Geometrical appearance of circumference as statistical consequence

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***Abstract*— Because identical fermions (elementary particles with rest mass) have (except spacetime coordinates) exactly the same features everywhere, these are (per proper time) a multiple mapping of the same. This mapping also leads to the geometrical appearance (of spacetime) and it provides a set of possibilities from which can be selected (like "phase space") within proper time. Selection of possibilities means information. New selection of possibilities means decision resp. creation of information. This paper should motivate to a more consequent information theoretical approach (not only in quantum mechanics but) also towards spacetime geometry. It is a short supplement to previously published material [O2], where it was shown that proper time is proportional to the sum of return probabilities of a Bernoulli Random Walk. The probabilities at every point in such a walk result from "OR" operation of incoming paths. The probability of a "AND" operation at a certain point can be interpreted as meeting probability of two simultaneous and independent Bernoulli Random Walks. If no direction is preferred (p=1/2), after n steps this meeting probability (of two simultaneous independent Bernoulli Random Walks resp. BRWs) in the common starting point goes for large n to 1/(2πn), which is the inverse of the circumference of a circle with radius n. So if a BRW pair denotes two commonly starting simultaneous independent BRWs (each with p=1/2), after n steps (in case of large n) in the average 1 of 2πn BRW pairs meet again in its original starting point.**
Likewise due to the limited speed of light our knowledge of surrounding is the more delayed, the greater the distance n is. Therefore there are the more (geometric) possibilities of return (2πn possibilities for multiples of the same fermion on a circle with radius n), the greater the distance (the radius) n is. This shows a basic example for a connection between statistical results and geometrical appearance.

***Keywords* — Bernoulli Random Walk, BRW, quantum physics, statistics, circumference, circumferential length, circle, geometrical appearance, spacetime geometry**

1. Introduction

Geometrical approaches to physics are still in common due to their practicability for description of macroscopic appearances. Differential calculus over geometrical (spacetime) coordinates is often a matter of course, but we know that this is imprecise and that it allows completely wrong extrapolations. Even for microscopic experiments the geometric term "particle" is (2017) still common. So there is clearly the danger to overinterpret geometric terms and pictures. (Due to relevant consequences it is worth mentioning that extrapolation and overinterpretation of geometry forms the basis of restricted "materialistic" views of life.) But there is no need for discussion (e.g. about "wave–particle" duality) - it is long overdue to *derive geometry* from a more fundamental information theoretical basis: Results of measurements provide *information*, geometry is a quickly derived first approximation of a subgroup of measurement results. Due to quantum physical results we know that measurements play a determining role (at once demonstrable in the microscopic world). This means that we need an approach where the (later complex) selection of a possibility from a set of possibilities (measurement = acquisition of information) plays a determining role. Of course we need also such an approach to space-time geometry. This paper should recall this and provide first hints. There are important basal questions: How are possibilities generated and selected under strict consideration of long term symmetry (and resulting conservation laws) *from the beginning*, so that the macroscopic (within proper time multiple mapping of "particles" resp. possibilities with) appearance of spacetime results? What are the consequences?

Due to quantum physical results it is reasonable to assume that geometry of spacetime has a discrete (and statistical) origin. A basal geometric feature is the nontrivial proportionality factor 2π between radius and circumference of a circle. Here we show a short statistical approach to this proportionality factor.

2. Approach

A Bernoulli Random Walk is generated by a sequence of independent trials or "steps" [Fe] [Sp], each one of which can have two results, e.g. "positive" (with probability p) or "negative" (with probability 1 - p). We can interpret it as model for the movement of a particle in a one-dimensional lattice of equidistant points or "states" which are indexed by an integer coordinate k. With every trial the particle makes a step from point k to point k + 1 with given probability p ("positive direction") or a step from point k to point k - 1 with probability 1 - p ("negative direction"). As in [O2] for $n \in \{1,2,3,\ldots\}$ we denote by Q0P(n, k, p) the probability, that the particle is at point k after the n-th step and by Q0P(0, k, p) this probability before the first step. We assume start of movement at k = 0, so Q0P(0, 0, p) = 1 and Q0P(0, k, p) = 0 for k ≠ 0 and furthermore

$$Q0P(n + 1, k, p) = p\ Q0P(n, k - 1, p) + (1 - p)\ Q0P(n, k + 1, p) \tag{1}$$

When making n trials, point k is only within reach, if n - k and n + k are non-negative even numbers. We will presuppose this subsequently. There are exactly n!/(((n+k)/2)! ((n-k)/2)!) paths with (n+k)/2 steps in positive and (n-k)/2 steps in negative direction, which lead into point k after the n-the step. They respectively have the probability $(1-p)^{(n-k)/2}\ p^{(n+k)/2}$. So the chaining of these Bernoulli trials results into the binomial distribution

$$Q0P(n,k,p) := \frac{(1-p)^{(n-k)/2}\ p^{(n+k)/2}\ \ n!}{\left(\frac{n-k}{2}\right)!\left(\frac{n+k}{2}\right)!} \tag{2}$$

<u>Subsequently assume assume p=1/2</u> and define $Q0(n,k) := Q0P(n,k,\frac{1}{2}) = \frac{n!}{\left(\frac{n-k}{2}\right)!\left(\frac{n+k}{2}\right)!\ 2^n}$ (3)

By <u>BRW</u> we denote a Bernoulli Random Walk with p=1/2. Due to p=1-p and so equal probability of both alternatives its probability distribution is symmetric.

Q0(n,k) represents probabilities in case of p=1/2. In the symmetry center we get $Q0(n,0) = \frac{n!}{\left(\frac{n}{2}\right)!\left(\frac{n}{2}\right)!\ 2^n}$ (4)

Fig. 1 shows the Q0(n,k) which represent the probabilities of a BRW (Bernoulli random walk with p=1/2).

n ↓ \ k->	-9	-8	-7	-6	-5	-4	-3	-2	-1	0	1	2	3	4	5	6	7	8	9	
0										1										*1/1
1									1		1									*1/2
2								1		2		1								*1/4
3							1		3		3		1							*1/8
4						1		4		6		4		1						*1/16
5					1		5		10		10		5		1					*1/32
6				1		6		15		20		15		6		1				*1/64
7			1		7		21		35		35		21		7		1			*1/128
8		1		8		28		56		70		56		28		8		1		*1/256
9	1		9		36		84		126		126		84		36		9		1	*1/512

...

Fig. 1 Probabilities of a BRW (symmetric Bernoulli random walk with probabilities p=1-p=1/2 for both sides). The probabilities in the central column k=0 are underlined. Conservation laws suggest a natural privilege of these central states. The probabilities of the inflowing paths are in the columns with k=-1 and k=1.

The probabilities of the 2 (left and right) paths into the center are

$$Q0(n-1,1) = Q0(n-1,-1) = \frac{(n-1)!}{\left(\frac{n-2}{2}\right)!\left(\frac{n}{2}\right)!\ 2^{(n-1)}} = Q0(n,0)\frac{\left(\frac{n}{2}\right)!\left(\frac{n}{2}\right)!\ 2}{\left(\frac{n-2}{2}\right)!\left(\frac{n}{2}\right)!\ n} = Q0(n,0) \tag{5}$$

It is $Q0(n,0) = \frac{1}{2}Q0(n-1,1) + \frac{1}{2}Q0(n+1,1)$ because Q0(n,k) is an OR-operation of both incoming paths (from Q0(n-1,k+1) plus from Q0(n-1,k-1)). This defines a BRW.

Suppose that two BRWs (BRW1 and BRW2) start simultaneously and are stepping simultaneously.

First we assume that the sum of all k is constant (symmetry around k=0, conservation law). In this case we know: If k increases in BRW1, then k decreases in BRW2, and reverse. If at start k=0, there is complete symmetry. We can assume that one of both BRWs moves freely and the other totally depends on it. If one BRW arrives at k=0, then also the other. So the meeting probability is the return probability of a BRW:

$$Q0(n,0) = Q0(n-1,-1)/2 + Q0(n-1,1)/2 \tag{6}$$

Now suppose that two BRWs again start in k=0 and step simultaneously, but step directions (k+1 or k-1) are done independently. Let Q0AND(n,k) denote the meeting probability of two such BRWs with independent step directions. In this case the probability that one arrives after n steps at k=0 is Q0(n-1,-1)/2, and that the other arrives at k=0 is Q0(n-1,1)/2. Because steps are done independently, the probability Q0AND(n,0) that both meet in k is due to (5):

$$Q0AND(n,0) = \frac{Q0(n-1,-1)}{2}\frac{Q0(n-1,1)}{2} = \left(\frac{Q0(n,0)}{2}\right)^2 \tag{7}$$

Equivalently we can suppose to do the split into two halves directly in the start, so that every half is an independent BRW with half probability. In point (n,k) it is Q0(n,k)/2 which again leads to the combined probability (7).

Using the Stirling formula $\lim_{n\to\infty} n! = \sqrt{2\pi n}\left(\frac{n}{e}\right)^n$ we get for large n

$$Q0(n,0) \approx \frac{\sqrt{2\pi n}\left(\frac{n}{e}\right)^n}{\left(\sqrt{\pi n}\left(\frac{n}{2e}\right)^{n/2}\right)^2 2^n} = \frac{\sqrt{2\pi n}\left(\frac{n}{e}\right)^n}{\pi n\left(\frac{n}{2e}\right)^n 2^n} = \sqrt{\frac{2}{\pi n}} \qquad (8)$$

and for large n so from (7)

$$Q0AND(n,0) \approx \left(\sqrt{\frac{1}{2\pi n}}\right)^2 = \frac{1}{2\pi n} \qquad (9)$$

From this follows (for BRWs with no preferred direction and large n)

Formulation 1:

The meeting probability of two commonly starting simultaneous independent BRWs after n steps in their common starting point goes for large n to 1/(2πn), which is the inverse of the circumference of a circle with radius n (or the probability to meet a segment of length 1 on a circle with radius n).

More demonstrative may be the viewpoint after "renormalization". Implicitly we make within every perception a renormalization. The "probability" of an altogether very improbable perception is renormalizated to 1. According to the following formulation 2 the factor for such renormalization after n steps can be just 2πn:

Formulation 2:

If a *BRW pair* denotes two commonly starting simultaneous independent BRWs, after n steps (in case of large n) in the average 1 of 2πn BRW pairs meet again in its original starting point (normalized to 1 per proper time).

This is interesting because it shows a relatively simple connection between statistics and geometry. If both BRWs start simultaneously and the sum of k is conserved (symmetry), the return probability (6) is also a meeting probability ("OR" operation). If, however, the BRWs start (later) simultaneously and decide independently ("AND" operation, (7)), the probability that they meet after n steps in the starting point k=0 is the geometrical probability Q0AND(n,0) which is the inverse of the circumference of a circle with radius n.

The following chapters are in parts not strict but added for explanation and to show ideas and connections to current models.

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3. Interpretation, Thoughts for further thoughts

At first the above approach seems to be only 2D (two-dimensional) because circumference is contained in a 2D plane. But this fits to propagation of electromagnetic fields. With (3) p=1/2 and according to [O2] this is connected with the propagation speed v=c (speed of light). So we can assume electromagnetic interaction. At this inducing resp. induced electric currents and changes in electric (resp. magnetic) fields are proportional to the circulating magnetic (resp. electric) fields. The 2D plane of a circulating (magnetic or electric) field is shown (resp. determined) by the direction of the inducing resp. induced (electric or magnetic) field.
The 3D propagation of information results after more steps.

Due to the limited speed of light our knowledge of surrounding is the more delayed, the greater the distance n is. Therefore there are the more (geometric) possibilities of return (2πn possibilities for multiples of the same fermion on a circle with radius n), the greater the distance (the radius) n is.
So the above approach also shows first steps to answers of the following questions:

- Why are there conservation laws?
  - Because completed perception at last is only possible inside the symmetry center (k=0, see Fig. 1).[1]

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[1] A strict conservation law would even require that every BRW is coupled with a mirrored (negative) BRW "on the other side". The meeting probability of mirrored BRWs is identical to (6) which is the return probability Q0(n,0) for one BRW. The proportionality of the sum of these return probabilities to proper time is shown in [O2]. If the BRWs are independent, their meeting probability is shown in (9) .

- Why is v=c (Why is the maximal information speed constant and finite)?
  - Because a well defined delay (at least n>=2 in Fig. 1) is necessary for statistical development of geometry, i.e. for freedom of geometrical coordinates in surrounding. The delay is probably necessary for creation of new information, see 101.1.1.
- Why do the same fermions have exactly the same features everywhere?
  - Because during statistical development of geometry multiple possibilities (geometrical coordinates) lead (back) to the same elementary constellation.
- What is the information theoretical origin of the proportionality factor π in geometric formulas?
  - see (9). Due to limits (8) and (9) the occurrence of π in geometric formulas (e.g. the proportionality factor 2π between radial distance and circumference) indicates a combination (concatenation or "AND" operation) of two statistics (BRWs).

Two past[2] BRWs compared to what? One step forward is more probable than a series of 2 steps back - this could define an order. Interpretation of experimental results concerning definition of time direction?

4. Questions for continuation

As already mentioned above, for description of 3D propagation of information more steps are necessary. How can we extend the (information theoretical) approach to 3 dimensions which represent statistically nearly uncorrelated quantities?

Connected ideas and questions:

- Comparison is basal element during measurement and information acquirement. To avoid confusion of languages we need to go back from "elegant" (analytical) concepts to basal comparable combinatorics using (nested) matrices with comparable quantities, e.g. 2x2 matrices instead of complex numbers in quantum mechanics, discrete matrix representation of Maxwell Equations.
- Information theoretical interpretation of basal (discrete) Maxwell Equations? We could study their development using varying conditions.
- Connection to basal (discrete) Schroedinger Equation?
  In connection with the Schroedinger Equation it is noteworthy that
  $$(Q0(n,k-2)-Q0(n,k)) - (Q0(n,k)-Q0(n,k+2)) \quad = \quad 4(Q0(n+2,k) - Q0(n,k))$$
  where the left side can be interpreted as discrete 2. derivation along location and the right side can be interpreted as discrete derivation along time.
- Can the simplified low energy model of atomic shell help as connection?

5. Constructive comment to current cosmological models

We should recall that a direct experimental evaluation of cosmological models is not possible. We cannot make experiments under conditions at very past time (e.g. with past physical constants). Therefore cosmological models are extrapolations. Current cosmological models ("Big Bang") extrapolate and start geometrically - despite the experimentally proven limits of geometrical models. Compared to this an approach with geometry as statistical consequence leads to completely different start conditions[3] and conclusions. We recommend to investigate these in more detail. Plausible would be to use from the beginning an information theoretical approach which develops into increasing complexity resp. branching depth. We can ask for the initial (most simple) situation of "information".
We know that information means selection from a set (of possibilities). A selection from a set with 0 elements is not possible. A selection from a set with 1 element (without alternative) provides no (new) information. So the most fundamental initial new information must describe selection of one element from a set with 2 elements. If both elements have equal probability (which defines a completely new situation), this is just one step in a symmetric BRW (Fig 1). At this starting from an initial original state (state 1) one element from a set with 2 elements (state 2 or state 3) is selected. Return to its original center is related to progress of time [O2]. It seems that from this results order of time and secondarily order of other dimensions. A graph theoretical approach can provide deeper insight into multiple steps. These allow multiple possibilities for return. If this allows different distinction between "past" and "presence", there must be a temporary separation ("localization"). Information exchange between separated systems must not contradict (long term) progress of common time.

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[2] Geometry shows past (due to the limited information speed), so statistics which lead to geometry are past.

[3] An information theoretic approach would not allow within finite time the selection from an a priori infinite set (e.g. continuous sets are a priori infinite). The sets must be created stepwise from the beginning. Concerning conditions at much earlier times: It is plausible that there was significant less branching depth which was connected with other physical constants. It would be interesting to look for possibilities to test the **hypothesis** that the quotient of comparable physical sizes (e.g. of electromagnetic and gravitational interaction of proton and electron) at much earlier times has been nearer to 1 or -1 (concerning gravitation and electromagnetism "much more gravitational effect"). Initially discrete sign conversion is possible.

So it is recommendable to look in more detail and consequently for discrete definition of (local and global) time and to develop from this a contradiction free (information theoretical) interpretation of macroscopic geometrical appearance as statistical result.

6. CAN WE ESTIMATE MAXIMAL N?

How large may be n since start of our observable universe? In this chapter we try a rough guesswork using above Formulation 2: Let age := $4.3*10^{17}$s (rough age of the observable universe) and c := 3 $*10^{8}$ m/s (speed of light) If we assume r := 10^{-15} m as (rough) diameter of a typical nucleon (proton, neutron) and use this as minimal stepping size, we get c/r = 3 $*10^{23}$ steps per second and m:= age*c/r= 1.29 * 10^{41}steps since t=0 [4]. Due to above Formulation 2 we assume that from n=1 to m with every step $2\pi n$ new possibilities are generated, then for the total sum of possibilities we get

$$\sum_{n=1}^{m} 2\pi n = 2\pi \frac{1}{2} m(m+1) \approx 5.2 * 10^{82} \qquad (10)$$

This seems not so far away from the currently estimated count of nucleons resp. positive or negative charges in the observable universe.

So the next idea is to regard every BRW pair as +-charge pair. Charges are conserved per perception because complete perception implies a complete BRW pair (with way there and back, i.e. + and - direction, sum=0). There is a strict primary conservation law (total sum of k is 0) around the global symmetry center (all conserved quantities are 0 there, also charge = 0. It is plausible that other conservation laws result from measurements with more branching depth relative to the global center.)

Also for propagation of information electromagnetic interaction is relevant, i.e. Maxwell Equations provide important hints (and of course also probability functions of quantum mechanics). For information theory we need to search comparable quantities.

7. MAXIMAL M UP TO THIRD POWER FROM NUCLEON VIEWPOINT

According to example of chapter **6** from viewpoint of a nucleon (neutron, proton) the maximal stepcount (along proper time) is about m:=10^{41}. Some rough probability quotients:
p(all time) / p(this time) = m
p(all nucleons) / p(this nucleon) = m^2
p(all space) / p(this space) = p(outside) / p(inside) = m^3
(p(all time) * p(all nucleons)) / (p(this time) * p(this nucleon)) = m^3
This suggests after renormalization by p(this time) := 1 and p(this nucleon) := 1
all together a very large (and increasing) statistics per proper time.

8. STEPS TOWARDS AN INFORMATION THEORETICAL APPROACH

Supplementary brainstorming: Incomplete list of ideas, to be continued, to be checked and to be converted into algebraic expressions of expressions.

- For elementary considerations the formulation
  "Information is selection from a set of possibilities (domain)"
  must be precisely analyzed and applied to physics.

  Necessary is exact definition of the domain and "simultaneous" and evaluation of temporal order in dependence of elementary measurement method and information-variant (new "decision" or transfer of measurement result). For unification of current approaches we need to go back in time more and more (theoretically).
  Important advantages of the information theoretical approach are clear basic conditions ("everywhere" ensured temporal order since beginning of measurable time, consistency, symmetries and conservation laws). Considering these basic conditions a new pure information theoretical model must lead to current statistics. This probably would require assumption of certain former symmetry breakings (resp. decisions resp. measurements). These assumptions could allow due to conservation laws today enhanced statistical predictions.
- Fig. 1 can help, consider sum of central meetings as proper time ([O2]).
- The standard deviation of an extreme large (see chapters **6** and **7**) Binomial distribution is much smaller than its size. So it is pointed and shaped like the Dirac delta function δ(x) which is much used in quantum mechanics. This interpretation seems very interesting and worth for further research.
- Progress of time, creation of new information is connected with central meetings.

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[4] Start of the observable universe: t=0 is defined inside the considered reference system as the earliest time since which information (from a symmetry breaking) is available. It is plausible that in total there is further growing nesting (nesting along time leads to the only possible "time conform infinity"), so that in the current system this out of range and therefore not observable.

- Consider BRW pair as charge pair, study overlapping of +- BRWs: For this we define the Q1-triangle which results from a superposition of two Q0-triangles with opposite sign, starting in position n=1, k=±1 after multiplication by 1/2. Addition of both means a "discrete differentiation" along k.

  $$Q1(n,k) = -\frac{k}{n}\,Q0(n,k)$$

  Can be considered from one side (from decentral) as absorbing (3.1.1. of [O2]) or outflow (not only "proper" time). It can define a border.
  It is also a discrete derivative along n and also k:
  Q1(n+1,1) = Q0(n+2,0)-Q0(n,0) = (1/2) (Q0(n,2)-Q0(n,0))
- Up to now +-probabilities have been added, study change of situation in case of measurement (multiplication of +-probabilities). Every time step probabilities are multiplied, stable repeated measurements need probabilities near 1. To be continued...
- Initially set(s) of possibilities (uncertainty) have to be created, from which selections (events) are possible (definition of information).
- For usage of information comparison is essential. How is information (selection of a set) compared with past information? (Try correlation.)
- After "perception" or "measurement" the resulting information can be "copied" towards future, using "free energy" "E" which together with time direction is initially created as symmetry breaking or decision.
- The relative consumption "delta_E" of reference by measurement should be small. For permanent reliability (of predetermined time) the total sum "E" must be finite, i.e. the steps "delta_E" must go to 0 more quickly than 1/n.
- A decision is a new ("locally most future") selection (resp. information).
- "Locally" or "inside" a decision *defines* time order. This must be a sequence. Our time perception shows that this sequence can be *split* into irreversible parts or steps whose "direction" is determined by the initial time order.
  For decidable definition of time we need a primary set of possibilities for exact definition of order. For this we need at least 3 states. Perhaps 3 quarks are confined, because they represent 3 such states for common definition of time order. They cannot be separated, because starting from different locations a time difference would result which would lead to contradictions at defining time order.
  Generally there is the more "attracting force" or "commitment", the more there is tendency to a common time order.
- Pauli Exclusion Principle is necessary to avoid contradiction of (information about time) order.
- The graph of a decision must show that it starts with uncertainty (creation of entropy resp. possibilities) and later provides information (selection) from the set, probably as "potential" back to the original symmetry center due to conservation laws.
- Before using geometry "outside" must be defined. Outside is "past", information from there can be "known" resp. copied only with "delay" (to avoid contradictions).
- Copying of information, energy transfer, are additionally connected with decentral meetings (Fig. 1).
- For an information theoretical approach we need an exact representation of terms like "simultaneous" (time not distinguishable), "conserved" (connected quantity has total sum 0). The original conservation law determines time direction in different frames, see below.
- For an information theoretical approach a systematic vectorial description of elementary particles, using only numeric data of relevant (directly or indirectly measurable) quantities, exactly regarding the logic role of conservation laws together with (contradiction free) time dependence, could provide additional insight (in contrast to this names require preknowledge which tends to be forgotten). The vectorial description can be enhanced to more complex combined states.

9. CONCLUSION

From the above interpretation (see chapter **3**) we conclude that an information theoretical approach which develops into increasing complexity resp. branching depth (with geometry as secondary statistical consequence) is more plausible than a primarily geometrical model (like "Big Bang"). It seems that geometric (macroscopic) physical measurement results follow from differentiation, superposition and concatenation of (meanwhile partially very large, periodically in a symmetry center synchronized) statistics.

So (reconsidering physical experiments) we have to start with (in very different scale) along time ordered information theoretical terms (like "simultaneous", "before-after", "compare", "copy", "true-false", "longer-shorter", "past-presence-future", *secondary* geometrical terms like "inside-outside", "separated", "larger-smaller"), so that current physical "interactions" result as side effect (consequence) to guarantee (since t=0)[5]

[5] t=0 is defined inside the considered reference system as the earliest time since which information (from a symmetry breaking) is available, see also chapter 6 . In the same system future paths must not contradict past

long run and everywhere (information theoretical) consistency and need not be introduced using independent terms (like "electromagnetism", "gravitation", "xx-interaction", "xx-particle"). The need for such (non information theoretical) terms usually only shows a weakness of the used model and that we don't know the (information theoretical) connection (since t=0).

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101. ADDENDUM: SHORT REMARKS TO CONNECTIONS TO TOPICS OUTSIDE PHYSICS

As long as (in our time frame) the "circuit does not close" (the important fundamental questions are not solved by solutions which fit fully together and with reality), we have at best a patchwork and relevant gaps in knowledge. The current approaches in physics make research in a part (2017) of the complete relevant "circuit" - naturally they started with the statistically easiest predictable part. We know that an information theoretical approach is more fundamental than a geometric approach. So it is natural to search for hints in other important fields connected with information.

101.1 Information theory

101.1.1 Connection between conservation law, time direction, long term information (truth)

The (primary) conservation law (the basis of the other subordinate conservation laws) probably plays an important role even for determination of (also of long term) time direction (and with this for reliability of "truth" which is defined that it "applies at last"): After a perceptible **symmetry breaking** (in frames which we recognize in our time frame at once as "alive" it may have the name "decision") our reference frame gets another perceptible information (a selection from a set of initially 2 possibilities). The **conservation law** defines, that former or later (locally there are hierarchical time frames which are very large differing) "**time**" (which can be represented as sum of return probabilities to the local initial symmetry center [O2]) leads back towards the symmetry center and so defines **time** direction towards "future" within different time frames. We call the original long term (reliable, future) information also "*truth*" - it is associated to the root and has maximal branching width. Due to the conservation law this original information is accessible on the way back to the *original* symmetry breaking.

If the conservation law at last leads back, from which results (temporary) untruth?
To allow freedom for generation of new information there is an initial delay from initial decision until associated first perception. Only then we can compare it to the more early original and recognize correlation or not (true or false - or in case of more complex branching better or not so good). As long

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symmetry breakings. If a *complete* repetition of the same constellation (at later time) is a contradiction, this (e.g. by consideration of fermions as possibilities in (10)) could lead to the Pauli Exclusion Principle.

as there is freedom[6] (geometrically there is a natural delay due to light speed) we can also decide for the wrong alternative, because the truth is still not clear enough for us. The "own later" decision creates a new truth, a new own standpoint which is in case of a wrong decision more away from the truth. The branching in this direction can grow (even consciously with perceptions). Then (also psychological) inertia (see 101.2) hinders initially return to the truth and the new (temporary) own standpoint is (finally) not true. Due to the larger (maximal) branching width of the original root this has to become (more and more) clear former or later on the way back to the former original information.

101.2 To psychology and information

There is a tendency to remain in the old standpoint. But fact is that we are born outside the center (with connected asymmetries from birth on which can only remain for a limited time). So we have to correct our own standpoint during life to come nearer to truth. (Psychological) inertia is hindering - the "movement" of the own standpoint is uncomfortable, it also leads to new open questions (new missing information). Psychological inertia helps us to keep true standpoints, but it also hinders us to correct wrong standpoints. The best what we can do is to search again and again for the complete truth to find best rules for our decisions.

(Psychology and musical information: Music (time coded information) can be a more original topic than geometrically coded information. There is no radial distance, recognition seems to be "nearer" to the center. The recognized information is positioned and occurs within the very different time frames of the recognized patterns.)

101.3 To Biology

Obviously there is a connection between biological constructions and physics. The statistical branching depth is in large parts outside the range of our current (2017) approaches. But the principles can give important hints. Some obviously relevant topics:

- Handling of genetic information.
- How leads genetic information to growth? The genetic information alone is not sufficient. How can it be an "initial key", which opens access to more complex information?
- Evolution, Biogenesis: There is e.g. a connection to geometry. Animals with radial symmetry produce two germ layers - the *ectoderm* and *endoderm*. Animals (also humans) with bilateral symmetry produce a third layer (the *mesoderm*). The layers grow to organs with different tasks (e.g. decisions (brain), collection of energy, visible movement).

[6] Later (more branching depth) due to physical inertia we need to incorporate "free" energy which allows us to express own decisions with our body.