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THE IMAGINARY NORM PART II

Another View of the Origins of Real Space

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§ ABSTRACT

This present presentation further explores the nature of Norms which i proposed in part one of this title. The mathematical primacy of the Norm Wave Function forms the foundation stone for the current work and on this basis we set out to erect a formalism of how real space manifests from directional singularities (also Norms).

§ KEY WORDS

Norm, Quaternions, Imaginary Time, Directional Singularity, Isotropic Expansion.

§ INTRODUCTION

A Norm (Makopa, 2018) can be visualized as a state vector formalism that represents directional singularities which distorts the symmetry of Euler rotations i.e. –

$\boldsymbol{j} = \sum_{-\infty}^{\infty} \begin{pmatrix} Lcos\odot \\ iLsin\odot \end{pmatrix} = \sum_{-\infty}^{\infty} \begin{pmatrix} 0 \\ iL(-1)^{a} \end{pmatrix}$ where $\odot(a) = \pi\ (a + \frac{1}{2})$ and L is the magnitude. [1]

Real numbers for instance the intrinsic term a in [1] can represent some notion of a progressive quantity that co-exists both in our physical space and in the imaginary space however; this separation cannot be overstated against imaginary numbers. In a nutshell, modern physical laws are built upon nonphysical numbers, that is quantities having no representation in our 3+1 space-time, however we can still stress out a crucial point that the *complex numbers are more fundamental than the real numbers and that no construction of real numbers can yield an imaginary number* (Carter, 2012). We can still say that a real dimension is constructed from two imaginary dimensions, in some sense as a *cycling product* of imaginary numbers i.e. -

$1.i = i, \qquad i.i = -1, \qquad -1.i = -i, \quad -i.i = 1$ [2]

The essential paradigm shift implicit in [2] is that real space is not fundamental; but rather, a *somewhat radical conclusion can be drawn that real spatial dimensions emerge from the operations of imaginary dimensions*. However, we can begin by visualizing the projection of a real dimension as emerging from the cross product of two orthogonal imaginary vectors. This principle can be visualized when applied to an imaginary *plane*. Since the area of the rectangle in the imaginary plane is real and is a product of two imaginary numbers, then the magnitude of the cross product is real. (Carter, 2012). Extending this principle to space itself, a real space dimension manifests as a normal projection from two orthogonal imaginary dimensions whose magnitude is the absolute value of the cross product of the imaginary dimensions. In 1843 the Irish mathematician Sir William Rowan Hamilton was focused on the problem of extending the complex plane to three dimensional space when famously the solution came to him during a walk in Dublin. In an event celebrated annually to this day, he carved the following into the stonework of Brougham Bridge:

$$i^2 = j^2 = k^2 = ijk = -1$$

The formula represents the multiplicative rules for what Hamilton called Quaternions. Hamilton's key insight was that when the complex plane is generalized to three-dimensional space, the resulting mathematical object is four-dimensional. The general quaternion, is written as –

$$q = t + ui + vj + wk$$

where i, j, k are each an independent imaginary numbers and t, u, v *and* w are real numbers. For the purpose of the present presentation, the philosophy with which the quaternion paradigm is constructed will be adopted to demonstrate that real spatial dimensions can be projected from the norm formalism. We have so far understood the effects of a on the norm paradigm as simply state descriptions of *directional* singularities rather than instantaneous measurement of the system[1]. However, to develop a different view in that notion, we can re-view a in [1] as a real intrinsic term which sets the norm into oscillations. Before we begin to investigate if a can be classified as a time parameter, first we need to briefly edify ourselves on the currently debated notion in theoretical physics that time originates from change in the state of a system. In his paper "*The Emergence of Time and Its Arrow from Timelessness*", J. B. Barbour's sets a primitive view of the passage of time as derived from change in the state of a system. From one of the paragraphs in his paper he visualizes the following model in an attempt to explain how measurement of time results from change in the state of a system -

He models this idea by imagining one picture and then another, slightly different from the first, and suggests that it is good enough to give the idea that time has passed. Barbour then continues further by considering starting with the picture at one end mounted on a rod and calling it the first and then taking the next one and move it around on top of the first until you find the position where they are in their best matching positions relative to each other. If the pictures are spaced out equally along the rod and if No. 3 is taken and moved around on top of 2 until they too are locked into the best matching position, then the pictures seem to change in the steadiest possible way.

His model establishes distinguished spacings between the successive pictures. While Newton called these spacings the intervals of Absolute Time, but in Barbour's view, he argues that the pictures do not occur at instants of time. They are the instants of time.

§ Corollary of the Introduction

In closing our introduction, we can say that there co-exists simultaneity between events occurring on both sides of the boundary separating the real and the imaginary realms. Relation [1] tells us that the progression of the intrinsic term a sets the norm into oscillation in its own imaginary domain. For example if we station an imaginary observer within the norm domain, he can only measure the progression of a by observing the oscillations occurring between the norm and anti-norm. However, if we can relate that notion to (Carter, 2012), and visualize the norm projecting a real dimension, an observer stationed in the real domain can only measure geometric variations within their physical domain each moment there is a variation of a within the imaginary domain. This therefore means that the geometry of the projected dimension is affected by the state of the norm which depends on the intrinsic term a. J. B. Barbour may consider the intrinsic variations of a as instances of time defining the geometry of the

[1] System – a state being defined by a number of inter-dependent variables.

projection. From the next section, we shall set to investigate the projection of real 3-space by arranging two norms and the intrinsic term at an orthogonal basis.

§ THE ROTATIONAL MATRIX OF THE NIFR

In this present section, we want to establish a rotational matrix for the Norm Inertia Frame of Reference, NIFR. The NIFR is simply a combination of two stationary norms that are orthogonal to each other. The cross product of the orthogonal basis projects a real dimension whose magnitude is the absolute value of the cross product. If the NIFR rotates continuously as a function of a, then it means that the geometry of the real projection is affected by a. Therefore, in this section we shall begin by deriving a 2 dimensional NIFR rotational matrix and later on modifying it into a 3-dimensional NIFR rotational matrix such that the intrinsic term a becomes the third dimension and is the pole of rotation of the NIFR. To visualize this line of thought, let us begin by assuming two orthogonal norms $\boldsymbol{j_v}$ and $\boldsymbol{j_h}$ i.e. - $\boldsymbol{j_h} = \begin{pmatrix} iL_h \\ 0 \end{pmatrix} \check{e}_x$ and $\boldsymbol{j_v} = \begin{pmatrix} 0 \\ iL_v \end{pmatrix} \check{e}_y$ such that the orthogonal basis of the two norms is rest state of the system, NIFR. From Part I of this paper, Equation [9] introduced a strange looking state function which was of the form -

$$ {}_1^1\text{Ɣ} = 1 - \begin{pmatrix} 1 \\ 1 \end{pmatrix} \qquad [3] $$

This term $\begin{pmatrix} 1 \\ 1 \end{pmatrix}$ in [3] lurks polarization attributes and may have the potential to describe a 45 degree polarization of our Norm Inertia Frame of Reference i.e. If we consider the angle[2] $\odot(a)$ from [1] such that if $\begin{pmatrix} 1 \\ 1 \end{pmatrix}$ is modified to a *normalized* state that is: $\begin{pmatrix} Cos\frac{\odot}{2} \\ Sin\frac{\odot}{2} \end{pmatrix}$ then the normalized state is a $\frac{\odot}{2}$ degree polarization of the horizontal while $\begin{pmatrix} 1 \\ 1 \end{pmatrix}$ can also be modified to co-exist as a normalized state polarizing the vertical simultaneously, that is: $\begin{pmatrix} -Sin\frac{\odot}{2} \\ Cos\frac{\odot}{2} \end{pmatrix}$. But before we can make an independent substitution of our two normalized states into [3], let us express our NIFR as a function of a according to the fundamental formality of [1] i.e. $\boldsymbol{j_{hr}} = \begin{pmatrix} iL_h(-1)^a \\ 0 \end{pmatrix}$ and $\boldsymbol{j_{vr}} = \begin{pmatrix} 0 \\ iL_v(-1)^a \end{pmatrix}$. If we deliberately operate $\boldsymbol{j_{hr}}$ **and** $\boldsymbol{j_{vr}}$ independently with [3] we get two orthogonal state functions:

$$ j_{hr}\,{}_1^1\text{Ɣ} = j_{hr} - j_{hr}\begin{pmatrix} Cos\frac{\odot}{2} \\ Sin\frac{\odot}{2} \end{pmatrix} \quad \text{and} \quad j_{vr}\,{}_1^1\text{Ɣ} = j_{vr} - j_{vr}\begin{pmatrix} -Sin\frac{\odot}{2} \\ Cos\frac{\odot}{2} \end{pmatrix} \qquad [4] $$

The first term of each state function in [4] expresses the oscillating nature of the NIFR while the second term of each state function reveals the rotational behavior of the NIFR that is:

[2] $\odot(a) = \pi\,(a + \frac{1}{2})$

$$j_{hr}{}_{1}^{1}\Upsilon = \begin{pmatrix} iL_h(-1)^a \\ 0 \end{pmatrix} + \begin{pmatrix} -iL_h(-1)^a \\ 0 \end{pmatrix} \begin{pmatrix} Cos\frac{\odot}{2} \\ Sin\frac{\odot}{2} \end{pmatrix} \text{ and}$$

$$j_{vr}{}_{1}^{1}\Upsilon = \begin{pmatrix} 0 \\ iL_v(-1)^a \end{pmatrix} + \begin{pmatrix} 0 \\ -iL_v(-1)^a \end{pmatrix} \begin{pmatrix} -Sin\frac{\odot}{2} \\ Cos\frac{\odot}{2} \end{pmatrix} \qquad [5]$$

We can extract two matrices from [5] – for 1 the matrix of the oscillating Frame $\widehat{\boldsymbol{\xi}_1}$and for 2 the rotational matrix of the norm frame $\widehat{\boldsymbol{\xi}_2}$ -

$$\widehat{\boldsymbol{\xi}_1} = \begin{pmatrix} L_h(-1)^a i & 0 \\ 0 & L_v(-1)^a i \end{pmatrix} \text{ and } \widehat{\boldsymbol{\xi}_2} = \begin{pmatrix} -Sin\frac{\odot}{2} & Cos\frac{\odot}{2} \\ Cos\frac{\odot}{2} & Sin\frac{\odot}{2} \end{pmatrix}$$

The algebraic product of the two matrices $\boldsymbol{\xi_1\xi_2}$ **yields** the rotational matrix of the norm inertia frame of reference -

$$\hat{\boldsymbol{\zeta}} = (-\mathbf{1})^{\boldsymbol{a}} \begin{pmatrix} -\boldsymbol{Sin}\frac{\odot}{\mathbf{2}} & \boldsymbol{Cos}\frac{\odot}{\mathbf{2}} \\ \boldsymbol{Cos}\frac{\odot}{\mathbf{2}} & \boldsymbol{Sin}\frac{\odot}{\mathbf{2}} \end{pmatrix} \begin{pmatrix} \boldsymbol{iL_h} \\ \boldsymbol{iL_v} \end{pmatrix} \qquad [6]$$

where $\begin{pmatrix} \boldsymbol{iL_h} \\ \boldsymbol{iL_v} \end{pmatrix}$ is the NIFR**.** The NIFR rotates into the clockwise direction as the values of a progress. However as we discussed in Section 2, we can think of the projection of *real vector space* as emerging from the cross product of an orthogonal imaginary bases with **magnitude** determined by the **positive area** of a parallelogram having sides defined by the magnitude of the two orthogonal norms. Therefore the projected dimension is the **absolute** value of the determinant of the [6] i.e. –

$$= \begin{vmatrix} -iL_h(-1)^a Sin\frac{\odot}{2} & iL_h(-1)^a Cos\frac{\odot}{2} \\ iL_v(-1)^a Cos\frac{\odot}{2} & iL_v(-1)^a Sin\frac{\odot}{2} \end{vmatrix} = (-1)^{2a}\ |L_h L_v| = Lm \qquad [7]$$

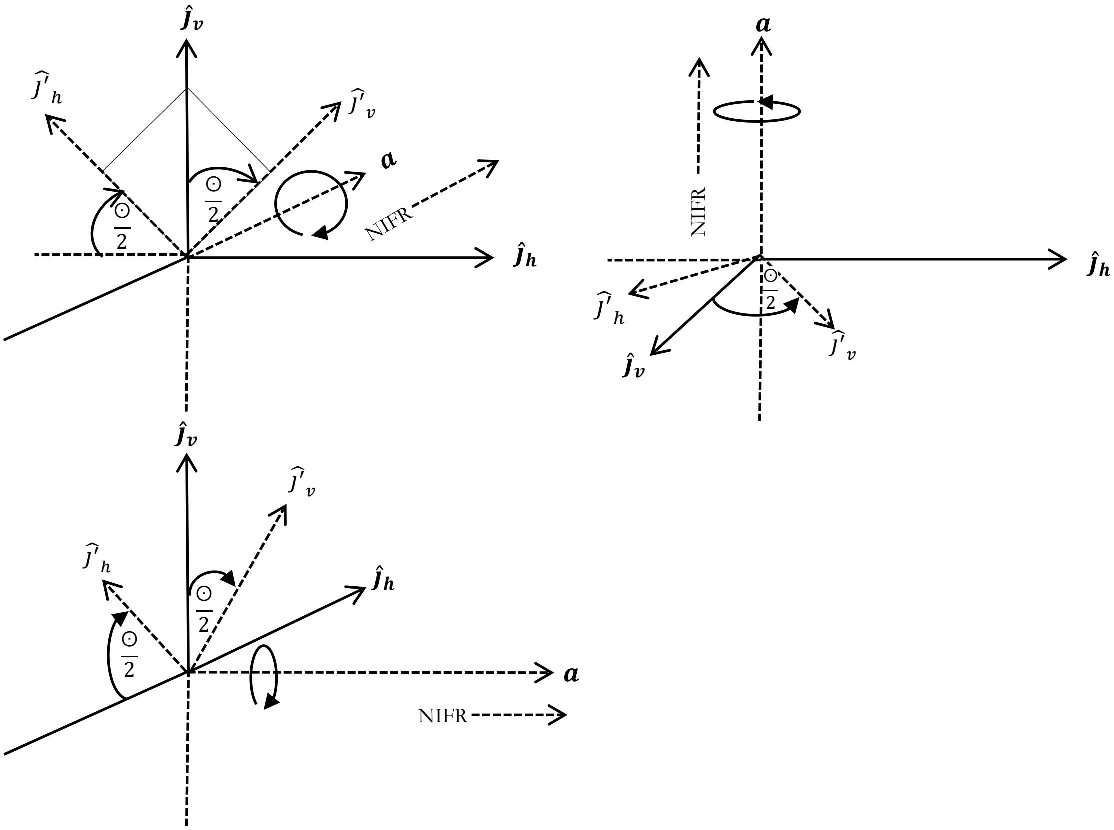
where $|L_h L_v| = L$ and the term $(-1)^{2a}$makes the projected dimension positive. We can generalize matrix [6] into a 3-dimensional matrix having 3 different orientations of rotation diagonalized by $\boldsymbol{a}$ i.e.-

$$\varsigma_x = \begin{pmatrix} a & 0 & 0 \\ 0 & -iL_y(-1)^a\ Sin\frac{\odot}{2} & iL_y(-1)^a Cos\frac{\odot}{2} \\ 0 & iL_z(-1)^a Cos\frac{\odot}{2} & iL_z(-1)^a Sin\frac{\odot}{2} \end{pmatrix}$$

$$\varsigma_y = \begin{pmatrix} -iL_x(-1)^a Sin\frac{\odot}{2} & 0 & iL_x(-1)^a Cos\frac{\odot}{2} \\ 0 & a & 0 \\ iL_z(-1)^a Cos\frac{\odot}{2} & 0 & iL_z(-1)^a Sin\frac{\odot}{2} \end{pmatrix} \qquad [8]$$

$$\varsigma_z = \begin{pmatrix} -iL_x(-1)^a Sin\frac{\odot}{2} & iL_x(-1)^a Cos\frac{\odot}{2} & 0 \\ iL_y(-1)^a Cos\frac{\odot}{2} & iL_y(-1)^a Sin\frac{\odot}{2} & 0 \\ 0 & 0 & a \end{pmatrix}$$

The system in [8] can be visualized by the diagram below:



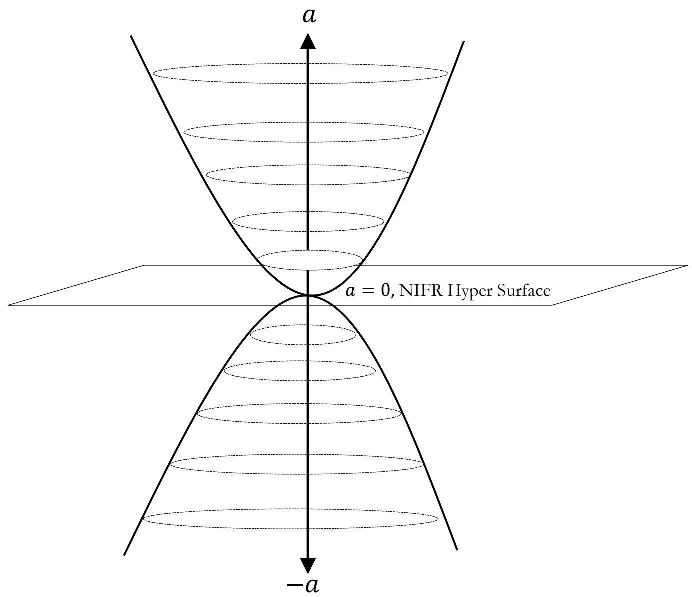
By using the same procedure we used to project the real dimension in [7], we can find the absolute values of the determinants of the cross products of the system [8] to project 3 real dimensions i.e. –

$\|\boldsymbol{\varsigma_x}\| = |aL_yL_z| = aL'_x$ and $\|\boldsymbol{\varsigma_y}\| = |aL_xL_z| = aL'_y$ and $\|\boldsymbol{\varsigma_z}\| = |aL_xL_y| = aL'_z$

$$\boldsymbol{V(L'_x, L'_y, L'_z, a) = aL'_x\hat{e}_x + aL'_y\hat{e}_y + aL'_z\hat{e}_z} \qquad [9]$$

§ GENERAL DISCUSSION & CONCLUSION

So far we have managed to demonstrate that, real space emerges from the imaginary and that events occurring within the imaginary realm have simultaneity with the events occurring within the physical domain. Clearly there is a plethora of useful information which lurks in outcome [9]. Relationship [9] can be represented by the illustration below:



Expression [9] projects instantaneity of events occurring in the NIFR into real space. We can consider a as a function projecting instances of change occurring in the imaginary into the real realm simultaneously. The combination in [8] tells us that at $a = 0$, the state of system projects no space into the physical domain therefore we can say that physical projections are engulfed within the NIFR directional singularity at that instance. However, as the values of a progresses, the projected 3-Space either expands or contracts isotropically as a function of a. In closing this section we conclude this:

- The term a is discrete within the imaginary domain and sets the NIFR into oscillation at angular frequency $\omega_a = \frac{\pi}{a}$.

- The real intrinsic term a is a function of real time.

- Directional singularities that distort the symmetry of Euler rotations occur as a function of real time: $\boldsymbol{j} = \sum_{-\infty}^{\infty} \begin{pmatrix} Lcos\odot \\ iLsin\odot \end{pmatrix} = \sum_{-\infty}^{\infty} \begin{pmatrix} 0 \\ iL(-1)^t \end{pmatrix}$ where $\odot(t) = \pi\ (t + \frac{1}{2})$.

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