

Man in Spacetime - Complexity and Present as Process

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1 Summary

The observable universe has spatial limits, on the small side the Planck length, on the large side the particle horizon. The thing that observes has a functional unit, the neuron. All are fundamental by nature: The Planck length due to the uncertainty principle, the particle horizon due to the speed of light, the neuron as basic element of biological cognition.

Taking the logarithm of Planck length, particle horizon, and size of neuron, shows that the neuron is exactly in the middle between Planck length and particle horizon. This is striking, the thing enabling cognition, here man understood as brain with everything about it, has as its most fundamental element a thing, the neuron, which logarithmically is in the middle of the universe of cognition. Conjecture: This observation is related to the Dirac Large Number Hypothesis.

Temporally man is a sentient being of the present, a being neither of past nor future. The neuron enables cognition of existence in the present. Taking space-time as conceptual frame, it can be shown that the present is a process in space-time, and not a point sized look-out, associated with a volume in 4D-space-time in the order of magnitude of 10^6 m^4 .

In short, that which cognizes is a generating process with the most fundamental element of this process, the neuron, in the middle of the universe of cognition.

2 Prolog

Perils happen. Observing and catching them protect. What is that observes, what catches? This essay is an examination from a physical and a metaphysical viewpoint.

Man exists in something. Call it space, a speculation probably originating from Anaximander (ca. 600 BCE): *Apeiron* (ἄπειρον), roughly the *boundless* from which all we can perceive is derivedⁱ.

Man, due to his brain, is the most complex thing known to him in the universe. All existing insight stands in connection to or derives from that complexity. The best physical descriptions of the universe are on the small side the Standard Model of particle physics and on the large side the General Theory of Relativity. To this date all efforts of their falsification failed.

Start with the *apeiron*, a somewhere else without attributable qualities except being the origin of the here and now. The here and now, its contrast, contains matter, quantum fluctuations, man and all of his insights. These insights, by nature experiences, are man's very own experience. Scientists often take the following standpoint: Scientific insight is an image of reality but not reality itself. The images are models, if ever possible in mathematical formⁱⁱ, approximating background structures of what we observe in the foregroundⁱⁱⁱ. Scientific insights are experiences by those who apply the scientific method: These insights teach about things which are independent of the observer to a high degree. Summarized as laws of nature, these experiences are valid for all beings, understood or not understood by them.

The Standard Model^{iv} of particle physics and the General Theory of Relativity^v have tremendous predictive power. With their clarity they stand in stark contrast to the lack of clarity of man about himself, individually as well as mankind as a whole. Phenomena like wars (historically more than ten thousand with more than three billion dead)^{vi}, overuse of planet Earth (should man continue to consume at present levels, then, on a geological scale, Earth will soon continue without man)^{vii} hint at forces not understandable in the contexts of models like the Standard Model and General Relativity. These phenomena, consequences of action as such, presuppose complexity of a kind unique to man. Models like the Standard Model and General Relativity cannot describe many phenomena experienced by man. The experiences by artists, craftsmen, tortured beings, couch potatoes, mystics, usually are very different, very personal images of inner realities. And they express these inner realities in forms very different from the scientific format.

Standard Model and General Relativity are part of something larger, working hypotheses on the march to a more inclusive insight. They describe an architecture of the universe, again working hypothesis, enabling existence of things like man. This leads to the question: Where is man's apartment in this building, **where is man in space-time?**

3 Man: Situation in Space-time

3.1 Space-time: Spatial Aspect

Human observation has limits, on the small side the Planck length^{viii ix} ($\ell_p \approx 1.616 \times 10^{-35}$ m), on the large side the particle horizon of the universe^{x xi} ($\ell_{PH} \approx 46 \times 10^9$ ly $\approx 4.35 \times 10^{26}$ m). The Planck length is a consequence of Heisenberg’s uncertainty principle, a fundamental property of quantum systems. At the Planck length measurement becomes fuzzy due to quantum effects. The particle horizon is a consequence of General Relativity with the velocity of light in vacuum as universal constant. The particle horizon, radius of the observable universe, is classical physics in contradistinction to the Planck length. Its estimate is deterministic by nature and depends on models like the Lambda Cold Dark Matter (Λ CDM) as the leading model. This makes the particle horizon a measurable quantity with definable errors. However, it is dependent on the place of the observer in the universe, and it grows: Each point in the universe has its own and expanding volume of observability. The best estimates of the Λ CDM-parameters^{xii} go back to Planck-2015 of the European Space Agency.

Standard Model and General Relativity are, working hypothesis, models enabling as well as limiting insight. However, their stability may justify to take their limitation to observation as by nature fundamental.

Observing presupposes a nerve system, with the neuron as the most fundamental functional unit^{xiii}. What is meant here by neuron is the cell body without axon and without dendrites, with a size range of (5-100) μ m and mean of about 50 μ m. It is the thing enabling man cognition and insight, man thought of as brain and everything about it to make the brain function.

Common to Planck length, particle horizon and neuron is their fundamental nature in the context of particle physics, cosmology and biology. The following calculations show, on a logarithmic scale, that the neuron is in the middle between Planck length and particle horizon:

Basis of Calculations	Measurement	Assumption
	(m)	(m)
Planck length	1.62E-35	
Particle horizon (44 Gly)	4.16E+26	
Particle horizon (46 Gly)	4.35E+26	
Particle horizon (48 Gly)	4.54E+26	
Macromolecule		5.0E-09
Neuron		5.0E-05
Human		1.7

Observable		x	ln (x/1 m)	ln(ℓ_M) = 0	x
Universe		(m)	(log nat)	(log nat)	(m)
Plank length	ℓ_P	1.6E-35	-80.1	-70.7	
Macromolecule	ℓ_{MM}	5.0E-09	-19.1	-9.7	
Neuron	ℓ_N	5.0E-05	-9.9	-0.5	
Mean	ℓ_M		-9.4	0.0	8.4E-05
Human	ℓ_H	1.7E+00	0.5	9.9	
Partikelhorizont (46 Gly)	ℓ_{PH}	4.4E+26	61.3	70.7	
	ℓ_M / ℓ_P	5.2E+30			
	ℓ_{PH} / ℓ_M	5.2E+30			
	ℓ_{PH} / ℓ_P	2.7E+61			

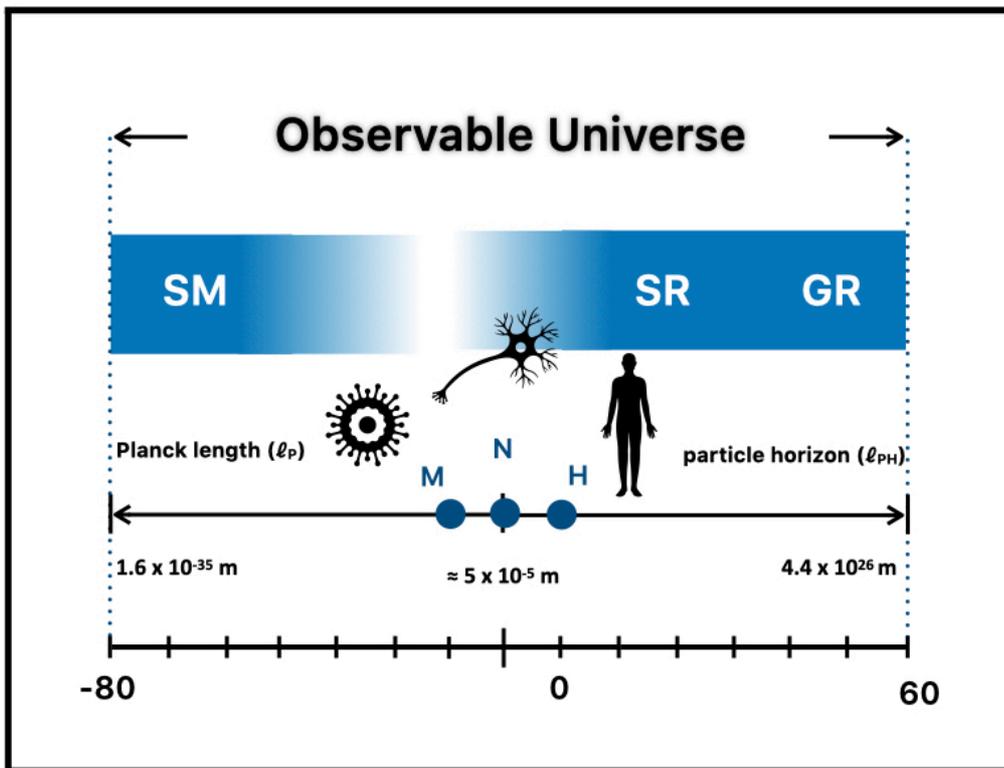
Particle horizon	ℓ_M
(Gly)	(μm)
44	82
46	84
48	86
	5 μm < Neuron < 100 μm

The mean is not very sensitive to the value of the particle horizon.

Strange, the neuron, precondition for the discovery of observational limits, lies logarithmically nearly exactly in the middle of these limits. The neuron, electrically excitable, has the ability to transmit signals via axon and dendrites. This exactly makes it the fundamental element in neural processing^{xiv}.

Regarding this fundamental aspect the degree of cerebral complexity as such is irrelevant. However, in order to formulate things like the Standard Model or General Relativity necessitates a brain like humans have (order of magnitude 10^{11} Neurons with a connectome of similar order or larger).

Fig. 1 Standard Model (SM), Special Relativity (SR) and General Relativity (GR) with their approximate ranges of validity, as well as Macromolecule (M), Neuron (N) and Human (H) on a Logarithmic Scale (logarithmus naturalis).



Decisive on the small side is the Standard Model. With increasing size, roughly in the range of macromolecules, order of magnitude (1-10) nm, the quantum effects vane. Decisive on the large side is the General Relativity. With decreasing size, but larger than human size, the effects of curvature of space vane. In the order of magnitude of human size space-time appears as flat and General Relativity reduces to Special Relativity^{xv xvi}. The human observer, carrier of the neuron, exists in a range where quantum effects and space curvature effects become insignificant and Special Relativity is a valid approximation.

Conjecture

The logarithmic middle position of the neuron relative to Planck length and particle horizon is approximately a factor of 10^{30} in either direction. This factor hints at a deeper structure which would also have to incorporate the expansion of the particle horizon.

This observation reminds of the Large Number Hypothesis^{xvii}, initially due to Hermann Weyl (1885-1955) and mainly developed by Paul Dirac (1902-1984). Dirac suspected the ratios of cosmic parameters to fundamental constants, numbers ranging 10^{40} to 10^{120} , to be in some sort of relationship. They would somehow bridge Standard Model and General Relativity. What that bridge by nature could be is open.

Conjecture

The ratio of approximately 10^{30} relates the element necessary for cognition, the neuron, to what lacks this kind of cognition. The number could tie what we consider as living to the not-living. Assigning it by category to the Large Number Hypothesis seems plausible. This hypothesis, expanded by what is able to cognize, would then be the Large Number Hypothesis plus.

Sheldon Glashow projected the universe in the context of Standard Model and General Relativity onto a logarithmic scale (Timothy Ferris, 1982)^{xviii}. He sketched an ouroboros (a snake biting its tail, archetypal symbol dating back to Ancient Egypt 1300 BCE) including all categories of physical phenomena. The zenith, the bite point, he marked with "GUT" or "GUT?" (Grand Unified Theory) and the nadir, a bit to the side, he marked with a human figure. At the bite point Planck length and particle horizon meet, and that is what a GUT would have to bridge.

Thus, the spatial place of man can be characterized as follows:

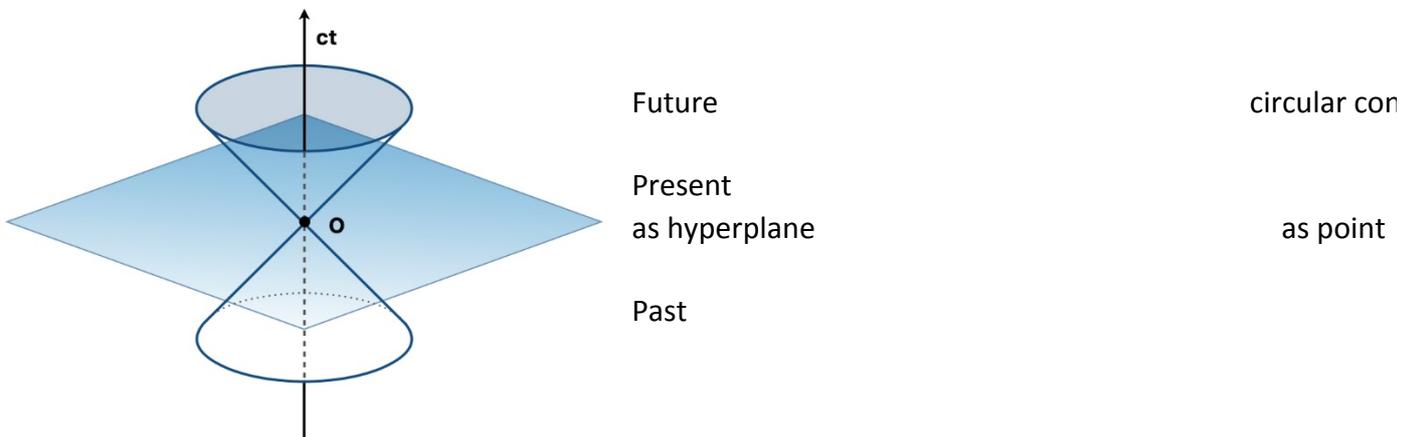
As carrier of the thing enabling cognition and searching for insight, the nerve system, man also is carrier of its fundamental element, the neuron. Relative to the spatial cognitive limits, the neuron logarithmically is in the middle. Thus, the fundamental, functional unit in the quest for insight, embedded in man seeking insight, sits in the middle of its universe of cognition. The fundamental precondition for insight sits in the middle of its own insight.

3.2 Space-time: Temporal Aspect

Man experiences the present within space-time. The following arguments demonstrate the limitations of an objective correlate to this subjective experience.

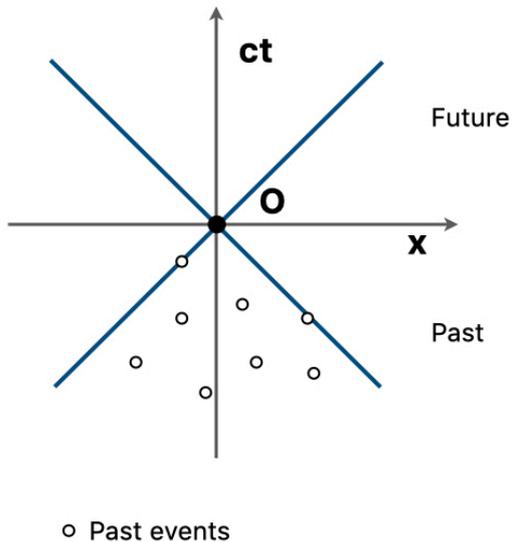
On a human scale General Relativity reduces to Special Relativity, space-time becomes flat. Its geometric description is the Minkowski space $(\mathbb{R}^{1,3})^{xix}$, the flat 4D-spacetime (ct,x,y,z) with c the velocity of light in vacuum, Minkowski space as an extension to the Euclidian space $(\mathbb{R}^3), (x,y,z)$. Without loss of validity of argument the 4D-presentation here is reduced to the 3D-presentation (t,x,y) with the light double cone (3D-light-cone)^{xx} ^{xxi}.

Fig. 2 3D-Light-Cone with its Surface Representing the World Lines of Light



This 2D-present may here be called Minkowski-present, in order not to be confused with present as process, as subjective experience.

Fig. 3 Cutting Plane through the 3D-Light-Cone with ct as Ordinate



The observer, a point of zero dimension at the origin of the coordinate system, is at present. This observer is able to record all past events within the light cone, inclusive those on its surface, given the limiting velocity is the velocity of light in vacuum.

Problem

A brain of a certain spatial extension is precondition for an observer to be. Thus, a point size observer in the hyperplane of the present is problematic. It is an observer lacking hardware and software. A sentient being, like man, has such and is at the same time originator of the models of the universe. A worldview of the type Standard Model / General Relativity cannot contain its discoverers, it cannot offer existence. The requirement of the scientific method to generate and calibrate models largely independent of the observer is satisfied, but the observers themselves are homeless.

What follows are considerations allowing observers a finite volume and an experience of the present as process, considerations that allow the observer to sit down and ponder things like Standard Model, General Relativity and the drive wanting to know.

4 Models of Observer

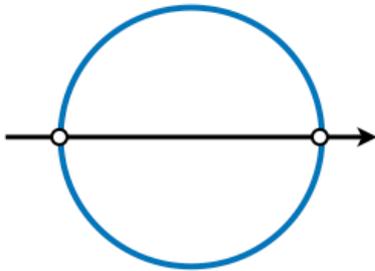
The models start from a most simple, a drop of water helping to understand a cell, and are developed as to reflect observation as process with duration and volume in space-time.

4.1 Drop of Water

Consider a drop of water in a universe of steam, homogeneous and isotropic. Then it will assume spherical shape. Its molecules are subject to Brownian motion, statistically isotropic. They move at a molecular scale, but for a macroscopic observer, at a macroscopic scale, there is no change discernable. The drop stays the way it is^{xxii}. Thus, because time is a measure for change, no evidence for the existence of macroscopic time can be derived from such observation.

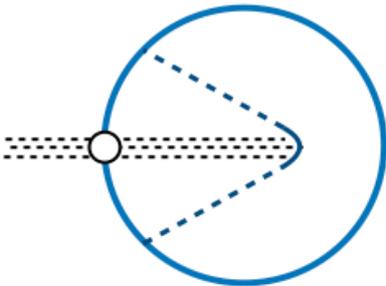
Consider the arrival of a light beam, small in diameter relative to the drop, and short, a short pulse.

Fig. 4 Drop of Water Macroscopic



Entrance and exit of a pulse of light, with concentric direction, and angle of incidence = angle of refraction = 0° , as special case of the law of refraction by Snellius (1546-1613). An off-center direction would have no influence on the subsequent arguments.

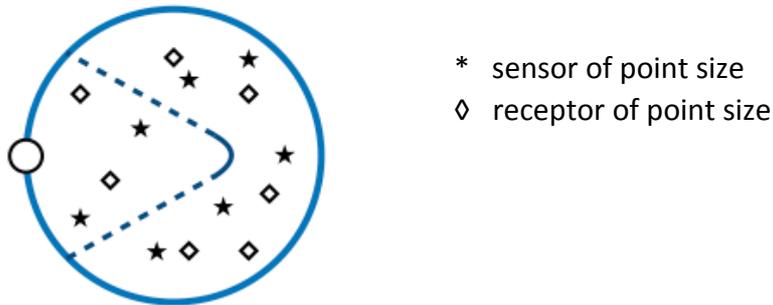
Fig. 5 Drop of Water Microscopic



Entrance of light pulse with significant cross section relative to drop, a pulse with finite cross section, beginning and end. The surface of the pulse is fuzzy, fractal-like, quantum-like. The volume involved in the interaction of photon energy ($h\nu$) with water^{xxiii} is cone shaped.

At this scale change is recognizable. Thus there is observable time and in particular, there is present time. Would the drop of water want to know its state in the Minkowski-present, then an instantaneous and complete image would be needed. Imagine this done by point size sensors connected to point size receptors with zero delay.

Fig. 6 Drop of Water Microscopic with Sensorium



Transfer of information is always limited by the velocity of light. Thus, all internal transfers are of different duration. Thus, a drop can never know its present state exactly.

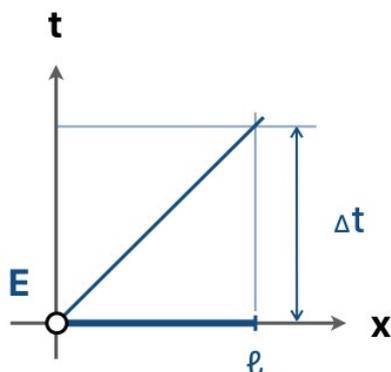
In short, the present is a process of a certain duration, with a kind of beginning and a kind of end, both probably fuzzy. Consider the length of stay of the pulse and its interactions within the drop. Given a drop size of 1 mm and a velocity of light in water (c_w) of approximately 225'000 km/s, and neglecting aftereffects, gives a process duration for the present experienced by the drop of roughly 4 ps.

A drop of water is a very rough model for an animal cell. However, regarding present recognition, within the models of Standard Model and General Relativity, the abilities of a cell are hardly superior to a drop of water. Thus, for a cell the experience of the present would also be a process of roughly 4 ps duration.

4.2 Sentient 2D-Beings

A 2D-being in (t,x) is a straight line segment of length ℓ .

Fig. 7 2D-Being in (t,x)



E, an event at time zero,
at the left end of the 2D-being:
Consider E to move with velocity v
in the 2D-being.

E arrives after a time interval Δt
at the right end of the 2D-being.

Consider sentient beings like mammals of size $\Delta x = \ell$

and three characteristic speeds of signal transmission (v), $v = \Delta x / \Delta t$:

neuronal, not myelinated, nerve fiber type C	1 m/s
flow in blood vessel	10 m/s
neuronal, myelinated, nerve fiber type A_α	100 m/s

Consider a human of mass 65 kg with a density near water (+/- 2%, depending on the degree of filling of the lung), and take the diameter of a volume equivalent sphere as its characteristic length. This roughly is 51 cm. Take 50 cm, which gives estimates for the time intervals of the present from 5 ms to 500 ms. Thus, the process we are able to register as present lasts roughly one tenth of a second. This view is compatible with the evidence for neurological cognition^{xxiv}.

In summary, the present occupies in the t-x-plane an area ($\Delta x \Delta t$), a 2D-volume (V_{2D})

$$V_{2D} = \Delta x \Delta t = (\Delta x)^2 / v$$

where $\Delta t = \Delta x / v$.

For example, $\Delta x = 50$ cm und $\Delta t = 50$ ms (corresponding $v = 10$ m/s) results in a 2D-volume of 0.025 m s. This dimension [L T], not attractive for an area, can be normalized:

Replacing Δt by Δct ($= c\Delta t$), results in a normalized Definition of V_{2D} with dimension [L²]

$$V_{2D} = c \Delta x \Delta t = (\Delta x)^2 \frac{c}{v}$$

The above Δx and Δt , with $c = 0.3 \cdot 10^8$ m² yield $V_{2D}(v=10 \text{ m/s}) = 0.75 \cdot 10^7$ m²

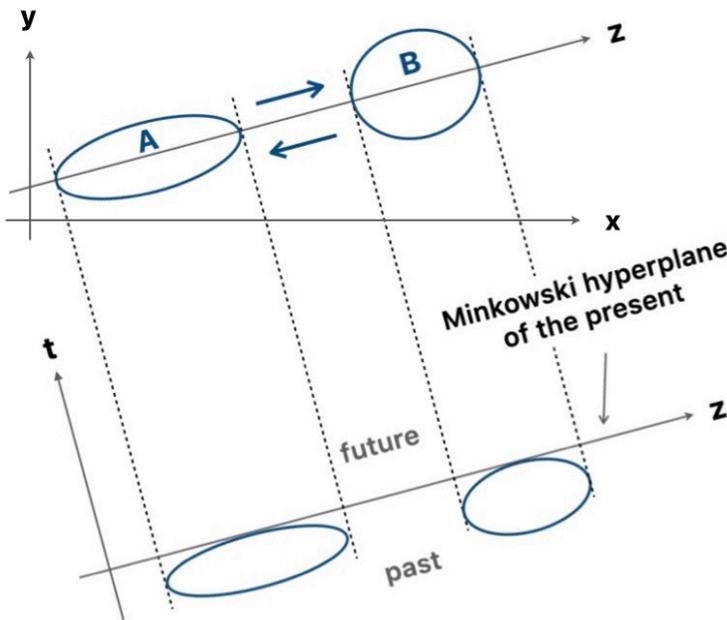
and at maximum speed of signal transmission c $V_{2D}(v=c) = 0.25$ m²

4.3 Sentient 3D-Beings

Consider in extension to the above 2D-situation a sentient being in 3D. Call it A, a 3D-being in spacetime (t,x,y) with volume finite, surface contiguous, shape something like a potato. A be interacting with a similar being B, both separated. Look at the two from the future (t>0) and project them onto the x-y-plane of the present (t=0). This present, here the Minkowski-present, be the paper plane.

Cut a profile perpendicular to the paper plane that includes A and B. Call the intersection z. The t-z-plane illustrates past, present as experienced by the beings A and B, Minkowski-present, and future. In this 3D-world beings like A and B have 3D-volumina (V_{3D}), in analogy to V_{2D} in D2.

Fig 8. Two 3D-Beings A and B interacting



Two 3D-beings, A and B, projected from the future onto the present, the x-y-plane at time $t = 0$.

The t-z-plane illustrates:

- Future
- Minkowski-present
- Present as experienced by A and B
- Past

4.4 Sentient 4D-Beings

There also exist graphic representations for the 4D-situation, but no more as vivid as in 2D and 3D. However, in analogy to V_{2D} und V_{3D} , it is plausible to define a 4D-volume for 4D-beings in space-time (V_{4D}):

$$V_{4D} = c (\Delta x)^3 \Delta t = (\Delta x)^4 \frac{c}{v}$$

Δx characteristic length of being, for example 50 cm

Δt characteristic duration of present, for example 50 ms

v speed of signal transmission

These values, at $v = 10 \text{ m/s}$, yield $V_{4D}(v=10 \text{ m/s}) \approx 2 \cdot 10^6 \text{ m}^4$

and at maximum speed of signal transmission, c $V_{4D}(v=c) \approx 0.06 \text{ m}^4$

Thus, the 4D-present experienced by sentient beings, here animals with a nerve system, has a finite volume in the order of 10^6 m^4 .

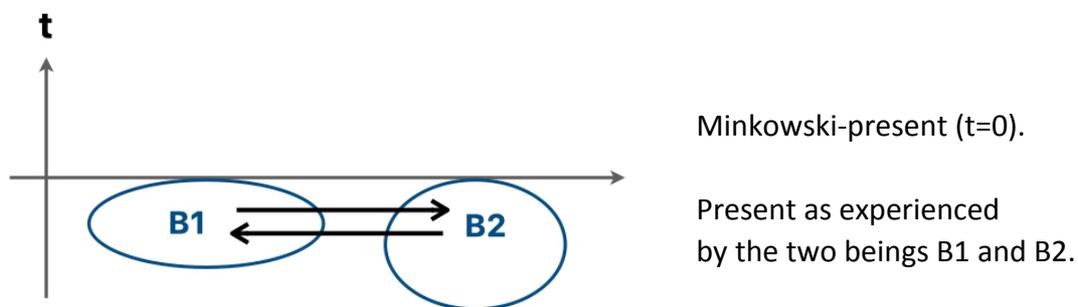
4.4.1 Human and Human

A meeting of two humans can also be viewed as a meeting of two similar process architectures. This is not meant mechanistically, but as existentially experienced. Relationships vary in time from

split second to life long. Correspondingly they take place on many different levels. We get in touch thanks to our sensory capabilities, where our central nervous system may also be considered sensory, but sort of downstream.

Normal humans know a cut bleeds and a loss hurts. When evil happens to fellow beings they have empathy and try to help. With evil humans it is like the other way around. Relationships can be very symmetrical, like in benevolent, long lasting relationships, or very asymmetrical. This asymmetry can be regarding knowledge, like when a person seeks help from a physician, or regarding intent, like when a person wants to destroy another, unaware person. Graphically:

Fig. 9 Human Interacting with Human



4.4.2 Human and Machine - Human versus Artificial Intelligence

The interaction of human with artificial intelligence is a meeting of two dissimilar process architectures. Artificial intelligence, here thought of as much more than processing large data quantities, needs hardware type neural networks. Its initial input are data and rules. The application of the output usually starts with humans judging its consequences. Human intelligence has the first say. These consequences can vary from helpful to harmful. Because humans usually have both tendencies (saints excluded) external ethical control is important, survival may depend on it. Whether machines can be made to act ethically is open. Self-learning machines may develop self-interest, may put this interest ahead of the interest of their creators, and begin moving evolution in a new way. It could be a hard fork, impossible to undo. If we identify beneficial with (+) and harmful with (-), both for man and machine, then all variations except (++) need very very careful examination.

Fig.10 Human interacting with Artificial Intelligence (AI)



Present as experienced
by being B (left)
and by AI-machine (right).

Sentient beings and machines with artificial intelligence are both 4D, but of different architecture. Their function is roughly characterized by clock rate, human low (order of magnitude Hz) and machine high (order of magnitude GHz), and parallel processing, human high and machine low. The above graphic is meant to represent this, human “more like a bubble”, machine “more like a knife”^{xxv}. However, machine parallel design is evolving fast and this could put artificial intelligence into a lead position. The rules of competition themselves could evolve, good version “the unfit or harmful will meet a Darwinian fate” and bad version “the unfit or harmful will successfully play chameleon and survive”.

The zebra phenomenon may be authoritative here. The physician Theodore Woodward (1914-2005) is said to have coined „when you hear hoof beats, think horses, not zebras”^{xxvi} around 1940 in Maryland, a country of horses and not of zebras. As a clinician he wanted to emphasize with this aphorism that the frequent is frequent (like fever in a baby, usually viral and usually passing). However, exceptions exist and experienced people know this. And exactly these exceptions need to be navigated. They can be very different from the norms, different to an extent that hardly anybody is willing to acknowledge their existence. Even when the person telling is experienced and respected. It could become existential for man to retain experience as a human domain, as a domain dealing with and containing the things for which neither measurements nor algorithms exist. A domain reserved for those willing to put in the work needed to chart such difficult terrain. It could turn out that artificial intelligence will become efficient at catching zebras but remain unfit to treat them, the reason being the rarity. There may be just one of its kind on Earth. Then the therapeutic process cannot find support in similar cases or matching groups. Everything happens “for the first time”, no guiding empirical evidence beyond the physician’s own experience exists.

I had a patient with situs inversus (internal organs reversed) and atypical amyotrophic lateral sclerosis (Stephen Hawking (1942-2018) had his disease, although in a typical form) which both have frequencies in the order of 1:50’000. Makes a few on earth, hard to find, even harder to study. Zebras, the animals as well as the circumscribed variety, have very many patterns. Inevitably, the older the practicing physician the more zebras in care. The attitude is do what you can but avoid harm by marching in small steps. Physicians tend to discuss such experiences “intra muros”, meaning behind closed doors, because they belong to the category of nobody-will-believe-this-anyway.

It could turn out that artificial intelligence will never match the zebras. It could boil down to human intelligence to remain in charge or perish.

5 Conjectures

5.1 Regarding a Grand Unified Theory plus

A worldview uniting Standard Model and General Relativity with the human observer must include the logarithmic middle position of the thing cognizing relative to its limits of cognition. This worldview would have to include the Large Number Hypothesis as well as the number 10^{30} that seems to bridge the living and the not-living.

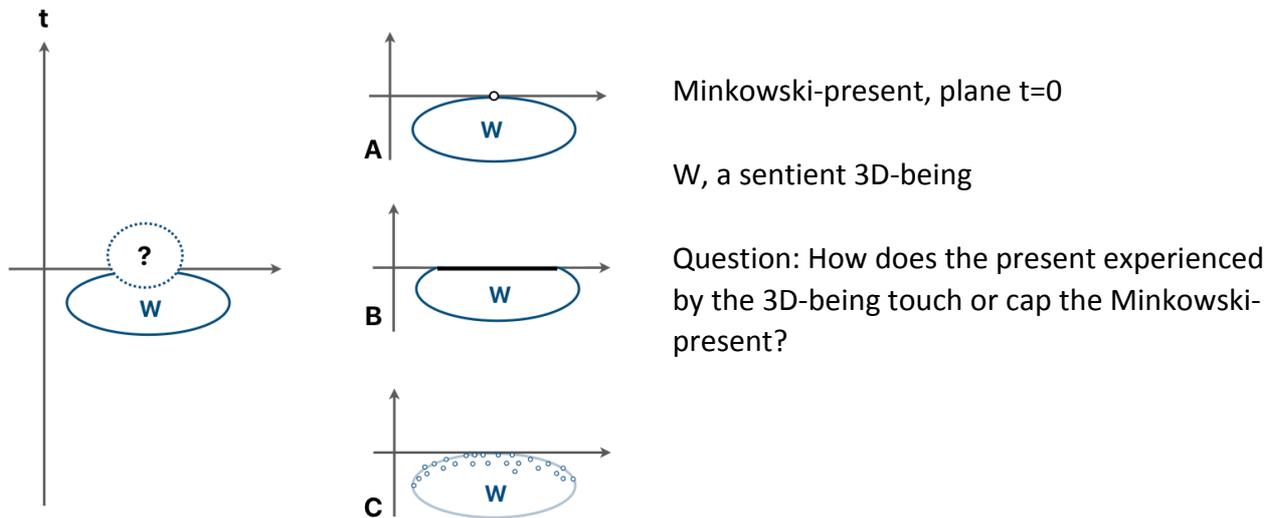
5.2 Regarding Intelligence - Human versus Artificial Intelligence

The vast diversity in clock speed and parallel architecture is significant. Human intelligence is able to tie in experience existing as internal knowledge from its own biography as well as external knowledge of mankind. This external knowledge, earlier the domain of books, moves rapidly into the domain of artificial intelligence. The knowledge of mankind will step-by-step be nearly instantaneously available. It is possible that the biographical knowledge due to physiological reasons (limits) remains, to a significant extent, personal good. Humans acquire experience, metaphorically, by burning fingers. Machines have no equivalent, no fingers to burn. Human and artificial intelligence compare differently. Humans react slow, also considering painful consequences, machines react fast, nothing similar to fear. The ability to catch peril and to react adequately, to respect exactly this aspect of human experience, could turn into a to be or not to be.

A strange quality in this context is the hunch, the stomach feeling, hard to catch and impossible to measure. I worked in the eighties of the last century in the emergency of the Ben Taub Medical Center in Houston, a place where as a physician you always had one ball to many to juggle. Remarkably few catastrophic judgments happened: Reason, the emergency nurses with their vast experience. They could catch what happens behind their backs and protect patient as well as physician. They were superb orchestra conductors, they did what they did efficient and hardly noticeable. To duplicate such feats machines will have plenty of learning to do.

5.3 Regarding relation of 3D-Present of Sentient Beings to Minkowski-Present

Fig. 11. Present as Process with the Minkowski-Present as Roof



Three situations: A and B macroscopically, C microscopically (quantum-like)

- A Point of contact
- B Area shared (in 4D this would be a shared volume)
- C 3D-present „hanging onto the Minkowski-present“
3D-present „pushing the Minkowski-present“

The question is open. The A-B-C-taxonomy may help to get closer.

5.4 Regarding Present to have a Beginning

The nothing or vacuum of quantum physics reminds of Anaximander's apeiron. It looks like a non-process, a hostel for quantum fluctuations without inherent time. It looks as if one of these fluctuations would have become "critical" causing the universe to be. Thus, there would have been a moment without a past. As soon as there was time there was a present, geometrically perhaps something like the Minkowski-present. However, for a 4D-present as experienced by sentient 4D-beings to be, image of the process of cognition, there had Goldilocks conditions with something like Goldilocks planets to be. In short, there were preconditions for the universe to "become cognizant of itself", and Earth most likely was not the first place to offer them.

5.5 Regarding Metaphysics

The observer can look outward and by intersubjective comparison reject what is observer dependent. This approach reduces illusion and superstition and corresponds to the scientific method. The observer can look inwards, ... thoughts ... thoughts ... like endless. Method for example meditation. Impossible to objectify, but as far as content goes experiences, experiences interpretable by experienced meditators.

If the 4D-present, a process as postulated, is what man is able to see as reality, then any permanence is impossible, an illusion. The view that reality is by nature illusion, imagination as well as projection of a self without any immanent existence, goes back to Buddha Shakyamuni^{xxvii}: Seen that way, the self can recognize at most its internal course, but to recognize a permanent, real reality is impossible.

To look in and to look out corresponds to two sides of one coin, the coin being metaphorically the thing that does the seeing, the self of man^{xxviii}.

The psychological opinions regarding the nature of the self vary plenty, the self perhaps not more than belief about itself^{xxix}. No doubt there is suffering, the experience of pain, of futility of life, of broken heart. The examination of of what is it that suffers leads to and ends with the self. The above arguments claim the self to be illusion. How can an illusion suffer?

One exit to this dilemma goes back to Buddha. In his view the self is the thing that, by its very illusionary nature, makes us suffer. The body has the broken bone, but without a self we would not be able to react adequately and immobilize the broken part. And this makes sense for the body and for the self because the self has a desire, also an illusion, to continue to be. Practicing the Eightfold Path (Buddha's idea) reduces illusion, and thus reduces the self. The end of this is no-self, no-thing. Thus, for a sentient being suffering would have found its end. This, metaphorically, extended to mankind, is the Buddha project of man^{xxx}.

6 Epilog

The neuron, the thing enabling man's insight, has its home, logarithmically speaking, in the middle between its own limits of cognition. The apartment is a process in space-time, tangent to the Minkowski-present (hyperplane of the Minkowski space), it can touch the plane but cannot contain it. This process is relative to the Minkowski-present always slightly in the past. The process makes it just up to the Minkowski-present, but cannot include the Minkowski-present.

A cup falls out of hand. The slipping feeling signals the brain "slipped" and that needs a bit of time, some hundredth of a second. Then the fracturing sound needs also a bit of time until the airborne sound hits the ear drum which signals the brain "fractured". Then the realization "cup broken". During this entire process of realization the Minkowski-present moves just ahead of the process. The realization as such is capped by the Minkowski-present.

If the present is process then all we are able to know is process, because all past once was present and all future has not yet been^{xxx1}. Only the nothing is not-process. This view is old. In the occident we ascribe Heraclitus of Ephesus^{xxxii} (about 500 BCE) "everything flows" (παντα ρει), in the orient Buddha Shakyamuni (um 500 v. Chr.), „all is impermanent“ (Anicca Sutta)^{xxxiii}. Linguistically, both of these antique thinkers referred to the macroscopic, complex world. They viewed their statements universally valid, there is no evidence to the contrary.

A recent thinker, already familiar with the beginnings of quantum physics, taking the same approach was the mathematician Alfred North Whitehead (1861-1947)^{xxxiv}. He saw insight as by nature experience, experience seen as a stream of elementary processes coalescing into a stream. Experience being the source of consciousness and not the other way round. In his view experience can be ascribed a process-like reality, but beyond that process-like reality all else is illusion.

7 Thanks

My most sincere thanks for constructive critique and careful thinking along go to Michael Krieger, Heinz Blatter and Tamaki Ohmura. All their suggested changes I have incorporated.

8 Sources and Notes

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ⁱⁱ Albert Einstein. 1921. Geometrie und Erfahrung. Erweiterte Fassung des Festvortrages gehalten an der Preussischen Akademie der Wissenschaften zu Berlin am 27. Januar 1921. Springer, Berlin, Heidelberg. 16 p.

<https://archive.org/details/geometrieunderf00einsgoog/page/n1>

last access 5 jan 2020

Albert Einstein (1879-1955) had an opinion to this problem (translation from German): „As far as mathematical statements relate to reality, they are not certain, and if they are certain, they do not relate to reality”.

ⁱⁱⁱ Ernst Mach. 1917. Erkenntnis und Irrtum. Leipzig. p 1-20.

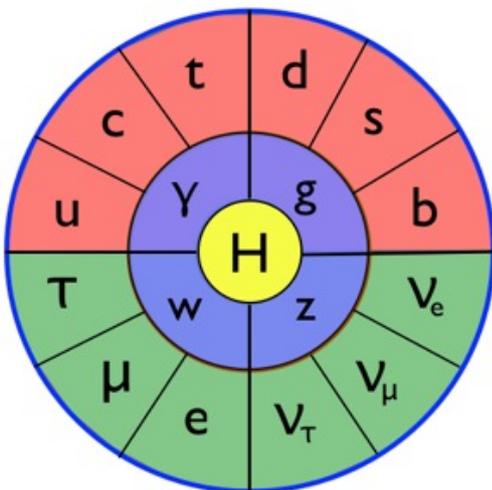
Permalink: <http://www.zeno.org/nid/20009213368>

last access 5 feb 2020.

Ernst Mach (1838-1916), one of the thought leaders of Relativity Theory, saw it like this (translation from German): “The imaging of fact as thought, or adjusting thought to fact, enables thinking to complement observed fact, if complementation is needed due to fact only partially observed. This complementation must be based on [has to make use of] interdependence of fact characteristics. Because vulgar as well as beginning scientific thinking has to be satisfied with a rather rough fit of thought with fact, the thoughts among themselves do not fit completely. The matching of the thoughts among themselves is a further task which thinking for its own complete satisfaction has to accomplish. This latter striving, which will purify the thinking regarding logic, but vastly exceeds that goal, does typify scientific, preferably, in contrast to vulgar thinking. For the approximate realization of practical purposes the latter is sufficient.”

Many scientist take similar positions. Probably it is an interaction. People with such inclination tend to work in science, where the experience in work supports and strengthens credibility in such a position.

^{iv} Stanford ATLAS Group. Introduction to Particle Physics. Particle Zoo.



Fermions (red) and Leptons (green)
Calibration bosons (blue)
Higgs boson (yellow)

„things“ like Protons and Electrons
responsible for interactions
responsible for the existence of mass

http://stanford.edu/group/stanford_atlas/3Introduction

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^v Ulf von Rauchhaupt. 2015. Das schönste aller Naturgesetze. (Translation from German): The most beautiful of all laws of nature. He continues: „The equation of motion of a body in the gravity field without being subject to any other force. Here the gravity field appears as space curvature, its geometry hidden in the gamma.“

$$\frac{d^2 x_\tau}{ds^2} = \Gamma_{\mu\nu}^{\tau} \frac{dx_\mu}{ds} \frac{dx_\nu}{ds}.$$

The geodesic equation in Einstein's handwriting:

To the left the Euclidian part, to the right Riemannian part.

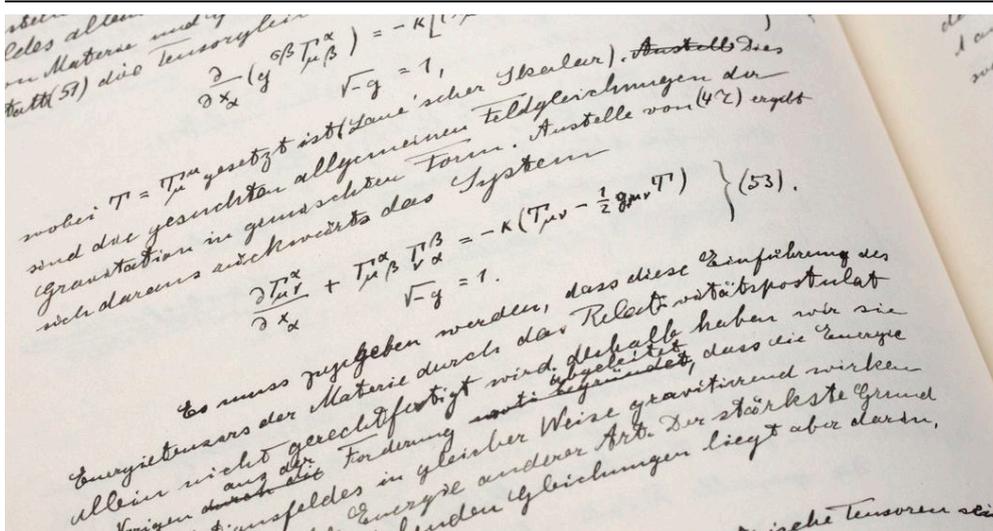
The Albert Einstein© Archives. The Hebrew University of Jerusalem.

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https://www.faz.net/aktuell/wissen/physik-mehr/100-jahre-allgemeine-relativitaetstheorie-13949908/die-bewegungsgleichung-eines-13955158.html#fotobox_1_3949908

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Page from „Grundlagen der Allgemeinen Relativitätstheorie“ (The foundations of general relativity theory) by Albert Einstein, his manuscript to the Royal Academy of Sciences (Königlich Preußische Akademie der Wissenschaften) submitted on 25 november 1915.



<https://www.pr-agent.media/news/2019/als-limitiertes-buch-die-allgemeine-relativitaetstheorie-von-albert-einstein/9000>

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^{vi} Frieden. Kriege der Menschheit. 2014. (Frieden. Wars of Man. 2014).

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^{vii} Harald Lesch. 2017. Die Menschheit schafft sich ab. KOMPLETT-MEDIA, München/Grünwald. 515 p.

^{viii} John C. Baez. 2001. Higher-Dimensional Algebra and Planck-Scale Physics.

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^{ix} United States. National Institute of Standards and Technology (NIST).

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^x Tamara M. Davis and Charles H. Lineweaver. 2003. Expanding Confusion: common misconceptions of cosmological horizons and the superluminal expansion of the universe. University of New South Wales, Sydney, Australia. 25 p.

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^{xi} Ethan Siegel. 2018. Ask Ethan: How Large is the Entire, Unobservable Universe?
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^{xii} ESA. Planck 2018 Results.
<https://www.cosmos.esa.int/web/planck/publications>
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^{xiii} Neuron.
<https://en.wikipedia.org/wiki/Neuron>

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Perikaryon.
[https://en.wikipedia.org/wiki/Soma_\(biology\)](https://en.wikipedia.org/wiki/Soma_(biology))

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^{xiv} The earliest known fossil creep traces stem from the Ediacaran Period, about 600 Ma ago. Example *Yilingia spiciformis*, about 550 Ma old.
<https://www.nature.com/articles/d41586-019-02556-x>

last access 5 sep 2019

Fossil creep traces are evidence for contraction (imagine smooth muscle cells) and coordination (imagine a nerve system like worms have one). They are indirect evidence of neural excitability. Thus, neurons or something similar, have an evolutionary age of roughly 600 Ma. Because this step is precondition for a central nervous system to be, the neuron (perikaryon) is the fundamental thing in this evolutionary process.

^{xv} Albert Einstein. 1905. Zur Elektrodynamik bewegter Körper. *Annalen der Physik*, Leipzig. Band 17, p 891-921.

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^{xvii} Ana Maria Cetto, Luis de la Peña, E. Santos. 1986. Dirac's large number hypothesis revised. *Astron. Astrophys.* 162. p 1-5.

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Sheldon Glashow, together with Howard Georg, pioneered 1974 the possibility of a GUT (Grand Unified Theory).

^{xix} Hermann Minkowski. 1909. Raum und Zeit. Jahresberichte der Deutschen Mathematiker-Vereinigung. Verlag B. G. Teubner, Leipzig. (Vortrag: 80. Naturforscher Versammlung, Köln, 21. Sep. 1908). Kopie des Originals:
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^{xx} Light cone.
https://en.wikipedia.org/wiki/Light_cone
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^{xxi} John D. Norton. 2018. Einstein for Everyone: Spacetime.
https://www.pitt.edu/~jdnorton/teaching/HPS_0410/chapters/spacetime/
last access 5 jan 2020

^{xxii} Consider an observer in a room with a pendulum out of reach and at rest. The observer can observe his breaths, in and out, and so on. Before the out breath there is an in breath, there is a before and an after. The observer may call this time, inner time. As the pendulum stays put the observer has no way to know whether there is anything that changes outside. The existence of an external time cannot be experienced, it would remain conjecture based on the experience of inner time.

Give the observer a microscope with a single coli-bacterium in a drop of water. The tremor path of the bacterium can be observed, evidence for external time. Give the observer many bacteria, too many for single path observation. The observations have to be reduced to statistical moments like

mean, variance, and so on. Then these estimates will converge with an increasing number of bacteria observed to stable, constant values. Time, statistically speaking cannot be experienced anymore. In case the observer only has an object with millions of bacteria, its kinematic statistics “invariant” then there is no evidence of external time, it would remain conjecture based on the experience of inner time.

^{xxiii} Macroscopic absorption is the result of a series of microscopic processes of shell and nucleus: Shell (Thomson scattering, Compton scattering, photoelectric effect, pair production). Nucleus (photodisintegration).

^{xxiv} Tessel Blom, Daniel Feuerriegel, Philippa Johnson, Stefan Bode, and Hinze Hogendoorn. 2020. Predictions drive neural representations of visual events ahead of incoming sensory information. PNAS first published March 16, 2020

<https://doi.org/10.1073/pnas.1917777117>

<https://www.pnas.org/content/early/2020/03/10/1917777117>

last access 25 mar 2020

These authors noticed some brain activity to occur ahead of visual input: „Using time-resolved EEG decoding, we show that predictive mechanisms are sufficient to activate sensory-like neural representations of anticipated future events, and that these representations are activated before the arrival of afferent sensory information. This reveals that predictive neural mechanisms might allow the visual system to overcome its neural processing delays and interact with our environment in real time.”

Both processes observed here, visual input as well as predictive central mechanisms (activity), correspond to present as an experience capped by a Minkowski-present. “Real time” usually is meant to be something like the Minkowski-present. However, “real time” also is process, a process very near Minkowski-present, or “as near as possible” to Minkowski-present.

^{xxv} Chris Chatham (2007), Paul King (2012), John P. Barbuto (2017), Anonymous (2017). What is the clock speed equivalent of the brain?

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^{xxvi} Theodore Woodward.

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^{xxviii} Max Kälin. 2009. Dharma and Science. Prophecy versus Prediction. Institute of Chung-Hwa Buddhist Culture, Chan Meditation Center, 90-56 Corona Avenue, Elmhurst, NY 11373. *Chan Magazine* (autumn), p. 17-23.

^{xxix} Joan Gay Snodgrass and Robert L. Thompson (Eds.). 1977. The self across psychology: Self-recognition, self-awareness, and the self concept. *Annals of the New York Academy of Sciences*: Vol. 818. 300 p.

^{xxx} Buddha means awakened, wakening to mean seeing through all illusion (the method proposed by Buddha Shakyamuni is the Eightfold Path). The thing hindering the seeing through is the distorting effect of the self. Distorsions influence actions. The more grave the distorsions the more burdening the consequences.

The enigma of self is a dispute of millennia. Different traditions harbor different views:

The Old Hindus	does exist
Semitic Traditions	does exist, at its center the soul
Buddhist Tradition	does exist, but as an illusion

^{xxx} Human history shows various views and beliefs to explain misery and delight. For example, the karma model of the universe by the Old Hindus (first documentation in the Upanishads, about 600 BCE): Burdening actions from earlier existences may mature in the present existence and cause misery. The Bible addresses this enigma in the Book of Job.

Karma of the Hindus as well as Faith of the Hebrews hint at inscrutable mechanisms, particularly inscrutable by the scientific method. The paradoxical may offer glimpses into this mystery

Sheng-Yen. 1982. Getting the Buddha Mind. Editor Ernest Heau. Dharma Drum Publications, Ch'an Meditation Center, 90-31 Corona Ave., Elmhurst, New York 11373. 147 p.

^{xxxii} Pre-Socratic philosopher, called the „dark“ due to paucity of documentation about him. „Everything flows“ (παντα ρει), is a later summary, not by him, but what he meant. He saw change, impermanence, as root process of the universe.

^{xxxiii} Anicca Sutta: Teaching of impermanence, impermanence of all that is.
Nyanaponika Thera. 1995. Anicca Sutta: Impermanent. Translation from Pali.
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^{xxxiv} Alfred North Whitehead (Gifford Lectures: 1927-1928). 1985. Process and Reality (An Essay in Cosmology). The Free Press, New York. Paperback Edition. 413 p.
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