ , cf. [19]. Most other astrophysical determinations also give a lower values of $H_0$ and this would correspond to the red curve in Fig. 2 giving lower values on the y-axis than the linear curve. It is also noteworthy that the red curve corresponds to an apparent acceleration of the universe at either end. The same idea (of an apparent acceleration) appears when modelling any observer in the universe as residing on a stationary electron surrounded by an orbiting nucleus [17]. Furthermore, at either ultimate end of the universe the local apparent expansion rate has the same numerical value ($tan\ \pi/4 = 1 = \Sigma\overline{\Delta q}$), which is compatible with the idea that primordial elementary particles contribute to the local material world, cf. [2] .

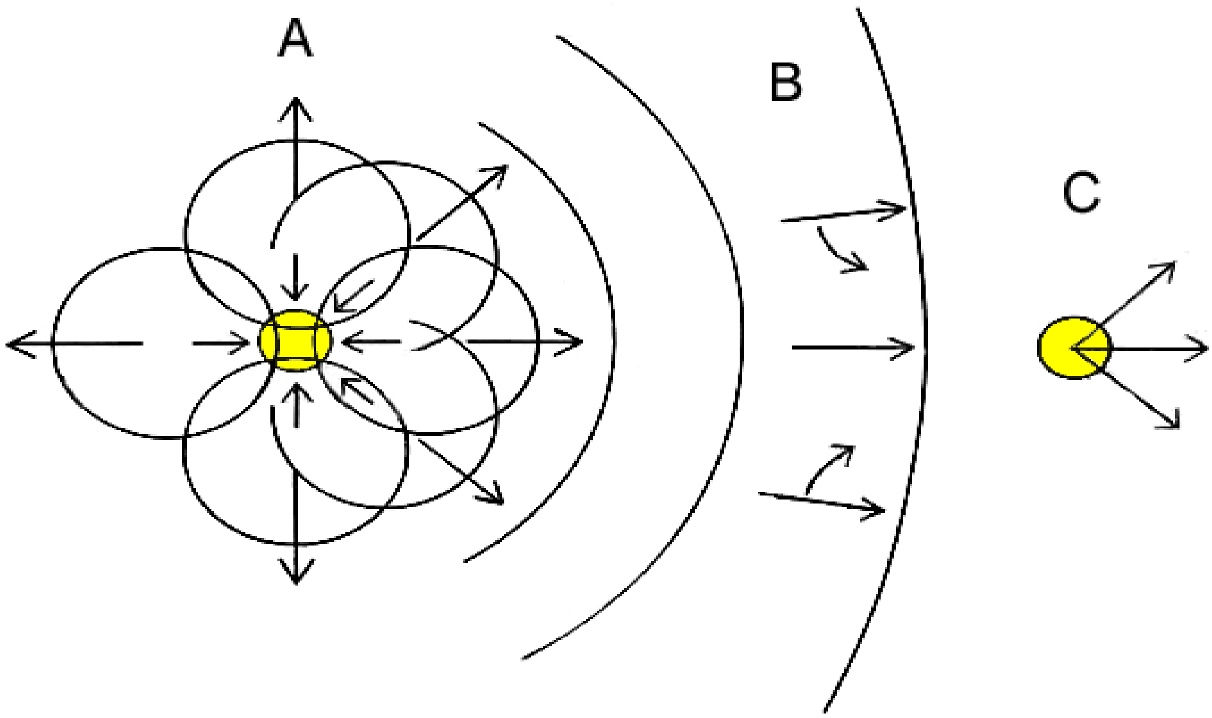


Figure 1: Schematic illustration of a 2-dimensional wave front leaving an atom (yellow) and then being absorbed into a recipient atom. As it leaves the collapsing orbit (A), its configuration is such as to allow an optimal ratio between the length of the arc (L) spanning an angle $\pi/4$. As the wave front flattens during signal propagation (B) the length L harbors outward vectors with less tilt than the original configuration at A. This means that the wave front must perform a rotation (torque as indicated by the bent arrows) in order to restore the optimal curvature that is required for absorption leading from B to the configuration in C where the signal can be absorbed by a recipient.

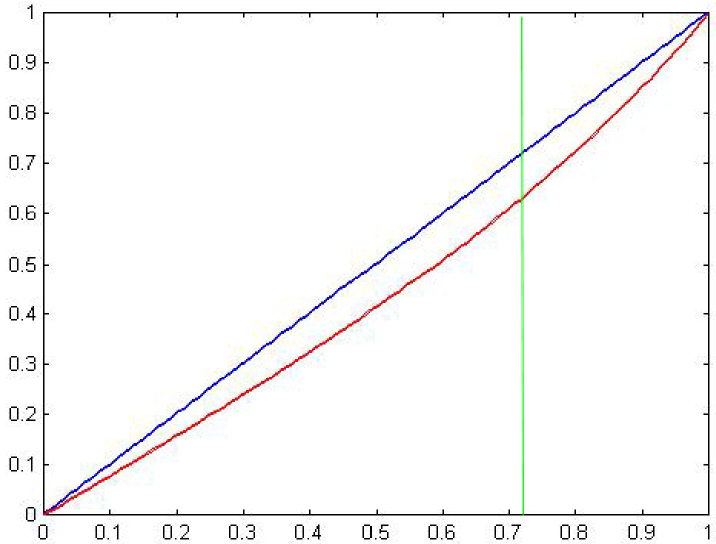


Figure 2: Graphical illustration of the 'linear universe' where each unit length along the line of sight has a line increment embedded in it (blue curve). This is plotted as linearly proportional to an angle divided by $45^o$ spanning from the origin to $45^o$. The red curve is the tangent, $sin\ x/cos\ x$ which expresses the torque in the signal and/or its correction to the configuration the signal had when it left the source.

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