On Time & Dynamics

A space-time 4D topology in 3D space

'The virtual edge of time'

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Abstract

A conceptual 4-dimensional vector space-time consisting of an orthogonal vector-time coordinate in a 3-dimensional space is developed to support system dynamics.

This 4D space-time concept deviates fundamentally from the observer oriented theory of special and general relativity, is based upon true time simultaneity of events and separates true, objective reality oriented simultaneous events from observed simultaneous events (in A.Einstein's relativity).

The proposed geometric model is conventional Cartesian in 3D space and introduces virtual time-surfaces of true time simultaneity as a fourth dimension for validity in vector- and tensor- spaces, leading to a compliant 4-dimensional orthogonal vector coordinate system in space-time; the model is thereby implicitly introducing a different space-time topology.

The evolvement of events in this space-time then are traced in a coordinate system of 4 truly independent vector-coordinates i.e. with an *independent* scalar magnitude of the time-vector.

The treatment modifies space-time into 4D curved virtual time-surfaces inside the empty and un-curved 3D space, i.e. confining 3D space in a virtual reality of projected, dynamic evolving 'present' surfaces, spherically closed as the space-time 'edge' of time.

This system model facilitates descriptions both of events in true (proper) time as well describes space-time in a local time defined orthogonal vector coordinate system i.e. referenced, backwards compatible with space-time dependency parameter models as used regularly in scientific descriptions of local events/experiments in space.

The mathematical treatment in virtual surfaces of a-symmetrical time, as well as the (observed) flow of clock-time by the growing radius of curved surfaces, matches human notion of time intuitively; it introduces a time-vector coordinate orthogonal to space coordinates and in a triad/trihedral vector system supports evolving events in time embedded virtual surfaces. This local system description may inherit true time length marks, and events starting on a timesurface can evolve in any spatial direction and be described in properties by the triad e.g. momentum, radiation, in general energy, with it's own virtual surfaces and direction of energy, while maintaining the *mandatory* orthogonality of the 4D coordinate system.

This mathematical treatment of vector time as a virtual fourth dimension, has profound consequences for the mainstream concept of time in vector/tensor spaces in physics - it models and restricts time to the very task of identifying sequences in evolvements of events: time then in principle cannot be affected anymore by parameters/variables in other coordinates i.e. with the consequence that e.g. even by gravity, time cannot be *moulded* to affect space.

§1. Introduction

A. Einstein's special and general relativity theory is based upon the assumption that simultaneity exists by virtue of observation i.e. is observer oriented and the theory is *relative* with regard to different observations in simultaneity, as observations in nature (cosmos, universe) are propagated by em radiation e.g. photons as carrier providing information of reality – Einstein's 'light agency' [7].

In this paper is argued that this assumption contradicts with evidence in astrophysics, as e.g. an underlying cause of information i.e. an 'event', carried and propagated by radiation that -for some

reason- cannot reach us, then would be classified as a non-existing event.
Therefore *absolutivity* of universal simultaneity is introduced supporting objective reality, to include events that we may not be aware of right now and in the past, because information has been ignored not being recognized as information or may not have reached us (yet) i.e. absolutivity is bypassing an observer oriented 'filter' of subjective (observer) information.
In principle, this means that 'time' in the definition of simultaneity, in nature as well as in a mathematics description of nature, is required to be fully independent i.e. not depending on information by photons, as in astrophysics an overwhelming amount of evidence (e.g. background radiation, birth of stars and discovery new stars, at lightyears distances) is found by radiation c.q. photons that have or may still have to reach mankind (the earth, telescopes) of events that already happened in the 'past', caused by the time delay in the information by em radiation.
Therefore surfaces of *virtual time* are created, separating 'observed' from 'true' (objective reality) simultaneity: in principle the delay or 'dead time' in delivery of information literally is 'taken out of the (vector) equations' by projections on the surface, leading to a description in universal, true un-delayed events in space i.e. the blank spots of unknown events in 'past' time surfaces, may be filled by information received in *later* surfaces up to the 'present' surface.
This 'fill by information' identifies the true nature of the virtual objects: the virtual surfaces consist of i.e. 'are' *time information surfaces* i.e. reducing uncertainty in time by datapoints. In the end these datapoints are required not to have any effect on other co-ordinates i.e. must be co-ordinated and orthogonal to arrive at complete sets of unique space-time datapoints of events.
Also one may realize that 'information' is a *created* order e.g. a sequence carried by energy, reducing uncertainty about some event [5], hopefully leading to knowledge.

Time is regarded the fourth dimension, marked by the introduction of a parameter t in mathematical equations. This leads to a 4th dimension that would exist separate from the three space dimensions 3D and therefore is *unrelated*, however when combined in equations, introduces (scalar) *dependencies* between coordinate parameters in the sense that parameter t can affect space coordinates and vice versa e.g. by measured or observed time as well as a 1-dimensional vector treatment, §3.0. Moreover, to date there is no experimental proof of a 4th dimension[1], and a (virtual) 4-dimensional vector space yields ambiguities in vector operations i.e. in mathematical operators, §3.0. Therefore in a spatial environment, a mathematical setup in virtual time surfaces of projected events as orthogonal 4^{th} dimension is introduced.
Although an independent 4th dimension axis does not exist in the reality of 3D, still there is no objection to continue with an addition of time as local parameter t in algebraic equations, however the consequence is that the equations do not hold for any other *state* than the localized state (in relativity, §3.0) in the parameters in formulae, in particular when states cannot mathematically be described by evolutionary changes as e.g. experienced in the quantum realm. The treatment in vector space in §3.0 provides a resolution.
In this paper therefore is argued that time requires to be described by a *vector*, despite it's perception of a scalar e.g. the often heard phrase "time has no direction" is argued to be replaced with "time may take any direction" i.e. as a vector, §3 and further.

The clock-time i.e. time measurement of a clock moving as part of a spatial large experiment or other system in technical sense can be relatively easily corrected by re-calibration or synchronization of these daughter clocks with the local system clock, however the datapoints marking the evolvements in the system dynamically are *only* valid in this possibly large however

[1] Let alone higher dimensions

local defined system.
This is not an issue when locally a state of an object e.g. speed is measured with a local clock that is coordinated with local space dimensions: i.e. in general when the clock moves with the system in which is being measured e.g. as in a local (lab) experiment [2].

The evolvements in nature in a 4D embedded orthogonal time dimension, enables to describe events in universal, true unique space-time datapoints, in which independent time is linked with a unique space location in evolvement of an event in nature.
To proceed with this new approach of time, as well as to arrive at an objective *reality* description and dynamics at all scales, a proposal of absolutivity is introduced in the model.

§2 Simultaneity, Independency & Clock-time

Due to the setup of time surfaces of (true, projected, absolute) simultaneity, the principle of relativity will be abandoned in favour of absolutivity in simultaneity: absolute simultaneity by projections of true simultaneous events on the virtual surfaces and separate it from observer oriented simultaneity. The observer oriented approach as well includes 'measurements' by observing instruments such as clocks.
Despite human factual experience of 'time', daily life is experienced through e.g. our basic sensors: eyes, ears, smell, feeling, taste[2]. Daily life experience is transformed into electrical signals, and sent to a space called 'brains' – and *there* one experiences daily life and self-consciousness: and, without exception, everyone considers this 'reality'.
Essentially this is a virtual reality, a processed projection of sensor signals and our brain makes inferences ('best guesses') filling any missing parts [1], manifest more clearly e.g. with aging.
In nature, the notion of time is primarily created by our environment and likely is settled in memory as information i.e. in our dna: perception of sequences of day-night and seasons are created locally in the solar system as phases/sequences of nature, and obviously the sequences in time are as well present in daily life e.g. before you can drink, get water first. This is a fundamental property of the 'role' of time: it identifies the order in a causal sequence, and it's usefulness is tested in nature by *survival* of the best fit, as in nature time serves as an enabler only.

In a stringent mathematical abstraction i.e. the virtual setup, time by convention must be *coordinated* orthogonally: this however as well renders time *independent* of any, in space-coordinate variables described properties of energy-objects or space topology, i.e. derived and described using concentrations c.q. densities in volumes and flows through surfaces in space. The consequence of the rigid independency, is that *true time intrinsically cannot be affected by energy, particle or space properties* e.g. speed and *gravity*, and then indeed truly serves by (complex) vectors as identifier of sequential order in dynamic events at any scale i.e. in retrieving information by unique space-time datapoints of evolving energy in dynamic events that possibly may enhance human knowledge.

A time coordinate is differently perceived compared to a space coordinate; perceived as moving, but literally there is nothing to 'grab' as one can with objects in space, unless we have a clock. This device makes it possible for us to 'read' time and measure the length of time on a dial or display: it is usually an ingenious system but essentially consists of an oscillator or resonance (pendulum, 'Unruh', crystallic, atomic), a counter mechanism and hands and/or a display, that's all. A clock does *not* measure time directly, but uses the inverse of time i.e. an (oscillator/resonance) frequency

[2] and our 6th sense.. .

and displays the result as local ‘time’ - and looking at the hands/display we conclude that ‘time goes by’.
Any clock in the end thus may be described in parameters of space coordinates of influences, fields, states e.g. velocity and material properties, meaning that clocks are affected by all these parameter elements (no matter how much cost/effort is spent to manufacture them for maximum independency) – clocks thus in principle are sensitive to e.g. temperature, em-fields, motion, as well as gravity.
However ‘time’ *isn’t* – time is presented as a conscious perception of a model of virtual, imaginary visualized moving object, unaffected by space, seasons or day-night phases/rhythm of nature nor is it some-*thing* to ‘grab’ but yet is *experienced* i.e. is a conscious perception created in our brains, just as much objects in space are. This perception is kept vivid in consciousness daily, not in the least by the notion of our daily agenda and schedule in time to organise life by often enough reading the clock and of course *aging.*
In physics, ‘reading’ time on a clock is an *observation,* i.e. clock-time is a *measurement* of time and may therefore deviate (slightly or significantly, e.g. Lorentz factor) from absolute, true ‘real’ time: i.e. in daily life a ‘clock’ is the synonym of ‘time’ however is a measurement with an instrument, valid only in a limited (specified) environment.
In a thought experiment we may isolate the ‘clock’ from motion, temperature and gravity etc. or define or construct it without dependencies.

The forgoing tempted me in this paper to further explore absolutivity[3] i.e. to abandon relativity in simultaneous observed events to replace it by the proposal of time in a *virtual* object of projections of true simultaneous events in modeled surfaces that – due to the absence of a *real* 4th dimension - mandatory fit a 3D vector space, preserving unambiguity in mathematical operators.

§3.0 Vector/Tensor -Space, Coordinate System, and Time
Although mathematically there is no objection to use more parameters than e.g. 3 (x,y,z) and equations extended with a parameter t (x,y,z,t), as in space-time, as then one may address each individual space-time location with a unique number. The basic rectangular coordinate system in space has scalar x,y,z parameter axes but *in principle* is a vector coordinate system in 3 vector dimensions thus with 3 fixed directions and 3 scalar variable magnitudes; algebraic scalar equations then may render exact results in a independent system.
To preserve independency, therefore a 4^{th} and any higher N dimensions are to be implemented independent as well. This however, already by the topology of a (virtual) 4-dimensional vector space, introduces in mathematical operators severe ambiguities:
6 planes of 2 vectors each and only 4 dimensions/directions i.e. dot and cross products fail by not being unambiguous[9]. In scalar algebras including t i.e. specifically in 4D desciptions, this independency of time is missing when orthogonality is assumed, not deliberately implemented (e.g. neglected) and verified, and consequently thus, less visible due to used notation, also in descriptions with tensors.
In vector spaces, the implementation of vectors consisting of direction and magnitude has a profound impact, by providing stringent demands on consistency in mathematical conventions i.e. coordination and independency of all coordinates: a standard in 3D, as coordinates share the same origin and are required to stay orthogonal to remain independent in the entire vector space: the basic rectangular coordinate system. Consequentially, in vectors appearing combined in equations, the

[3] I don’t think the word ‘absolutivity’ exists, so I made it up: contrasting with relativity, indicating the different basis of the thought experiment.

parameter derived scalars of -magnitudes and -directions of vectors are covariant in a vector description preserving energy, therefore remain valid due to mathematically defined independency, contrasting with 'unrelated' and uncoordinated parameters in scalar algebras, therefore vice versa meaning that scalar parameter dependencies yield deviating results.

The space dimensions in principle are a co-ordinated vector system of 3 perpendicular i.e. fixed directions and variable scalar magnitudes. With this system, any point in space may be characterized by 3 numbers i.e. unique data of locations. A coordinate system requires orthogonality[4] i.e. the inner (scalar, dot) products of the coordinate vectors are required to *always* yield zero in a vector space, which may entail the entire Universe.

This as well holds for complex vector spaces where an imaginary component may be introduced to include property descriptions e.g. by a phase information model, and a change of parameter of a magnitude in one vector dimension is not affecting the other parameters in orthogonal systems.
An extra parameter t for time does *not* lead to an identical unique number in space-time when time is not coordinated and orthogonal with space: a journey finally returning to the point of departure in space, does not return to the point of departure in time i.e. 'time goes by' and the unique datapoint in space-time has changed, unless time information is removed from the state description of events – however, obviously this separates statics from dynamics, where a time vector obviously is required to identify information of the evolving sequences in events.

In special relativity [2] the Lorentz transformation is extensively referred to[5].
This transformation results in incompliancies in vector spaces e.g. a treatment as in the Lorentz transformation, is not suitable in vector spaces as well as in tensor spaces: although in one coordinate a vector v is introduced, the transformation seems not meant for use in vector *spaces.* A basic rectangular coordinate system for use in scalar algebras in principle is a vector coordinate system in 3 independent dimensions by 3 *fixed* orthogonal directions (i.e. unit vectors) and parameters x,y,z for 3 *scalar* magnitudes; *a*lgebraic equations in 3D x,y,z *only* then render verified results in an independent system i.e. adding t and preserving independency, implicitly require a 4^{th} and any higher dimensions to be implemented orthogonal.
A 3D vector space requires a stringent approach: *all* coordinates are vectors, with scalar-products equal to 0, and with vector products yielding perpendicular vectors on their planes i.e. for a vector composed orthogonal coordinate system in a vector space, the components creating distance d related to time are to be implemented in the 3 coordinate axes, i.e.

$$d_x = x' + v_x t + \tfrac{1}{2} a_x t^2,\ d_y = y' + v_y t + \tfrac{1}{2} a_y t^2,\ d_z = z' + v_z t + \tfrac{1}{2} a_z t^2, \qquad (3.0.1)$$

with $d_x, d_y, d_z = x, y, z$ in a system with time related coordinate axes in 3D, and with $\underline{v}$ the (average) expansion velocity vector that may be corrected by acceleration and deceleration, is leading to distance $| \underline{v} | . t = R_t$ of assumed spherical expansion starting from the big bang origin i.e. $(x', y', z') = (0,0,0)$, relating the magnitude to the Hubble constant H_0.

An assumed linear expansion ($a_{x,y,z} = 0$) renders an expansion vector $\underline{v}$, with magnitude $R_t = t . | \underline{v} |$ from the origin and $\underline{R}_t$ the position vector in the origin to the surface.

[4] Orthogonality is covariant in transformed coordinate systems such as rectangular, cilindrical-, spherical-, bipolar-, paraboloidal- etc. systems, however not for *any* coordinate system and therefore should be verified; N-dimensional vector/tensor systems thus as well are to be verified for mathematical orthogonality.

[5] In general relativity [2] is stated that special relativity yields "Erkenntnistheoretischer Mangel" i.e. deficiencies in the theory are introduced, illustrated in e.g. rotating liquid bodies – this relates to the *chosen* location of the origin of the coordinate system, preventing free movement of one body in the definition of the thought experiment given by A.Einstein.

$$\underline{R}_t = \{(v_x t)\,\underline{i} + (v_y t)\,\underline{j} + (v_z t)\,\underline{k}\} = t \,.\, \underline{v} \qquad (3.0.2)$$

and the rate of increase of $\underline{R}_t$ i.e. d/dt $\underline{R}_t = \underline{v}$ obviously.

with $\underline{v} = v_x\,\underline{i} + v_y\,\underline{j} + v_z\,\underline{k}$, with magnitude

$$v = |\,\underline{v}\,| = \{(v_x)^2 + (v_y)^2 + (v_z)^2\}^{1/2}, \quad v < c \qquad (3.0.3)$$

with $|\underline{v}| < c$ i.e. $(v_x)^2 + (v_y)^2 + (v_z)^2 < c^2$

in which the components may take any value between 0 and c (m/s), provided (3.0.3) holds.
In particular at quantum scale i.e. in general when v may not be negligible compared to c , the Lorentz factor L_f may be incorporated in (3.0.2) yielding

$$|\,\underline{R}_t\,| = v \,.\, t / L_f = c.\, v.\, t / (c^2 - v^2)^{1/2} \qquad (3.0.4)$$

The following elaborations clarify the vector treatment.
With $v_y = 0$ and $v_z = 0$, in a vector space, one axis remains and the Lorentz transformation appears in a 1-dimensional vector space, incompliant with 3D vector space i.e. a spatial 3D trajectory cannot be identified with $\underline{t}$ in this coordinate system.
This sheds a different light on relativity theories relying heavily on the Lorentz transformation: in vector space, the theory has validity in only one dimension!
It raises the question “how can a theory with so many validated predictions be one-dimensional in a vector description?” and in the spirit of Einstein[6] can be answered as follows:
In the Lorentz transformation, in only one dimension (x) a time parameter is incorporated. In space travels i.e. changes of locations in space with an (e.g. average) speed, time i.e. by velocity must be measured in 3 directions, and a vector treatment ‘takes care’ by covariance that (3.0.2.) remains valid, meaning that a space curve of the travel trajectory in vector space renders the projected velocities covariant with the space curve i.e. time is to be rendered in three coordinates instead of one, i.e. measured by three clocks, i.e. shouts (over 100 years.. .) for a vector treatment in a vector space by direction and magnitude: then time is traced truly in 3D space.
This means that relativity theory is yielding exact results in one dimension, i.e. only provides one (1) *localized state* (space location) each ‘time’ (calculation), therefore in principle is a *state description in space location*. The results remain exact *only* by *rotating* the coordinate system i.e. for a new location space location vector $\underline{R}$ is aligned continually with the x-coordinate i.e. 1 calculated state is only valid in a restricted area of the space location.
In dynamic system descriptions, as locations change continually in a space curve, the vector treatment should be preferred, as (3.0.2) removes this limitation.

The expansion vector $\underline{v}$ by it’s magnitude identifies the with t increasing radius lengths R_t of the introduced 4th dimension of spherical time surfaces for use in e.g. a Hilbert space: i.e. the edge/shell of time moving i.e. being renewed instantly and continually.
This also implicitly means that a time surface may not only contain projections from outside the sphere surface i.e. also may contain projections from inside, created at a later stage in the ‘big

[6] “Never stop asking questions”

bang'[7].
Tensor analysis is developed because of the notion that laws of physics obviously should remain valid in any mathematically sound coordinate system, in order to describe behaviour of systems independent of coordinate systems[8]. In the most basic scalar parameter system, the axes are defined rectangular for independency between coordinates.
Tensor mathematics uses symbols in super- and sub- scripts, and the formal introduction/ identification of vector coordinates with independency in a vector coordinate system including it's transformations, is a mathematical[4] *prerequisite,* not tested (of course) in applying and using tensors. Using tensor mathematics thus implies that e.g. vectors/scalars of the coordinates, embedded in the tensors, are to be based on *orthogonal basis vectors,* in a 4D vector space therefore mandatory is to include e.g. time as an orthogonal basis vector, verified for mathematical independency in *any* space[9].
Due to the symbolic representation and focus on *validity* in coordinate transformations ("allgemeinen Kovariantentheorie", [2]), the mathematical prerequisite often is *implicitly assumed* but may not be incorporated at all: e.g. a 4th axis of time 'out of the blue' used in algebras can by no means acquire validity in a vector space.

In this context it is fair to mention that in treatment of gravity by I. Newton notably the original Newtonian formulae are valid in 3D vector space, being based on vector equations (at the time 1687 regarded unsolvable.. .); the results in [3] for symmetrical objects in gravity, and papers based on results of general relativity e.g. of K.Schwarzschild and J.Droste [...], of Einstein's curved space-time and derived geodesics in relativity, in [6] are seamlessly be derived with the Newtonian formulae in the Hilbert vector space without tensor mathematics, as in vector spaces, obviously vector properties by mathematical vector operators essentially preserve energy by covariance, see e.g. [6].

§3.1 Orthogonal Space-Time, Datapoints

As argued, time by a parameter t axis is not part of c.q. co-ordinated with the spatial dimensions and does not create a orthogonal reference system by itself: this leads to the 4 dimensions proposal of the 4D topology by virtual surfaces of all *projected* simultaneous events. The basic rectangular coordinate system in space has scalar parameter x,y,z axes and in principle is a vector coordinate system in 3 dimensions with 3 fixed directions and 3 magnitudes; algebraic equations in x,y,z then render the correct results in an independent system. To preserve independency, the 4th and any higher dimensions are to be implemented independent as well with an independent clock in the origin i.e. in a re-designed *space-time* model. The virtual time surfaces then are set up to the 'present' surface, and the clock *remains* in the origin providing the correct time marks for the surface's radius of the system.
By simultaneous events in the entire universe in a time-sphere closed surface in the continuum i.e. all events occurring at exactly the same time in space (most of which we will not be aware of), events are *projected* on their particular virtual true time-sphere surface and thus the projection

[7] Trying to describe this in terms of past and future, is a brain catch of 'controlled hallucination' [1]: *outside* the sphere is almost everything created in the BB *before* the Earth existed, thus earlier i.e. in a past, and *inside* the sphere almost everything that was *not yet created* even i.e. in the future, seemingly leading to an inconsistency as past surfaces are inside and future surfaces are outside. However, the projections are space events occurring simultaneous in time i.e. not in the past or future but 'at the same time' i.e. showing objective independency of space and time in a space-time location.

[8] Provided that the origin chosen allows the description of movements of all objects e.g. as usual in a distributed system of energy objects, in the centre of gravity.

[9] As a pure mathematical requirement, this verification should include N-dimensional spaces.

identifies events on the particular time surface with *unique* time (-labeled) datapoints and facilitates causal evolving events with a certain length of time (collection of space-time datapoints) as evolving events, continually leaving time sphere surfaces that instantly become the past. The space-time datapoint numbers are unique as each number is composed of 3 unique space data points and 1 unique time data point on a virtual surface, i.e.:

S*pace-time thus is composed of 3 dimensional space and an orthogonal 4th dimension of virtual i.e. imaginary spherical curved time surfaces, up to the dynamical present, which serves as the perceived virtual time edge, with beyond this edge the future.*

The proposed time-surface model integrates observer *in*dependent i.e. an infinite amount of time-surfaces of the 'past' in space separating true objective reality from *observed* reality we live in, and thus many surfaces obviously will contain events that human kind will not (never) be aware of: the treatment is reality oriented. This reality of simultaneous *events* therefore deviates *inherently* from the *relativity* of simultaneous events as treated by Einstein and Lorentz, being *observer* oriented. Obviously measurements of events are observations and treated as such: many simultaneous observations of distant events in the Universe may belong to (very) different time surfaces, in contrast e.g. with nearby events. This provides a natural separation of true real-time reality and daily life observed/measured reality[10] [2, 3] .

In physics, it seems an obvious choice to opt for real time surfaces as in principle *physics should provide a reality description of nature at all scales*, be it in an extreme large context, our solar system or locally, even at an *un*observable scale. The proposal integrates real time of events as un-quantized, i.e. a dimension in the 'continuum' of true 4D space-time surfaces in the 3D space.
The verification e.g. in descriptions in multi-dimensional spaces that may also contain covariant transformations, therefore as well should be formally rooted in the vector/tensor mathematics by the implementation of a proven true orthogonal N-dimensions relation.
In the 3D model of space, implementing time in a vector environment compliant with the space coordinate system, thus may be by virtual spherical curved and closed time *surfaces.*
This implicitly requires a time embedded vector yielding a magnitude i.e. in line with our natural perception of 'the length and flow of clock-time' and for independency defines the vector perpendicular to space coordinates to arrive at a true orthogonal system: it therefor requires a mathematical *definition* of the time vector in a 3D vector space accordingly.
By this model, the different topologies of space and time become embedded as true dimensions in a 4D coordinate system.

§ 3.2 The Time Vector

To construct the time vector according to the definition in the foregoing paragraph, it's direction is mandatory in a tangent plane anywhere on the virtual time surface i.e. is in the direction of *a* unit tangent vector $\underline{T}$ on a timesurface, to be orthogonal with an expanding location vector, and it's magnitude is provided by the true time distance r_t to the origin of the coordinate system, i.e. from (3.0.3) follows

$$\underline{R}_t = (t \,.\{(v_x)\,\underline{i} + (v_y)\,\underline{j} + (v_z)\,\underline{k}\}) = t \,.\, \underline{v} \qquad (3.2.1)$$

[10] One of the reasons to introducte the virtual time surfaces.

and with $|\underline{R_t}| = |t \,.\, \underline{v}| = R_t$, the dynamic surface radius of the ‘present’, the time vector is defined in this system in the tangent plane i.e.

$\underline{t} = R_t \,.\, \underline{T}$, with unit vector $|\underline{T}| = 1$, tangent on the time surfaces. (3.2.2)

This result is valid for an expansion speed way smaller than c (m/s) (see (3.0.4)), and identifies a vector with a direction tangent on the surface for orthogonality and a magnitude of the increasing radius of the time surfaces.
This time vector will be incorporated in a triad (trihedral) vector coordinate system §3.3 .
This represents a time vector in a 4-dimensional vector space; furtheron the vector should support energy evolvements in events starting at the surfaces and thereby register information of the evolvement of a dynamic event. The actual vector direction therefore is derived in the tangent plane in the model of evolving energy in events i.e. evolving in any direction in space.
Notably the requirement does not force the direction of time vector $\underline{t}$ in the direction of the time surface normal vector as at first sight would be assumed, but anywhere on all evolving time surfaces as a tangent vector, leaving one degree of freedom to define the actual direction of the time vector in space.
While being defined on a surface, vector $\underline{t}$ remains equal when moved parallel (conserving direction and magnitude) to an origin i.e. then may share the origin to measure time on the radius of the surfaces, coordinated with the 3 space vectors leading to an orthogonal basis for a 4-dimensional space-time description of the system in 3 dimensional space. The same is valid in the triad vector system introduced in §3.3 .
The growth of it’s *magnitude* $d/dt\ |\underline{R_t}| = \underline{v}$ i.e. R_t intuitively is related to the distance of the surfaces to the origin and supports our notion of time flow by the rate of change of the location vector in time by the expanding universe.
This definition results in unique datapoints in space-time and is suitable in vector space *reality* descriptions of dynamic evolvement of (stellar and quantum) events in evolving time-surfaces of the present instantly becoming the ‘past’.
The proposed time-surface is backwards compatible i.e. not upsetting earlier scientific research in a local space-time parameter environment, moreover the 4D coordinate system may be located *anywhere* to describe, verify and apply physical laws locally i.e. when required each with it’s local clock in the origin i.e. system time ‘reference frame’.
The local system e.g. a triad (see §3.3) may also *inherit* time length marks of the true time position vector $\underline{R_t}$, or (somehow) be synchronized with the motherclock in the origin, or administrated cq. adjusted in frequency when speed is to be accounted for in an event to use identical time marks in the evolvement. In true time thus the expansion speed is to be accounted for whereas in a local system the distances are extremely small compared to the distance to the BB origin and $\underline{v}$ may be neglected.

Each timesphere surface thus identifies a true history and future of timesurfaces of events occurring before c.q. after the particular time-surface, thereby as well serving as ‘the present’ in the past i.e. separating history and future and identifying causal relations such as e.g. rotation of the earth and a nearby star leading to a day-night rhythm as well as the sense of phases in time in repeatable events.

The surfaces are virtual i.e. imaginary and movements or gravity fields influence *measurement* of time by clocks, therefore human observation of time will be affected by *clock-dilation* as they will deviate because ‘clocks’ are measurement systems with specification in accuracy depending on

physical properties and quantities e.g. velocity, temperature, mass and space parameters x,y,z, as argued in §2.

This conceptual treatment of time thus contrasts with relativity by being observer independent, consists of a 4D orthogonal basis with a time-vector, uses inherited timemarks, (instantly) synchronized or administrated clocks in origins and is set up to validate unique datapoints for any space-time event. Although it cannot be realized at the scale of the universe, technically works well at the scale of e.g. GPS alike systems, when in principle, clocks may be synchronized with the speed of light c (m/s) or by adjusted frequency, pre-meditated by exact knowledge of their behaviour including information of sources in trajectories of the GPS satellites.

§3.3 Causality, Triad and Energy-States

Despite human perception of time and in contrast with causality, *time however does not play any active* role in the evolution in nature being an enabler of events: vector time takes on the role of an identifier of causal order[11]: nature evolves with a certain order in events and includes a process of memorizing order e.g. in dna, thereby only needing a lot of time as enabler :-)) in comparison with e.g. the length of (human) life.
Time merely is an identifier of sequential order (e.g. states) in causality relations required to understand and memorize evolving causal relations, e.g. described by causal evolving *states* any object or event may be in and/or evolves in. This in principle includes *information* i.e. energy based created order that may be identified and *stored,* to be recognized e.g. in energy transfers for understanding.

Vector $\underline{t}$ is required to serve the direction of *energy* propagation in events departing from the time surfaces and to support this, with the appearance of $\underline{T}$ in time (3..2.2), the moving triad (trihedral) is introduced with origin on the surface for curved line trajectories described by the start on geodesics on the time surfaces by $\underline{T}$, $\underline{N}$ and $\underline{B}$, and we arrive at the evolvements of energy states.
The direction of the energy in the event is in the normal $\underline{N}$ direction of the *surface* i.e. represented by a binormal $\underline{B}$ direction at a curved geodesic in a triad on the surface i.e. (3.2.2) is rewritten as

$$\underline{t} = R_t . \underline{B} \text{ , with } |\underline{B}| = 1 \qquad (3.3.2)$$

In the triad the binormal $\underline{B} = \underline{T} \times \underline{N}$, and as triad vectors $\underline{T}$, $\underline{N}$ are tangent on the spherical time surface, the direction of $\underline{B}$ (inside/outside the sphere) follows from choosing the one degree of freedom left in the direction of $\underline{T}$ such that ($\underline{T}$, $\underline{N}$) form a RH system with $\underline{B}$ for energy evolution/transfers in space-time in any space curve i.e. in any spatial direction.
This describes the energy-states in the 4D topology by a starting event in space and proceeding propagation in the triad/trihedral.
The local system of dynamic energy evolvement thus can inherit real time marks of R_t from the virtual surfaces for start-end of an event in true time and may follow any e.g. torsioned, curved, straight or combined in a trajectory synchronized in true time, from 0 in *infinitely small distances* and in any direction of the ‘continuum’.

§4. Topology & Time Perception

The proposed space-time transforms the time topology into curved Riemann ‘history’ time surfaces up to the surface of the ‘present’: with a clock at the origin t = 0 at the start of the ‘big bang’ and a

[11] The sequential order - being energy carried information - may be preserved in some memory function; see [2].

set of created marked time surfaces, as well a *true proper* definition of time is possible, however seems rather impractical because of the large numbers, compared to more localized events like spatial experiments; as in experiments, time differences play an important role, a precise length of time may be 'inherited', i.e. more important and more practical.

A mathematical treatment of time should align with the notion that one cannot travel back in time[12] i.e. negative time and negative clock-frequency (no matter which direction the hands take when observed) don't exist even in imaginary, virtual time mathematics describing reality.
Dynamic travel events occur only in positive, vector time: in true time, R_t is a distance to the origin and increases, while the time vector direction is *tangential* with the surface, therefore an opposing, considered "negative" direction of vector $\underline{t}$ in the tangent plane thus always remains *positive* because the vector direction is defined by the evolvement of energy in the event (§3.3) i.e. may take *any direction in a tangent plane* on the surface and therefore is valid in any event.
This means that the *intrinsic* properties in this description support our notion of time evolving a-symmetrical; as one speaks of 'back in time', in the equations just means reducing R_t to 'go' backwards on the radius e.g. to come to grips with a causal relation in an event using the unique space-time data-points.
In this time-surface model of *one* expanding Universe, obviously the topology of time is spherically curved, is a *virtual dimension* one experiences, but is hard to visualize as 'at a particular moment in time' the surface data-point is valid by projection anywhere in space, i.e. by the strong preconditioned tendency of our brains to visualize in 3D space.
In both a local and in a true time setup, the coordinate system is positioned such that e.g. travels, evolving events, experiments etc. i.e. 'life' or 'natural events' take place in these time surfaces to stay in the 'present', leaving history surfaces behind us and e.g. illustrates that because of the extreme large radius of the true time surfaces, the notion of time is attributed to a scalar rather than a vector and therefore, although curved, is perceived being 'flat' in topology.
A journey of a certain length of time i.e. is measured by differences of the radii R_t of the time spheres and an object state e.g. speed $\underline{v}$ thus is treated identical as usual: dR_t/dt. Speed in a local event e.g. experiment thus as well can be measured locally by counting time-surfaces in the 3 directions of space coordinates i.e. measuring time by a local (system synchronized) clock as in the proposed description where time intrinsically evolves evolutionary in positive scalar increasing manner perceived as the 'flow'of time.

Imaginary surfaces of the past up to the 'present' state create a volume, and *inside* this considered empty created volume, the cords c.q. trajectories are perfectly straight in an uncurved space, leaving the space coordinate system unchanged - this thought-experiment model thus renders 'space-time' in *curved time* topology.
Finally, the curved trajectories of energy observed in this uncurved 3D space are the effects of sources i.e. causes (matter, energy, including their fields) acting in a causal relation (be-cause) of their presence in space and are found to be the geodesics of compensating 'actions' i.e. accelerations c.q. forces in the Standard Model [6] .

The spherical closed time-surfaces in only *one* expanding Universe, precludes the existence of separate curved dimensional spaces with their own e.g. manifold topology inside the space of the sphere e.g. to explain space-time curvature or even quantum states and properties.

[12] This means as well an invitation to describe any experiment by the mathematics as presented that may be set up to deny this fact of life.

It as well locates the entire realm of physics i.e. including quantum physics in a space-time of time-surfaces and space-volumes in the continuum and e.g. does not affect the uncertainty relation of Heisenberg at the extreme small scale of a quantum system, is mathematically validated in [6], and is applied in a *gravity* model description in vector space volumes and surfaces *without* yielding asymptotic functions.

In principle, the measuring device of the system i.e. a 'mother-clock' is located at the origin of the space-time-surface coordinate system and does *not move* relative to an evolving system event, providing the time marks for a local system in a triad, thereby avoiding e.g. all the administrative tasks of timely adjustments required e.g. in systems with moving sub-systems or components needing individual synchronized or adjusted daughter clocks e.g. in GPS network systems - i.e. just leaves this a practical issue for engineers to solve … :-)).

§5. Summary & Conclusions

In this thought experiment of a new space-time model, time is incorporated as a curved orthogonal virtual 4^{th} dimension in 3D empty space i.e. the space location vectors are perpendicular to the time surfaces' tangent time-vector, and does not require transformation.
For compliance in vector spaces, time then evolves as a virtual curved surface in 3D of projected true simultaneous time-events i.e. as time-sphere, and creates the 4D environment in which time as vector truly may act as a identifier of sequential order in energy evolvements (events).
In space, any direction is possible rendering the time surface fully independent of the other space-direction coordinates, while the 4 coordinates are all modelled inside the same 3D space and coordinated, i.e. a 4D reality model in 3D space.
It allows the curved time-sphere coordinate to remain mathematically orthogonal with space coordinates at all evolving time surfaces, and at the *same time* - meaning 'anywhere on the surface' - , therefore space coordinates may indicate *any* direction of the space location vector: *each* mathematical causality relation then evolves in the triad in a true orthogonal 4D space-time coordinate system and is predictive in dynamic behaviour by analogue or digital (e.g. Stossvorgänge) causal evolving energy relations in mathematical functions.

This supports the following conclusions:

***.** The objective reality oriented description of space-time in absolutivity, is fundamentally differing from observer oriented relativity.

***.** This description of space-time in absolutivity results in a time vector model instead of a scalar time model, in line with human perception of time: a-symmetrical, dynamic flow, almost flat topology.

***.** Relativity theory is restricted to state-descriptions in system dynamics by relying on the Lorentz transformation. The restriction is lifted in a vector space incorporating time in 3D by the expansion velocity vector as proposed.

***.** The vector treatment results in a radius of the present time sphere R_t increasing linear with t, and may be corrected by the Lorentz factor L_f .

*****. The model is rendering time in virtual surfaces as part of the continuum i.e. not quantized.

***.** The mathematical orthogonality of space and time in the model renders the time vector independent of descriptions of space- and material- properties[13] in space parameter variables.

*****. Dynamic energy transfers in triad-system descriptions in vector space are formally supported by orthogonal space-time.

*****. A space-time 'warp' connection inside a black hole is not supported in this model of space-time, i.e. time cannot affect space coordinates e.g. describing connections with other spaces. This supports the conclusion in [6].

***.** The usually named 'time' dilation, is related to the 1D state description in relativity theory and (local) clock-time dilation caused by e.g. motion, gravity, em fields, temperature etc. as well as material properties related to *observed time* on local clocks i.e. in observer oriented relativity.

[13] *Properties* described with spatial variables i.e. acquiring their values by functions in coordinate variables (x,y,z): electric, mass or chromatic *charges* i.e. as *sources* affecting space properties by their fields in functions of space variables thus consisting of parameters in space coordinates to describe e.g. concentrations, densities, flows of electrical charge, mass in volumes, transfers through surfaces etc. i.e. properties as well as states of energy-particles, therefore *do not have any effect on the time vector* when the vector by mathematical convention is independent of space coordinates – time thus truly serves as description identifying order in (a sequence of) evolving events. E.g. in [6] is illustrated that in a symmetrical black hole model of gravity, accelerations in the centre of the hole are zero i.e. an origin of the proposed local coordinate system might even be located (exactly) in the black hole centre *without affecting it's clock (measurement of time), time and other coordinates*.

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