BLED WORKSHOPS
IN PHYSICS
VOL. 15, NO. 2

Proceedings to the 17th Workshop
What Comes Beyond . . . *(p. 239)*
Bled, Slovenia, July 20-28, 2014

13 Influence from Future, Arguments

H.B. Nielsen*

The Niels Bohr Institute,
Blegdamsvej 17 - 21, Copenhagen Ø; Denmark

Abstract. It is the purpose of the present article to collect arguments for, that there should exist in fact -although not necessarily yet found - some law, which imply an adjustment to special features to occur in the future. In our own "complex action model" we suggest a version in which the "goal" according to which the future is being arranged is to diminish the integral over time and space of the numerical square of the Higgs field. We end by suggesting that optimistically calculated the collected evidences by coincidences runs to that the chance for getting so good agreement by accident would be of the order of only 1 in 30000. In addition we review that the cosmological constant being so small can be considered evidence for some influence backward in time. Anthropic principle may be considered a way of simulating influence backward in time.

Povzetek. Namen tega prispevka je zbrati argumente za trditev, da obstaja nek (najbrž še ne odkrit) naravni zakon, ki dopušča vpliv prihodnosti na dogodke v sedanjosti. Avtor je v "modelu kompleksne akcije", skupaj s sodelavci, predlagal, da je "cilj", ki določa prihodnost, povezan z zmanjšanjem integrala vrednosti kvadrata Higgsovega polja po prostor-času. Avtor meni, da je antropsko načelo lahko način za simulacijo vpliva nazaj v času. Zbere nekaj primerov, ki jih uporabi za argument, da smo vpliv prihodnosti na sedanjost in preteklost že opazili. Predlaga poenoteno sliko enačb gibanja in začetnih pogojev. Predstavi model s kompleksno akcijo, ter povzame napovedi tega modela. Povzame tudi, kako drugi avtorjevi modeli potrjujejo vpliv prihodnjosti na sedanjost. Tudi majhnost kozmološke konstante se da pojasniti s vpivom preteklosti na sedanjost.

13.1 Introduction

Since long the present author and various collaborators[1–4] have speculated on possibilities for a physical theory having in it some preorganization in the sense, that there is some law that adjust initial condition and/or coupling constants so as to arrange for special "goals" to occur in the future. In works with K. Nagao[6,8,7,9–11] we sought to calculate, if effects of an imaginary part of the action of the type of the works with M. Nimomiya[3,4] could be so well hidden, that such a model would be viable. One could even say, that it is speculations about, that future could somehow act back on the present and the past. Usually - since Darwin and Wallace - it is considered (essentially) a fundamental law of nature, that this kind of back action does *not* exist. But is that trustable? In the present article we shall

* E-mail: hbech@nbi.dk, hbechnbi@gmail.com

collect arguments for the opposite, namely that there truly IS such a back action in time.

I would like to seek to make a kind of review of the evidence for such an influence from the future, and use it as an excuse for talking about some relatively recent works[12], some of which may not immediately seem to be relevant, such as my work with Masao[15,13,14] Ninomiya on "A Novel String Field Theory"[13–15]. My real motivation is to look for what the fine tuning problems for the various coupling constants may tell us about the fundamental laws of physics, which we seek to find [12].

In other words we could say, that I want to investigate if retro causation is possible and plan to argue for that there are indications that it is possible.

Although the idea of having retro causation is generally believed not to be true there were at least one proposal for a theory of that kind proposed, namely the theory about electromagnetic radiation being radiated *in equal amounts backward and forward in time* by Wheeler and Feynman [16].

The work of Feynman and Wheler avoids influence from the future by a discussion of the absorbers of the light emitted backward and forward, a mechanism a priori rather different form the one we use in our complex action model already mentioned; but the quantum mechanics interpretation inspired from the Feynman-Wheeler theory, which is called transactional interpretation and is due to Cramer[17], is the same one as the one supported by our complex action theory.

The plan of this talk about the influence from future will be like this :

- 1)Introduction
- 2) Listing of arguments for influence from future.
- 3) Discussion of Time reversal
- 4)Why should we NOT unite initial state information with equations of motion?
- 5) The finiteness of String Theory may hide in mine and Ninomiyas Novel String Field Theory [13–15] - an influence from the future, and that might be the reason for it being string theory.
- 6) Some fine-tunings as if "God hated the Higgs squared field
- 7) Bennetts and mine argument that at the time the Cosmological Constant must already have hat its value, when densities of energy so low as the present were unknown/did not yet occur.
- 8) The Multiple Point Principle being successful means influence from future.
- 9) If we count optimistically do we have sufficient evidence for a planned universe development?
- 10) At the end we conclude that one must take the possibility seriously.

13.2 Listing of Arguments

Here I should like to list a series of arguments for that there *is* indeed some adjustment going on to achieve some "goals" we may hope to guess some time:

- A) Funny that many religious people imagine, that there is a Governor of the world, if the principle preventing such government were truly valid.

- B) Strange that the laws about the initial conditions and equations of motion behave differently under the CPT-like symmetry (or under time-reversal)
- C) Cosmological constant were very small compared to the energy density in the beginning; how could it then be selected so small, when it had no significance at that time (argument with D. Bennett).
- D) Several evidences for anthropic principle, but mostly physicists do not like it. (Personally I would say: The anthropic principle is much like putting in the experimental fact that we humans exist into the theory; putting in experimental results can always help avoiding finetuning problems, so a good theory should be more ambitious than have to include such an input.)
- E) Multiple Point Principle (almost) successful: Higgs mass, top Yukawa coupling, and Weak scale relative to Planck scale.
- F) Our Complex Action model with Higgs field square taken to dominate gives[12]:
  - 1) n and p+e+antineutrino suppress Higgs field equally much (within errors).
  - 2) The "knee" cut the cosmic ray spectrum down close to the effective Higgs threshold.
  - 3) Nuclear matter has low binding energy.
  - 4) Higgs field in vacuum at lowest Higgs field square.
  - 5) Smallness of weak scale/Higgs field relative to fundamental/Planck scale.
- G)It may be very hard to make an ultraviolet cut off, that does not violate locally in time a little bit. So an ultraviolet meaningful theory may imply influence from future?
- H) General Relativity allows closed time-like loops...(well known to lead to time machines by worm holes etc.)
- I) Horowich and Maldacenas influence backward inside the black hole.
- J) The bad luck of SSC and the - though too little - bad luck of LHC would follow from Higgs machines getting bad luck.
- K)With large extra dimensions there appear in principle a frame dependence of which moments are earlier than which due to the frame motion in the extra dimension directions.
- L) Wheeler space time foam and baby universes imply almost unavoidably influence from future, at least small influences from near future. Baby universes make effective coupling constant depending on very far away influences in e.g. Time.
- M) In String theory in the formulation of Ninomiyas and mine (Novel SFT) the hanging together of "objects to strings, or chains giving strings better, is put in as an initial condition AND IT LOOKS ALSO AS A FINAL STATE CONDITION!

The following arguments are even more theoretical speculation arguments for influence from future:

- N) When we e.g. Astri Kleppes and mine derivation of space time and locality etc. - seek to derive in Random Dynamics e.g. Feynman path integral we get

the complex action and thus future influence from it. And seeking to derive locality we get left with effective couplings, which much like in baby universe theory depends on, what goes on averaged over all space and time.
- O) Were the many e-foldings in inflationary organized in order to get a big universe (a miracle) ?

Somewhat aesthetically arguments form the time reversal symmetry should also be mentioned:

- P) The usual picture: The laws concerning the time development the equations of motion are perfectly invariant under the CPT-symmetry. Nevertheless the initial conditions determining the actual solution to these equations of motion is chosen in a way that makes it look more and more complicated as one progresses forward in time! (This is the law of increasing entropy) Really the mystery is not why finally the world ends up in a state in which one can say almost nothing in a simple way; but we rather should take it that a huge number of states have same probability/ the heat death state. Rather it is the mystery why it ever were in a state that could be described rather simply, the state in early big bang times, with high Hubble expansion rate.
- Q) And even more mysterious we could claim: Why were the Universe in such a special state in the beginning, but do not also end up in such special and simple state? Initial State Versus Development Laws (equations of motion) seem not to have the same symmetry under time reversal (or say instead CPT) Since Newton we have distinguished between initial state information and the laws for the time development. Seeking the great theory beyond the Standard Models our best hope to progress is to unite some of the information about Nature, which we already have in our literature. One lacking unification is the unification of initial state information and the equations of motion. One little may be indicative trouble is that time reversal or better CPT symmetry is valid for equations of motion but NOT for the initial state information!

13.3 Discussion of Time Reversal-like Symmetry

Let us look now a bit on the problem for the usual point of view and thus the argument for influence from the future Q). What are the possibilities?:

- 1 Possibility) CPT symmetry could be the more fundamental and the asymmetry w.r.t. time direction of the initial state information (we know a lot about the start, but the future gets more and more chaotic) could be due to some sort of spontaneous break down, as e.g. in mine and Ninomiyas complex action model:
  In principle the “initial state information” could be put in at any time, but due to some special conditions in a certain time early compared to our era “the actual solution to the equations of motion chosen to be realized (by Nature)” became mainly determined by this certain era early compared our era. This should mean that in that special era the realized solution is arranged to obey some relatively simply rules, e.g. some strongly expanding universe being the rule.

- 2. possibility) The time direction asymmetry might be the more fundamental and the CPT symmetry just some effective result coming out of an a priori time and even CPT noninvariant theory. So the initial state CPT noninvariance were the more fundamental feature, and the CPT symmetry for laws of nature is only some sort of effective or “accidental” symmetry [5]. It is well known that CPT largely follows from Lorentz invariance, so that if it were correct as I have claimed for years, that Lorentz invariance could be a low energy approximation (only for the “poor physicists”), then also CPT would be a low energy limit symmetry.

Taking the first possibility means that you have in principle also the possibility of having some influence from the future, so that our question as to, whether such influence is at all possible, gets answered by yes; but of course the effect may be essentially zero such as the situation of the “spontaneous break down ” is realized, since otherwise we should already have observed it so safely, that we would have had to believe it.

If the time dominating the fixation of the solution as in mine and Ninomiyas model becomes a certain time which is earlier than our time - but not necessarily the very first moment (if such one should exist) - there would be an opposite axis for the entropy running on the other side of this special time era(that dominantly fixes the solution being realized). In other words before the solution-determining time-era the entropy would decrease! So in that “before solution dominating era ” there would formally be influence from the future. Of course, if we lived in such an era, we would invert our time axis and still say, that entropy grows, except if we get contact theoretically or truly to an era with another entropy development axis.

If the second possibility were realized, we should expect Lorentz non-invariant effects in principle. We should namely expect CPT not to be fundamentally true, but then Lorentz invariance could only with violation of other presumably good assumptions be exact.

If we fundamentally did not have Lorentz invariance it could mean that there were in the “fundamental terminology” beyond the Lorentz invariance appearance perhaps some fundamental frame in which the physics would develop strictly causally, in the sense that it would develop more and more chaotic (i.e. increasing entropy) and without any influence from the future. But logically it could nevertheless be so that in some Lorentz frames moving relative to the fundamental frame there could be influence from future.

13.4 Why Not Unite Initial Conditions and Equations of Motion

In looking for a unified theory of all physics, one often finds the idea of seeking to unify the various simple gauge subgroups of the Standard Model gauge group into some simple gauge group such e.g. $SU(5)$ or groups containing $SU(5)$ as a subgroup, such as SO(10). But since making progress towards finding the “theory of everything” is expected to go via successive unifications, one should also possibly imagine other types of unifications. Here we then ask: Should we not unify initial-state conditions with equations of motion? This is actually what our already in this article suggested complex action model (see subsection 13.6) would do. It predicts both (something about) the initial conditions and of course the equations of motion from the form of the action (as usual). In this sense one should really guess the form of the complex action so that we can obtain relations between features of the initial state conditions and the equations of motion. We can say that with a Standard Model real part of the action taken as phenomenologically suggested the dimensional arguments used to predict that the most important part of the imaginary part of the action determining (or at least providing some information concerning initial conditions) and ending with that the mass square term for the Higgs field, are results of of such a unification. So in this sense our results from this Higgs-dominated imaginary part can be considered results of a unification of initial state conditions and equations of motion.

Also the Hawking-Hartle no-boundary assumption for their (and others) quantum gravity gives information about initial state conditions, and thus it should be considered a unification of initial conditions and equations of motion.

But now one may have general worries about - this kind of - unifications of initial conditions and equations of motion, unless one allows for the influence from the future:

In fact the time reversal or the CPT-like symmetry leads to that the unified theory presumably should have such a symmetry, at least both in our complex action theory and in the non-boundary theory there IS cpt-like symmetry, except that the whole theory is on the manifold. Therefore it gets very hard not to have also a final state condition. In fact it seems only to be a spontaneous breaking of the symmetry of this type that is likely to solve the phenomenological problem. But then there appears indeed easily some remaining effect of influence form the future.

13.5 String Theory, Regularization Problem, and Our Novel SFT

Only String Theory Seems to Cope with the Cut Off problem in Nice Way!

Presumably the best argument for believing, that (super)String Theory should be the theory of everything(T.O.E.), is that it does NOT HAVE THE USUAL DIVERGENCE PROBLEM. One might wonder how string theory manages to avoid the problem of divergent loops. It is well know that by summing up the infinitely many loops from the various string states the integrand for the loop 26-momentum obtain a damping factor going with an exponential of the square of the loop momentum. Thus the divergence of the usual type got effectively cut off. A related property of the lowest order scattering amplitudes is, that they for large transverse momenta fall off even with an exponential in the square of the transverse momentum. Since String theory has gravity (almost unavoidably) having such wonderful cut off of loops behavior is remarkable good!

13.5.1 Cut off in the Light of Mine and Ninomiyas Novel String Field Theory

Let us now consider the for the success of the string theory in coping with the divergences plaguing the usual quantum field theories so important Gaussian cut off of the large momenta.

As an orientation let us look at the transverse momentum cut off from the point of view of mine and Ninomiyas novel string field theory:

The momentum of an open string say in our formalism is given by a sum over the “contained “objects, each of which has the variables (J, Π), i.e. 24 momenta J and their conjugates Π, and the total momentum of the open string is proportional to the sum of the even “objects, because the momentum contribution from the odd ones become zero due to their construction as *difference* of conjugate momenta of the two even neighbors. The scattering is in our SFT-model is simply exchanges of “even objects, while no true interaction takes place, only strings are divided and recollected, so that the “even objects in the initial strings get distributed into various final strings.

So how does the limiting/the strong cutting off of the transverse momenta come about in the optic of our model?

Although there is a divergent number “objects in any string in our novel string field theory, these “objects are sitting in chains with strong negative correlation between the momenta of neighbors (in the chains). So any connected piece of such a chain never reaches momenta much bigger than of the order of one over square root of alpha prime $\sqrt{\alpha'}$, except for the momentum assigned the total strings. So if we only split the chains of objects into a few connected pieces we cannot get any combination of the pieces, when recombined to final state strings, to contain big amounts of momenta compared to the alpha prime order of magnitude value$\sqrt{\alpha'}$. It is this restriction that means, that we get in Veneziano model the exponential of the squared momentum falling off amplitudes.

The limitation actually exponentially with the square of the momentum in the exponent, i.e. Gaussianly of the amplitude of scattering for large transverse momenta of strings coming out of collisions of strings in our novel string field theory (SFT) is due to the very strong anti-correlation of the momenta of the “objects - crudely functioning as constituents of the strings so that only very limited momenta are statistically found on connected pieces of object-chains. Since this so important - for the momentum cut off (anti)correlation of the “objects on the chains used for strings is put in as INITIAL and even as FINAL STATE conditions in order to describe the strings by means of “object-chains, one can say that in mine and Ninomiyas SFT we have arranged the transverse momentum cut off effectively by the initial or final states having been assumed to have the appropriate (anti)correlations!

13.5.2 The Limitation of Momenta in Loops

For each limited loop order corresponding in our novel SFT to splitting the “cyclically ordered chains of “objects into a limited number of subchains before being recollected into new “cyclically ordered chains forming the final state strings (depending on the order (of loops)) the amount of momentum, that can be sent out as transverse momentum in a scattering is limited due to the correlations among the "objects (neighboring on the chains). The higher the order though the higher is the effectively allowed order of magnitude of the transverse momentum, corresponding to the well known fact that higher and higher loop order in unitarity corrections to the Veneziano model has a slower and slower fall off for large momenta the higher the order (i.e. the larger the number of loops). Roughly this relevant correlation corresponds to the "stringness" in the sense, that it is also this correlation (between neighboring "objects"), that ensures that very small pieces of strings carry only very little momentum. But have in mind, that in OUR theory the hanging together to strings is only put in as initial state (and even final state) conditions. Even the alpha prime α' scale so needed to make a chance of having a cut off effectively is in our model *only put in as an initial and final state condition* (nothing in the completely trivial and basically non existing dynamics talks about alpha prime!)

So one really in mine and Ninomiyas novel string field theory must ask: String theory cut off, from where does it come?

Generally: When one interacts (locally) with the string in our formalism or in other ones you can only transfer little meaning given by apha prime (inverse square root $\frac{1}{\sqrt{\alpha'}}$) momentum into the scattering. Via Heisenberg uncertainty this is turned into an extension of the strings due to quantum fluctuations. But it is crucial for the effective cut off, that the string hangs piecewise together; if e.g. in mine and Ninomiyas novel SFT you could split the "objects in a way, in which no "objects kept attached to their neighbors almost, then the momentum in the scattering could be much larger, and very likely a divergence problem would reappear.

In fact it is well known that the higher loops one consider in string theory (unitarity corrections to Veneziano model) the slower becomes the coefficient in the Gaussian fall off of the amplitude with the exponential of the square of the transverse momenta. This means that the more pieces the string or in our model the to the strings corresponding "cyclically ordered chains" are cut into and recollected under the scattering, the larger can the transverse momentum become.

If one would attempt to split up the string to be actually built form discretized elements, one would be back in quantum field theory and it would be as hard as usual to avoid divergencies. The continuity of the string or in our novel SFT formulation the cyclically ordered chains is crucial for the achievements w.r.t. avoiding divergencies and keep tranverse momenta low.

13.5.3 Looking for a Cut Off Machinery

Let us now look whereto we are led when we look for a way to make a cut off:

Now I would like to speculate as to where we are led to think, if we which to get sense out of a theory, in e.g. too many dimensions, so that ultraviolet cut off is truly a necessity:

First we could think of modifying geometry or we may seek to keep it:

- 1) Cut offs like lattices which have a discretized geometry.
- 2) Keep e.g. flat geometry or at least a manifold.

In this second case where are we led, if we seek a cut off of the ultraviolet divergencies, but cling to continuous manifold or let us for simplicity say simple Minkowskian geometry (but continuous space and time) ?

If we use point particles with interactions we have no chance to get any form factors to rescue us against the ultraviolet divergencies.(we might though use higher order derivative on the fields in the Lagrangian density, but let us leave that as another possibility). So we are let in the direction, that we must take the particles, with which we want to work, to be composite objects / bound states or rather most importantly extended objects, so that interactions with the various components have the chance to cancel out couplings to very high momentum states (which is what cause the divergencies).

Thus let us at least look towards seeking cut off in direction of bound states:

Let us now think along the line, that we replace the particles, we consider phenomenologically, by bound states or composite structures. That is to say, that looking more deep inside they shall turn out to consist of some “smaller parts “partons say. It is fine that we may then get form factors, since they have the chance to cut off the loop integrals and make them converge.

Now we may talk the language of Bjorken x being the fraction of longitudinal momentum carried by a “parton.

If the partons have non-zero Bjorken x, then you get parton parton scatterings, when the bound states collide and the situation is much like, if the partons really existed and we are back to the point particle play: there will finally result divergencies again.

So if we are looking for avoiding divergencies we are driven in the direction of taken all the Bjorken $x = 0$. But that then in succession means that collision of only a few partons from one particle(=bound state) with partons in the colliding particle(=bound state) will hardly give any momentum transfer, hardly mean even a scattering.

Once assuming $x = 0$ for all the partons we will get negligible momentum transfer by just scattering a few partons with each other; that is too much cutting off. The effective way to get some significant scattering to identify with the scattering of the particles(=bound states), we want phenomenologically, is to exchanges from one bound state to another one a large number(infinitely many) partons. This means we are driven towards a picture, in which a scattering is mainly an exchange of some part of one composite particle with part of another one. But none of the constituents (=partons) truly interact. Rather the constituents individually just continue undisturbed as if not interacting at all!

Remark how we got driven towards the picture of String Theory in mine and Ninomiyas novel string field theory: The bound state, we consider should be composed from constituents not interacting at all!

These constituents or partons, we are driven towards, are of course to be identified with the “objects in Ninomiyas and mine novel SFT(= string field theory); precisely these “objects of our theory do not change at all.

So we for the moment think of “Even Objects as Partons:

Does it matter whether we consider our “Objects as constituents or the true string interpretation definition of the “Objects J from discretizing right and left movers in the string? For this true definition of the "objects" we have to refer to the other article in the present Bled Conference proceedings 2014 on what comes beyond the standard models [15] (starting on p. 184).

Very shortly let us though on the definition of the "Objects say:

Since the "objects are defined as the difference between the values of say the right mover component of $X^{\mu}(\sigma,\tau) = X^{\mu}_{R}(\tau-\sigma) + X^{\mu}_{L}(\tau+\sigma)$ i.e. as $J^{\mu}_{RI} = X^{\mu}_{R}(\tau_R(I+1/2)) - X^{\mu}_{R}(\tau_R(I-1/2))$ (where $\tau_R = \tau-\sigma$, and we imagine a discretization replacing τ_R by an integer number I instead and let $\tau_R(I \pm 1/2)$ denote the neighboring τ_R points around the point corresponding to I in the discretization.) at two near to each other values of the ONE relevant variable, it is in fact proportional to the derivative of the right mover component. To reconstruct the position field we both have to integrate (or sum) up and we need both left and right. On open strings boundary conditions causes the left and right mover to be the same. But for open strings they are different.

After we have identified the right with left mover "objects for the open string (as the boundary condition for open string leads to) the objects describing an open string sits topologically in a circle, called by us "a cyclically ordered chain of objects. So the topology of the structure describing the open string by us is a circle and and not as the open string itself an interval. But the momenta of the open string is written as a sum over contributions from the "objects sitting along the cyclically ordered chain (the circle). So as long as one can consider a distribution of momenta to the various "objects, we can consider the "objects constituents (for that momentum distribution purpose at least).

So we might ask: Can we forget the string and only think on Our "Objects ?

If you go over to considering the "objects of our model as constituents of the composite particle(described as the string), you ignore the string as not being the right way of thinking of the same theory.

Contrary to the string point of view, in which the string moves internally as it moves along, the "objects are stale and just do not change (Well, their position is a bit more tricky to consider, so we may think of them as free partons). The "objects fit with the constituents not interacting but just being exchanged en block from bound state to bound state. Pieces of String Time Track per Pair of "Objects with Lightlike Sides Time Track of String from Pieces per Pair of "Objects Lightlike Sides The Very Scattering Moment, Only Exchange of Pieces

Whatever the string may develop mechanically after a collision it is an almost pure exchange of parts that take place at the very collision. At least if the hit is only at ONE POINT of the hitting strings, then from locality nothing can happen at other places in the very first moment. So in the limit of infinitely many constituents (like continuum string) the first moment of a scattering ONLY an exchange of pieces can matter. So, if indeed no parton withx different from 0 is allowed in order to make a good cut off bound state theory, then when first partons hit we can ONLY have exchange of pieces interaction: So in this first moment there is in this sense no true scattering! (Like in mine and Ninomias model).

But there is a need for exchange of pieces

If we have $x = 0$ bound states, there would without exchange of pieces be no scattering, no essential momentum transfer at all.

Now I say: We are driven in seeking for a cut off to a theory with a system of particles (corresponding to the strings in string theory) being bound states with all partons having Bjorken $x = 0$, and they scatter only by exchange of pieces. So it is essentially only how one thinks the constituents as distributed between the particles, that change in the scattering.

It is well known that the higher dimensions spacetime has the more severe are the ultraviolet divergencies: High dimensions give ultraviolet divergences.

13.5.4 Rescuing the Species Doubler Problem by Pushing Chiral Charge to Central Station in Extra Dimension

In the Standard Model one has a remarkably tricky cancellation of the chiral anomalies associated with the (chirally coupled) gauge fields. Non of the fermions in Standard model have their "species doubler (with opposite handedness, but same charge combination). So it should after mine and Ninomiyas no-go theorem be impossible to put the Standard Model on a lattice, or for that matter regularize it in gauge invariant way at all. I.e. No cut off should exist, which can keep gauge invariance. The way Norma Mankoc Borstnik and I attempted to escape this problem were the following:

The way we attempted to escape the no-go theorem was by having infinitely large extra dimensions allowing superfluous fermions to be pushed out to infinity.

Let me look at the nogo theorem problem by thinking of the anomaly telling that the chiral charge is not conserved, but has a lack of conservation correction proportional $F\tilde{F}$(with some gauge fields put in for the two F's).

13.5.5 Anomaly way of Looking at No-Go Anomaly Requires Pushing out or Fetching in Chiral Fermions

Because of the anomaly we need locally in space-time to be able to obtain extra chiral fermions in spite of them having conservation laws making that impossible in the regularized theory. In Norma Mankoč Borštniks and mine attempt to cope with Wittens no go theorem we propose to have non-compact extra dimensions: Then the superfluous or missing chiral fermions may be pushed out or be brought in from the infinitely far away in the extra dimensions. You almost bring them out to a mysterious central station for pushed out chiral fermions, from where they may reappear in the practical world later or earlier or somewhere else than from where they were pushed out.

With such central station whereto chiral particles are brought in and out to various places or times in the 3 +1 dimensional world is to be imagined in the model needed (say Norma Mankoc's and mine), then one may suspect that one easily get times mixed up having such an exchange station for chiral fermions. There namely has to be somehow a control that the total number of chiral fermions of a certain type is conserved in the regularized model. But then how to get the information of the creation seemingly of one at a certain point in the 3+1 space time transfered and brought together with the uses or further creations around space time without endangering the no influence from future principle(which we attempt to attack in this article)?

If really the chiral fermions are fundamentally conserved in the regularization scheme here thought upon as the true theory but just seem not to be because they are pushed out to an in the extra dimensions infinitely far away place, it may seem difficult to keep truly no influence from future from the practical 3+1 dimensional point of view. Would one really could have the number of chiral fermions being added to the central station for such fermions pushed out be kept to net zero without some influence back from the future?

13.6 Some Potential Killings of Our Complex Action Turned Out Supporting It.

Funnily enough I have found a few cases, where seemingly arguments against the validity of the complex action model with its influence from future, actually get turned around and leads to evidence for the influence from future instead, because they turn out rather to show that nature has just some number just finetuned almost to solve the problem.

13.6.1 Short Review of Complex Action Model

Let me here review a bit the main point of the theory of the complex action. A priori it would seem obvious that if we took the action $S[history]$ to be complex rather than as assumed in the usually believed theory, then one would immediately see that effects of non-unitarity and if one used classical calculation one would also expect that otherwise real variables would run complex. In other words at first it would look as if the idea of taking the action complex is phenomenologically so bad that any hope is out unless the imaginary part is extremely small; and so if real and imaginary were about equal in size as one would guess there seems at first to be no chance. But that is according to the calculations or estimations on which we are still working not true! Most convincingly this is seen in a Hamiltonian formalism, in which not so surprisingly a complex action would lead to a non-Hermiten Hamiltonian. In fact the main point is that as long time has past since the start, almost certainly the universe developing by the now assumed non-Hermitean Hamiltonian gets increasing probability for being in those states, which have the largest (eigen)values for the antiHermitean part (divided by i) H_I of the Hamiltonian, if we think of having split it as $H = H_R + iH_I$ where then $H_I = \frac{1}{2i}(H - H^\dagger)$. If we now have assumed - as we have to assume to avoid that the Wentzel-Dirac-Feynmann-path integral shall not be divergent due to the imaginary part of the action $S_I[history]$ going to plus infinity - that there is an upper bound on the antiHermitean part H_I or almost equivalently a lower bound on the imaginary part of the action S_I, then we argue that the system after long time will arrive to a superposition of states with their (eigen)value for H_I close to the assumed upper bound. Once we have argued the system to be in such a state we have the suggestive approximation of $H_I \approx$ "upper bound" and can consider the antiHermitean part H_I an approximate c-number and by a time dependent normalization we can completely remove the effect of this antiHermitean part. This crude argument thus allows us to suppose that after all the antiHermiteamn part H_I of the Hamiltonian is not important provided we study what happens in a universe, that is already very old compared to some fundamental scale for the theory provided we have just an upper bound on this antiHermitean part. This may not be totally convincing as written, but we have formal formulations and it is essentially correct but in order not to have troubles with the Born rule of quantum mechanics that one shall the probability for measuring a state by using the numerical square of the coefficient to a normalized states one shall a new inner product which we call $|_Q$ (so that we can write $< b|_Q a >$) with the property that w.r.t. this inner product the Hamiltonian H gets *normal*. Normality means that the antiHermitean part commutes with the Hermitean part i.e. $[H_R, H_I] = 0$. (The Q that occurs as an index to the new inner product $|_Q$ to be used instead of the original inner product $|$ is an operator constructed from the Hamiltonian - using it diagonalization - and then we defined $< a|_Q b >=< a|Q|b >$.)

Even though now we have argued, that one will obtain a time development as if there existed a Hermitean Hamiltonian even, when the true Hamiltonian is not Hermitean, provided one uses the modified inner product $|_Q$, there is one very interesting and important effect of the antiHermitean part H_I or of the imaginary part $S_I[history]$ of the action left: These antiHermitean or imaginary parts determine the initial condition effectively seen! We saw already just above that the antiHermitean part of the Hamiltonian were important for the states into which the likelihood of finding the world got larger and larger as time went on. So effectively in a late stage of the development of the universe it becomes most likely to find that this universe is in a state with a high -i.e. close to the upper bound - value for the (eigen)value of the antiHermitean part H_I. This really means that we shall look at the complex action theory as a model *unifying the initial conditions with the equations of motion*.

Such a unification of course is in principle very wellcome, if one can find it. In the Hamiltonian formalism with a non-Hermitean Hamiltonian one can see that unless one puts the system/world in a state that has absolutely zero component after some eigenvectors of the Hamiltonian, it will go so that as time goes on the various eigenstates in an expansion of the actual state will grow up exponentially with coefficients going as $-it\lambda_i$ where λ_i is the for the coefficient relevant eigenvalue of the non-Hermitean Hamiltonian $H = H_R + iH_I$. Have in mind that for non-Hermitean Hamiltonian of course the eigenvalues λ_i are typically complex. It is of course the imaginary part of λ_i which gives rise to the time development of the numerical value of a coefficient $c_i \exp -t\lambda_i$ to some eigen vector $|\lambda_i >$ (even though these eigenvectors are not orthogonal to each other, one could still imagine using them in expansion). Exponentially soon a rather small collection of the eigenstates with the largest - in the sense of most positive - imaginary parts of their λ_i's will soon take over. Thereby a rather specific development of the universe gets selected out and one can understand that the antiHermitean part of the Hamiltonian can have strong influence on which states one at a late stage in time is likely to find such a universe with non-Hermitean Halmiltonian. Thus it is understandable that there can be something in the statement that the theory unites initial condition theory with equation of motion theory.

Our studies have led to that one may distinguish reasonably defendable ways of extracting the information from a quantum theory with a given action - two different ways especially suggestive in the case complex action - namely 1)"with future" and 2)"without future".

13.6.2 Guessing the Standard Model Imaginary Part of the Action

At the present conditions in the Universe - but not at all applicable perhaps in the early times just after a possible big bang say less than 10^{-12} s say - the Standard Model seems to work perfectly except perhaps in very high energy accelerators and in cosmic radiation. So we should expect that at least the real part $S_R[history]$ of the action $S[history]$ should be given well by the action of Standard Model. Now the very natural guess is, that you get the full complex action by just letting all the coefficients of the various terms in the Standard Model action become complex. You might even as the a priori most promising guess think, that the phases are rather random and of order unity, meaning of the order of 100^0, except though, that the mass term for the Higgs particle deserves special discussion.

Let us remind about the discussion around the hierarchy or the scale problem for the usual real action Standard Model:

If you imagine a cut off at the Planck scale or some new physics at some GUT scale at almost Planck energy scale, then one has the problem that corrections to the bare Higgs mass square as written in the Lagrangian density m^2_{Hbare} in order to obtain from that the measured mass square m^2_{Hren} becomes typically very large, either it is divergent or by means of fixing some unified scale it becomes when renormalized to that scale anyway huge compared to the scale of measured Higgs mass square or the weak scale. So it is a well known finetunig problem how to get the weak scale be small compared to the huge scales involved in the loop calculations even if one renormalizes to some unifying scale. You might keep the corrections smaller by having supersymmetric partners - but the LHC results so far rather show the surprise that such ones are so far not found -. But whatever might be the solution to this problem of how the weak scale became so small say compared to the Planck scale and how to keep it there it might it easily becomes so that the bare mass square m^2_{Hbare} becomes appreciably bigger than the renormalized one m^2_{Hren} numerically.In the case when some supersymmetric particles exist and makes the mass square correction *only* logarithmically (divergent) the size of the bare divided by renormalize will though only be "logarithmic", which means not so fantastically big after all. But if the supersymmetric partners do not exist or are very heavy then again the bare mass square will typically be much larger than the renormalized/observed Higgs mass square.

When we now want to guess the size of the imaginary part of the Higgs mass square, the suggested guess is that it should be of the same order as the real one; but now should it be as the real renormalized or as the real bare ? Most likely the loop corrections for the real and for the imaginary parts are completely different and huge, so the question becomes: Would the same mysterious fine tuning, which made the real part $m^2_{Hren}|_R$ = observed/effective Higgs mass square of the renormalized mass square for the Higgs also function for the imaginary part, so that in some way - which we may or may not understand - the effective/renormalized (whatever that might exactly mean) imaginary part of the Higgs mass square $m^2_{Hren}|_I$ becomes as small as the real renormalized part order of magnitudewise?

Very likely the solution to the finetuning problem (= the scale problem) of why the weak scale is so low compared to the Planck scale say will be solved in a way that will not make also the "renormalized" scale for the imaginary part of the "Higgs mass square" small compared to say the Planck scale. For instance this is the case for our own "solution" to this problem by means of the multiple point principle: This "solution" means, that, if we make the very strong assumption that there is some finetuning fixing the parameters/coupling constants of the theory working in nature in a way restricted so that there becomes *several different vacua all having very small energy densities(=dark energies = cosmological constants)* (for purposes of the weak scale we just say exactly zero energy densities are assumed in the vacua) we how found a viable picture with strongly bound states of 6 top + 6 anti-top quarks and a set of three different vacua in the Standard Model, in which this requirement leads to an exponentially small value of the weak scale compared the scale of the Higgs field in one of the vacua considered degenerate. In other words with our assumption of vacua with zero energy density (called "multiple point principle" (=MPP)) and some in principle calculable speculation about bound states of quarks and anti quarks the parameters of the standard model need to to take such values that the renormalized Higgs mass square must be very small compared to the scale for the Higgs field in one of the by us assumed vacua. We then add as an extra assumption to our multiple point principle that for one of the vacua the Higgs field present should be of the order of the Planck energy. This latter assumption is already supported by the parameters of the Standard Model if one assumes this Standard Model to be valid up to so high energies (or Higgs fields). It found a support together with the multiple point principle by the Higgs mass found in Nature agreeing with our PREdiction.

But really in our complex action model physics coming out of the real and of the imaginary part of the action are *quite different*, crudely the real part gives equation of motion and the imaginary the initial conditions, so to expect that some mysterious mechanism make the same finetunin on both is not at all likely. Therefore we shall conclude that it is most likely that there is no finetuning going on to make the effectively observed/"renormalized" imaginary part of the Higgs mass square small compared to say the Planck scale value. If so, then we should expect it to be probably of the order of the Planck scale. Putting into Standard Model extended to have complex action this size of the Higgs mass square imaginary part would mean that considering a process of daily life or of LHC the Higgs mass square term would give contribution to the imaginary part of the action, which are larger than the contributions from the other terms by a factor $M^2_{Pl}/(\text{ TeV}^2) \approx 10^{34}$. This means that we from dimensional arguments think we could argue that the most important term in the imaginary part of the action should be the part from the Higgs mass (square) term.

With this we argued that we under present conditions can approximate the imaginary part of the action $S_I[\text{history}]$ by only the contribution from the Higgs-mass-square term

$$S_I[history] \approx \int m^2_{Hbare}|_I |\phi_H(x)|^2 \sqrt{g} d^4x \quad (13.1)$$

(the $\sqrt{g}$ is just 4-volume measure inserted to make the formula o.k. in the general relativity case, but really you may use flat space approximation and ignore it). The Higgs field were denoted $\phi_H(x)$ and depends of course on the event coordinate (set)$x = \{x^\mu\}$. The integral is, provided we use the "with future"-interpretation of the complex action theory, to be integrated over all space time including *both future and past*, and then it is this quantity (13.1) which at least in first approximation selects initial conditions or what really happens by letting the true happening $history$ have the minimal value for the imaginary part of the action $S_I[history]$ among all the say by equations of motion allowed possible histories. For a crude understanding of our complex action theory one may take it that it predicts roughly that

$$S_I[true\ history] \leqq S_I[\text{any other } history]. \quad (13.2)$$

(more detailed calculations of some predictions may be found in [9–11] and in some of the papers with Ninomiya [3]).

One way of putting forward the idea of the universe initial conditions being arranged in a way governed so as to achieve say small (or preferably numerically large negative) contributions to $S_I[history]$ is to call it a "God" (it is only a god in quotes(thanks to Mette Høst)) governing the world so as to seek to minimize the imaginary part of the action $S_I[history]$. In this language our expression (13.1) means that this "God" only cares for the integral over space time of the Higgs field; "He"to day mainly care for Higgs particles and modifications in the Higgs field. Oscillations in the Higgs field meaning physical Higgs particles will obviously make the square of the Higgs field integrated over all space time bigger. So producing Higgses should e.g. be hated and avoided by the "God. (Had the sign been so that it corresponded to "God" loving Higgs bosons instead "He" would have filled more up with Higgs bosons, say an expectation value of the Planck order of magnitude at least).

But if "He hates the Higgs "He" should love the particles suppressing in there neighborhood the Higgs field? And fill the whole Universe with the most favoured ones.

It is for instance the quarks and the charged leptons that are surrounded by a Yukawa potential region in which the Higgs field has an additional Higgs field - the Yukawa potential -, and so a more strong field the bigger the mass or the lepton causing this field. One may easily understand that the Higgs field having in vacuum its well known expectation value $< \phi_H(x) >= 246\ GeV$ is a bit diminished numerically in the Yukawa-potential-region around a quark or a (charged) lepton. Now in principle we do not know whether the square of the Higgs field $|\phi_H(x)|^2$ increases or decreases as one enforce a little region in space(-time) to have a given Higgs field diminished say w.r.t. the usual vacuum Higgs field. Intuitively one would think the square would decrease when the Higgs field itself decreases but there could - and indeed there are - be effects causing it to go oppositely(as have argued for below and in the articles[12]). In any case unless there is just an extremum of the square $< |\phi_H(x)|^2 >$ as a function of the Higgs field itself $< \phi_H(x) >$ in the usual vacuum situation there would be an effect positive or negative upon the imaginary action $S_I[history]$ as given by (13.1) from the Yukawa-potential regions around the quarks or (charged)leptons, because the normal Higgs fields a bit suppressed in such Yukawa field neighborhoods.

This means that e.g. the "God" would either love or hate these quarks and charged leptons, and that the more strongly the heavier they and the stronger they therefore couple to the Higgsfield.

This in turn means that e.g. a particle like the neutron with its three valence quarks and further quark pairs inside it will suppress the Higgs field from its usual vacuum value a bit and then depending on the sign of the derivative $\frac{d<|phi_H(x)|^2>}{d<\phi_H(x)>}$ increase or decrease the imaginary part of the action $S_I[history]$, thus the neutron would be respectively hated or loved by "God".

Now in nature one can by weak interactions get a neutron transformed into a proton, an electron and an electron-anti-neutrino. Thus if the "God" loved say the neutron itself more than the proton the electron and the electron-anti-neutrino together we would expect that "He" would have arranged initial conditions - and if "He" were allowed to it also that coupling constants or whatever could help - so as to make there be only neutrons but no protons and electrons etc. We know from astronomy and our own earth neighborhood that there exist both neutrons and protons and electrons (and even neutrinos) in rather large amounts, none of them being truly so much suppressed compared to the other.

At first we may look at this fact there there are both neutrons and protons in the world today as a falsification of the minimization of imaginary part of action ideas!

It becomes in our complex action theory an embarrassing question: Why not only n or only p+e+antineutrino ?

An idea to an attempt to disprove our complex action model with the Higgs field square integrated as the imaginary part of the action: Why do we not have either?:

- 1) Only neutrons n and no protons nor electrons, or
- 2) Only protons with their electrons e and antineutrinos, but no neutrons at all.

Either one or the other would probably be favoured and thus by "God be arranged to be realized!

13.6.3 Solution to: Why both protons and neutrons?

Actually this problem of why not only protons(with their electrons) or only neutrons in the world in our complex action model has the "solution":

If the neutron is exactly equally much "loved" as the the proton the electron and the electron-anti-neutrino together -in the sense of contributing the same to the imaginary part of action $S_I[history]$, *then there would be no reason for "God" to eradicate one of the two types of particles. But this requires a certain relation between the masses of the quarks corrected by their Lorentz contraction factors and the electron mass. But remarkably this* *relation is satisfied within calculational accuracy!* (light quark masses are rather badly known so the accuracy is not so high)

Basically[12] in order that there shall be no reason to either remove from the world the neutrons nor the combinations of protons and electrons (the neutrinos anyhow contribute much less to the imaginary part than the massive quarks or leptons) we should get just same imaginary part of action contribution from a neutron and from such a combination of proton and electron. In an short time the contribution is estimated as an integral over space of the Higgs field suppression. We here just assume by Taylor expansion in the presumably rather small Higgs field around the quarks and leptons, that any effect will in first approximation be linear in the change in the Higgs field. Now we find small Yukawa-potential regions of size given by the inverse Higgs mass and centered around quark or lepton. A crucial little problem making the estimation a bit less trivial and bit less accurate is, that these regions of significant Yukawa-potentials are *Lorentz contracted*, because of the non-zero velocity of say the quark it surrounds. (The electrons most copiously found in our universe have actually very small velocities compared to the light velocity, so for them Lorentz contraction is not important.)

The following the reader should have in mind in order to estimate the contribution to the imaginary part of the action $S_I[history]$ under the assumption of the dominant Higgs mass term for a neutron relative a pair of proton and an electron:

- a Of course - unless a linear term should be lacking - the contribution must go linearly with the Yukawa coupling for the quark or lepton in question. Really the suppression of the Higgs field around a particle - quark or lepton say - must go proportionally to the Higgs Yukawa coupling (for fixed velocity)
- b But it will vary with velocity due to the Lorentz contraction of the Higgs-Yukawa effective extension volume, around the particle.
- c So at the end the effect on the imaginary action $S_I[history]$ becomes proportional to

$$\Delta S_I[history] \propto g_{particle} * \frac{m}{E}|_{averaged} \propto \frac{m^2 < \gamma >< \gamma^{-1} >}{E_{average}} \qquad (13.3)$$

  where m is the mass of the quark say (or lepton) and E its actual kinetic energy including the Einstein energy. The average as the quark flies around in the nucleon say is denoted of its $\gamma = E/m$ is denoted $< \gamma >$, while the average of the inverse of this same γ is denoted$< \gamma^{-1} >$. The average kinetic including Einstein energy E is denoted $E_{average}$. The combination $< \gamma >< \gamma^{-1} >$ would in the case of no fluctuations of the actual velocity of the quark be just unity, and thus we may hope that we can estimate this product somewhat more accurately than say its two factors separately.

The various types of quarks have of course the deeper Higgs fields around them the stronger their Higgs Yukawa couplings $g_{particle}$. The Higgs field is effectively extended over a range of size given by the Higgs mass but not dependent on the species of quark or lepton in question. The extend of the Yukawa potential rather is over an elliptic region, that is the Lorentz contraction of the spherical Yukawa potential, which is obtained around a resting particle. So the contribution to the integral of the Higgs field or presumably also over its square over all space from a quark or lepton is proportional to $g_{particle}$ and to the inverse of E/m where E is the energy and m the mass of the quark or lepton. The Lorentz contraction factor is for Yukawa potentials for quarks due to motion inside nucleons, if we have - as is most copiously the case - resting nucleons. Well, really the speed of the nucleons inside the nuclei is not so negligible again but compared to the speed of quarks inside nucleons it is small.

Does it Pay for "God to make Only Neutrons or No neutrons ?

The bigger integrated Yukawa potentials around the quarks and leptons the more the Higgs field is suppressed. The strength of the suppressions is proportional to the Yukawa coupling for particle making the suppression. The extension is roughly like the Lorentz contracted of a sphere forming an ellipsoid given by the Higgs mass(as inverse radius of the sphere).

The proton is almost identical to the neutron except, that one up-quark has been replaced one down-quark.

To keep Universe chargeless a proton should be accompanied by an electron.

A neutrino typically runs so fast that its Yukawa potential is much less extended in volume than those of quarks and charged leptons.

13.6.4 Contributions to See Whether Neutrons or Non-neutrons Favored My Prediction from Future Influence

To estimate the contributions coming from a neutron to compared it to that coming from what is its decay products a proton and an electron and even a not so significant electron anti neutrino we need the light quark masses which are not so well determined (and that makes our uncertainty rather large), but let us take

$$m_u = 1.7\text{to}3.3 MeV \tag{13.4}$$

$$m_d = 4.1\text{to}5.8 MeV \tag{13.5}$$

for respectively the up and the down quark masses.

One arrives as also sketched here to the relation

$$\sqrt{m_d^2 - m_u^2} = \sqrt{E_q m_e}/\text{“}ln\text{''} \tag{13.6}$$

where we have denoted

$$\text{“}ln\text{''} =< \gamma >< \gamma^{-1} > \tag{13.7}$$

because this quantity for light quarks compared to the energy $E_{average}$ tends to be approximately a logarithm. The relation(13.6) is relatively well satisfied, if we take the quark masses (13.5), $E_q \approx 160\ MeV$ and "ln" $= 2.3_7$.(see my previous article for this crude estimate) In fact then we would get (using $m_e = 0.511\ MeV$)

$$R.H.S. = \sqrt{E_q m_e}/\text{“}ln\text{''} = 3.81\ MeV \tag{13.8}$$

$$L.H.S. = \sqrt{m_d^2 - m_u^2} = \sqrt{13._9}\text{to}\sqrt{22._75}\ MeV \tag{13.9}$$

$$= 3.7_3\text{to}4.7_7\ MeV. \tag{13.10}$$

13.7 Fine Tuning Calls for Influence Going Back in Time

One argument, which Don Bennett and myself would give for some influence from the future being called for, is this:

We know the fine tuning problem of why the cosmological constant/dark energy /energy density in the vacuum is so small compared to the *energy density* given by the most fundamental constants G, c, and $\hbar$, i.e. the Planck energy density? The ratio of the actual vacuum energy density to the from the dimensional arguments expected value is enormously small. So it is clear that there must have been some enormous fine tuning arranging this enormously small energy density in the vacuum. Now we expect that the vacuum energy density should be constant as time has gone on. So even in a time of say minutes after the start of the universe or Big bang or whatever the vacuum energy should have had the present extremely small value. But now at these early times there were so big energy densities of radiation or matter that the present small vacuum energy density would be very small and insignificant compared to radiation energy density. But when it were at that time so insignificant, how could *at that time* any physical effect have made a so precisely close to zero as the vacuum energy density to day? So it seems that an influence from the future somehow must have arranged at this early stage already the exceedingly small energy density in vacuum? It is of course because of an argument in the direction of this that is the reason for that, when Weinberg looks through the various explanations for the cosmological constant being so small, then the most promising explanation is to use anthropic principle. The entropic principle, which states that parameters shall be so arranged that humans can come to exist, is namely in reality a method to to arrange a simulated effect of the future influencing the past. By throwing away the scenarios which happen not to allow for humans one has got what functions as a back in time effect.

13.8 Our Multiple Point Principle

There is one very general deduction from such a theory with a principle of minimizing some quantity as we above told that the imaginary part $S_I[history]$ would be minimized for the actually realized history. This deduction would be best achieved if we instead of minimizing over histories of the universe minimized over combinations/sets of coupling constants, but since one could imagine some vacuum being selected among several at least the effective coupling constants relevant for the by a quantity like $S_I[history]$ selected vacuum would effectively have been determined as if they were adjusted to minimize something (S_I) by adjusting the coupling constant combination. The deduction related to is found an article by Ninomiya and myself [18] in the Bled proceedings from 2011. The point is, however, to imagine that the right combination of coupling constants is achieved by asking to obtain the minimum for some quantity - in fact our S_I, which we now imagine to depend also on the coupling constants (with an effective vacuum providing such couplings this imagination would be true in our model) - under the restriction that the energy density of the various (local) ground states the vacua should be positive. This assumption of vacuum energy density being positive may be understandable in our model - as well as phenomenologically supported as a principle - by noting, that if a vacuum gets (appreciably) less energy density than zero, then the usual vacuum becomes unstable against making a transition to this low energy density vacuum. From the point of view of the history being selected such an instability would mean that it would be this vacuum rather than the usual one that got realized and the potential history meant as a history in the "usual" vacuum would no longer be realized; so if this latter history gave a smallest S_I that would be a lost achievement if another vacuum tales over. So one should avoid competing vacuum threatening the stability severely for the realized one, or one should presumably preferably think that there are several vacua getting their realization in a turn adjusted to be the most beneficial for the S_I being as negative as possible. Also in such a scenario of several vacua coming to exist as time passes on, the transition from to the next should not be too quick, they are to exist for of the order of 13 milliard years. Thus they should be approximately stable and we would obtain an approximate multiple point principle in such a scenario. In any case we already earlier argued that once you have the minimization of something like our S_I that just can manage some way to effectively depend on the coupling constants, then the couplings get very likely adjusted to lead to several degenerate vacua, meaning multiple point principle.

Having in mind that this multiple point principle is thus to be considered a deduction from a minimization of some quantity model including future in such a way that it really means influence from the future, we can now look at successes of our multiple point point principle (MPP) as also being evidence for there existing in the laws of nature some influence from the future.

Now I remind the reader that the most impressive confirmation of our multiple point principle were that we - Colin D. Froggatt and myself - PREdicted the Higgs mass[19] many years before the Higgs boson were found to 135 GeV $\pm$ 10 GeV ! With the present calculations and top-mass measured our prediction would rather have been 129.4 GeV with an uncertainty now rather down to about $\pm$ 1 GeV. So although our prediction is now only 3.4 GeV above the experimental Higgs mass 126 GeV, the deviation compared to the uncertainty may have gone slightly up compared to the old day PREdiction, but we should still consider it a great success for the multiple point principle that the Higgs mass is so close to our prediction!

Historically we - Don Bennett and myself and also in some papers with Colin D. Froggatt - we looked for some way of justifying to fit fine structure constants by phase transition couplings in lattice Yang Mills theories. We worked at that time with what we call Anti-GUT (meaning anti-grand-unification) meaning that we rather than as were most popular to look for simple groups like SU(5) or SO(10) etc. we did not unify in the sense that we used the not at all simple group $S(U(2) \times U(3)) \times \cdots \times S(U(2) \times U(3))$ (with N_{gen} cross product factors), rather meaning that we gave every family of fermions in the Standard Model its own family of also gauge bosons, so that our "anti grand unifying group" were the cross product of one Standard Model gauge group, one for each family (the number N_{gen} of families not yet known at that time; we had to fit it to the fine structure constants and PREdict it; luckily we PREdicted $N_{gen} = 3$). But the problem for which we needed the multiple point principle were to give an explanation or at least formulate a principle that could imply that the *phase transition* finestructure constant values were the ones for which Nature should care. But if we somehow had derived that Nature should have a couple (or more) energy density wise degenerate vacua/phases of course if nature really were a lattice Yang Mills theory, then it would mean that Nature should choose the phase transition value of the coupling constant/the finestructure constant.

Once we have suggested to believe in such a multiple point principle in the form of there being many/several energy-wise degenerate vacua, you just have to find one with an appropriate small cosmological constant and you can so to speak transfer that small energy density to other vacua, thus explaining the smallness and even fit *the* cosmological constant (or the dark energy). Roman Nevzorov, Froggatt and me did such an application in several versions, explaining the cosmological constant[20].

We even managed to make a solution of the scale problem (related to the hierarchy problem) in the sense of using the postulation of the multiple point principle to fix the scale of the weak interactions (compared to the Planck scale, taken as the fundamental scale). This we -Colin D. Froggatt, Larisa Laperashvili and myself - did by speculating up the existence of a further vacuum in which there is a Boson condensate of bound states of 6 top and 6 anti-top quarks. In the spirit of the multiple point principle postulating a further vacuum is somewhat natural, and at least each time we postulate a new vacuum, we get the information out of multiple point principle that this vacuum shall have the same energy density as the other vacua. Thus for each new vacuum we postulate - and take to be degenerate with the other ones - we get one more of the say Standard Model (if that is what we use) determined, because one more relation among them is obtained. Luckily it turns out that we essentially may use this new information to fix the weak energy scale and most importantly:

We get the weak scale out as restriction on between which values of the running top-Yukawa coupling $g_t(\mu)$ shall be taken on at 1) the high field scale of the second Higgs field effective potential minimum (assumed by us to be essentially the Planck scale) and 2) the weak scale.

Since then the running top Yukawa coupling must "run" between the two predicted values $g_t(\mu = 18^{18}\text{GeV})$ and $g_t(\mu = \text{"weak scale"}) = 1.02$, the ratio of the weak to the supposed more fundamental scale gets predicted to be "exponentially" small! Really the point is that with the rather weak couplings of the Standard Model the 'running" is actually a bit slow as a function of the logarithm of μ. Thus to get a given distance of change in the Yukawa coupling an exponentially big ratio of scales is needed. Actually our prediction of the logarithm of the scale ratio, the scale problem gets very well!

So our multiple point principle is here a great success: both explaining the exponential smallness and giving a good value for its logarithm.

13.9 Do we have Enough Evidence for Influence from Future?

I would like towards the end very optimistically for the hypothesis of there being indeed an influence form the future to give - the relatively optimistic, but still crudely true - numbers for how unlikely it would be that our small coincidences favouring the complex action model with the assumption that the Higgs field square dominates without such a model being true.

Say we look at the coincidence that the "knee" in cosmic radiation spectrum just order of magnitude wise happens to coincide with the threshold for Higgs production. If we say one has studied cosmic rays from some electron volts up to say 10^{20} electron volts, we could say over 19 orders of magnitude. Then if one finds a knee to coincide within one or two orders of magnitude, it represents a coincidence that should happen by accident only in about 1/10 cases. Similarly looking at the agreement of our formula (13.6) as being that we get inside the right interval of length one MeV for quantities - sides of the equation - being of order of 4 MeV, this is something that should only happen in one out of four cases.

Our argument that the Higgs-field vacuum expectation value should just have gotten that value, that minimizes the *squared* Higgs field expectation value - we get agreement up to some factor of one or two orders of magnitude - means that our minimization principle led to the right order of magnitude for the weak/Higgs field scale to say a couple of orders of magnitude out of 17 orders of magnitude (taking the Planck scale as the fundamental one). this means again that our influence from future got the right scale among say $17/2 \approx 10$.

We may even count here the smallness of the binding energy in nuclei compared to the separately bigger kinetic and potential energy of the nucleons, say one out of 2 cases accident.

These "numerical" coincidences together would give us a one out of 800 coincidence, which is a factor 4 more than 3 standard deviations. Taking this optimistic estimate seriously we really have more than 3 standard deviation evidence for the influence from future seeking to minimize the Higgs field square (integrated over space time), so as to use it to tune some couplings or the like.

Further to support this complex action with Higgs mass (square) term dominating model for the development of the world being supported we should collect also the evidence coming from the very bad lick of the S.S.C. machine, that would if it had worked according to plans have produced more Higgs bosons than L.H.C. has so far, and the - for our model though too little - bad luck of an explosion in the tunnel, which though were repaired and mainly so far had the effect of making the physicists choose to postpone the running of the L.H.C. with its planned beam energy of 7 TeV against 7 TeV (meaning $\sqrt{s} = 14$ TeV) till 2015. Although it now looks that finally it will come to run, we may though consider it, that this caused postponing of the full energy could be a result of our complex action model with Higgs mass term dominance. Together we might consider these after all not so terribly miraculous bad lucks for Higgs producing machines as something that would not be at least the very first expectation without theory predicting it like ours. So we might say e.g. that in at most one out of say 5 cases would so much bad luck hit the Higgs producing machines.

If we combine this estimate with the just counted, we would say that now the Higgs mass square term dominated complex action model has scored a success corresponding to one out of 800 *5 = 4000 cases!

If we add to this counting the evidence coming from say the Higgs mass being PREdicted from our multiple point principle, which also would follow from an influence from the future type theory, and take it that the range for Higgs mass were at first up to 600 GeV or just use the actually Higgs mass to set the scale for Higgs masses the deviation $129.4 - 126$ GeV = 3.4 GeV (relative to respectively 600GeV or 126 GeV) means a luck for our multiple point principle as one out of ≈ 200 or one out of ≈ 36 respectively.

If we already have counted the luck of our theory of getting the right weak scale it might no longer be new prediction to use the multiple point principle to predict the top -Yukawa coupling to be $1.02 \pm 14\%$ (oterwise this result should give a one out of 7 good luck for our model).

Also it would probably be too much to seek to include as a result of our influence the very remarkable smallness of the cosmological constant because this influence from future type theory in itself does not predict this smallness, although firstly it is very hard to see how such a small cosmological constant could come without an influence from the future and secondly we have works with Roman Nevzorov et al. [20] in which we actually even fit the cosmological well using the multiple point principle(which indeed is consequence of an influence from the future much like the one we discuss here. If we include this cosmological constant as were it prediction it would increase much our measure of the success since even counted only as a success on the logarithmic we could a priori have expect a "Planck energy density value" about 100 orders of magnitude larger. Counting with natural logarithm say we should then say we succeeded as one ot of 100*2.3 = 230.

But even as presumably most fair leaving out the cosmological constant proper as being a success for our model(s), but only taking in the Higgs mass PREdiction from multiple point principle (after replacing the one prediction of MPP by the Higgs or weak scale gotten by adjusting this scale to minimize the squared Higgs field integrated over space and time) we get that good luck for our model is of the order of getting one out of $4000 * 7 \approx 30000$ cases/possibilities correct!

This of course were optimistically counted, but it sounds that one should take possibility of there being effects from the future. especially we did not even in this number include anything from the arguments related to the need for ultraviolet cut off, which especially for gravity may be very hard without a bit of non-locality, thereby allowing the influence from the future sneak in in principle.

13.10 Conclusion and Outlook

We have in the present article looked at a series of arguments for that there should be in the laws of nature some law that makes e.g. the initial conditions or the coupling constants or both be adjusted as if it were with a special purpose (such as as here suggested to make a certain quantity depending on the history "the imaginary part of the action be minimal).

The main classes of arguments, which I suggested are:

- Numerical or observational successes of assumptions involving such an influence from the future. This includes:
  - The bad luck of SSC, and if we take it seriously the very minute bad luck of the LHC, both machines (potentially) producing relative to human history exceptionally many Higgs bosons.
  - Our relation relating the light quark mass square difference to the electron mass square and the fraction of energy carried by the quarks in the nucleons. This relation just organizes that the contribution from a neutron and from an electron and a proton (and an electron anti neutrino) together to this imaginary action is same. Thus when this relation - which seems to be fulfilled within errors in nature - happens to be fulfilled there would be no gain in minimizing the imaginary part of the action by neither arranging for more neutrons than for more of its decay products electron + proton (+ anti electron neutrino). The world would potentially be able to exist at a minimum for the imaginary part of the action.
  - analogously I argued that including the effects of virtual top quarks in the vacuum it could within errors be so that the Higgs field *square* is in fact at a minimum with just the present Higgs expectation value in the vacuum. So indeed the parameters of the Standard Model could have been arranged just so as to minimize the Higgs field square, and that could have led just to the from hierarchy problem consideration rather difficult to accept compared to the Planck scale or Grand Unification scale point of view exceptionally small value Higgs field expectation value.
  - Even the "knee" in the cosmic ray spectrum is so close to the threshold for the severe production of Higgs bosons that we can claim that it is as if it had been arranged to be just like that to make the production of Higgs bosons by the cosmic rays hiding material or planets etc. in the galaxies so small as possible under some restrictions.
    The "God" did not quite switch off the cosmic rays above the effective Higgs production threshold, but the "knee" looks like a weak attempt to do so.
- We called attention to that cut off methods which are needed to make especially renormalizable gravity theories are very hard if at all possible to conceive of without some non-locality. And then since non-locality really means that influence from future is getting allowed for small distances, also such cut off needs in fact calls strongly for that influence from future cannot be totally avoided. We looked especially as an example on string theory in the recent formulation of Ninomiya and myself. In this model the for the cut off effectivity crucial feature - the "stringiness" one could say - is put in as an initial state - and even as a *final state* - condition! If instead of or in addition to inclusion of gravity you also want to have more than the experimental number of dimensions 3+1, the need for such cut offs that in turn leads to non-locality and thereby formally admits influence from future gets even stronger.

- We also mentioned the old worries about that the usually assumed laws of nature for the initial conditions and those for the equations of motion do not have the same CPT ot say just time reversal invariance: The initial conditions usually assumed are only for the *initial state*, but not for the final state also as a time reversal invariant theory would have to have it. So again some influence from future is called for in order to make the symmetry be a least formally uphold.
- Although I did not go so deeply into it in the present article, it is of course also one of the arguments for influence future coming into the physical theory that one in general relativity has wormholes and baby universes. very easily leading to time machines. Such time machines namely leads to inconsistencies unless the happenings are finetuned to just make things go in a with the time machine consistent manner. This has been discussed by Novikov.

We will at the end stress that with the lists of arguments in the present article one should at least admit that the absolutely safe belief that there is no influence from the future deserves being investigated and confronted with as much knowledge as we can collect concerning this question. If one truly will uphold this absolutely safe belief that nothing from the future can influence us in any way, there is really no government of the universe - at least no government with any interest in the future fundamentally - then one would have to throw away as bad science/misunderstandings or pure (poetic) invention all stories about the government of God or destinies or the like which may be found in mythology in the holy texts or the like.

At least I hope to have put a little doubt on the validity of this by now in first approximation well working law of nature that future cannot influence anything in past or now and that there is no government of the universe whatsoever.

Instead one could look at it that the strong belief in this no influence from future nor government arranging for the future will turn out to be only something humanity believed in a relatively short historical era from Darwin Wallace Lamark to some day may be next year when a truly bad luck for LHC e.g. would convince humanity that there exists a "God" (here in quotation marks) that hate the Higgs sufficiently to stop a Higgs producing machine before it gets produced too many Higgses!

Acknowledgements

One of us (HBN) thanks the Niels Bohr Institute for allowing him to stay as emeritus, and Matjaž Breskvar for economic support to visit the Bled Conference.

References

1. D. L. Bennett, C. D. Froggatt and H. B. Nielsen, "Nonlocality as an explanation for fine tuning in nature," (CITATION = C94-08-30);
2. D. L. Bennett, "Who is Afraid of the Past" (A resume of discussions with H.B. Nielsen during the summer 1995 on Multiple Point Criticallity and the avoidance of Paradoxes

in the Presence of Non-Locality in Physical Theories), talk given by D. L. Bennett at the meeting of the Cross-displiary Initiative at Niels Bohr Institute on September 8, 1995. QLRC-95-2. D. L. Bennett, "Multiple point criticality, nonlocality and fine tuning in fundamental physics: Predictions for gauge coupling constants gives alpha**(-1) = 136.8 +- 9," arXiv:hep-ph/9607341. (CITATION = HEP-PH/9607341;) H. B. Nielsen and C. Froggatt, "Influence from the future," arXiv:hep-ph/9607375. (CITATION = HEP-PH/9607375;)
D. L. Bennett, C. D. Froggatt and H. B. Nielsen, "Nonlocality as an explanation for fine tuning and field replication in nature," arXiv:hep-ph/9504294. (CITATION = HEP-PH/9504294;)

3. "Test of Influence from Future in Large Hadron Collider: A Proposal," arXiv:0802.2991 [physics.gen-ph]. H. B. Nielsen and M. Ninomiya, "Complex Action, Prearrangement for Future and Higgs Broadening," arXiv:0711.3080 [hep-ph].
H. B. Nielsen and M. Ninomiya, "Search for Future Influence from L.H.C," Int. J. Mod. Phys. A **23** (2008) 919 [arXiv:0707.1919 [hep-ph]].
H. B. Nielsen and M. Ninomiya, "Future dependent initial conditions from imaginary part in lagrangian," arXiv:hep-ph/0612032.
H. B. Nielsen and M. Ninomiya, Int. J. Mod. Phys. A **21** (2006) 5151 [arXiv:hep-th/0601021].
H. B. Nielsen and M. Ninomiya, "Unification of Cosmology and Second Law of Thermodynamics: Solving Cosmological Constant Problem, and Inflation," Prog. Theor. Phys. **116** (2007) 851 [arXiv:hep-th/0509205].
4. H. B. Nielsen and M. Ninomiya, "Degenerate vacua from unification of second law of thermodynamics with other laws," arXiv:hep-th/0701018.
5. D L Bennett et al 1987 Phys. Scr. (1987) 158;
www.nbi.dk/ kleppe/random/qa/qa.html;
6. K. Nagao and H. B. Nielsen, to appear (2012 or 2013).
Keiichi Nagao (Ibaraki U., Mito), Holger Bech Nielsen (Bohr Inst.) Theory Including Future Not Excluded – Formulation of Complex Action Theory II. May 2012. 30 pp. IU-TH-9 e-Print: arXiv:1205.3706 [quant-ph] — PDF
7. K. Nagao and H. B. Nielsen, Prog. Theor. Phys. 126 No. 6, 1021 (2011); Prog. Theor. Phys. 127 No. 6, 1131 (2012) [errata].
8. K. Nagao and H. B. Nielsen, Int. J. Mod. Phys. A.27, 1250076 (2012).
9. K. Nagao and H. B. Nielsen, Prog. Theor. Exp. Phys. (2013) 023B04.
10. K. Nagao and H. B. Nielsen, Proc. Bled 2012: What Comes Beyond the Standard Models, pp86-93 (2012), arXiv:1211.7269 [quant-ph].
11. K. Nagao and H. B. Nielsen, Prog. Theor. Exp. Phys. (2013) 073A03.
12. H. B. Nielsen, "Remarkable Relation from Minimal Imaginary Action Model," arXiv:1006.2455 [physics.gen-ph].
H. B. Nielsen, "Complex Action Support from Coincidences of Couplings," Int. J. Mod. Phys. E **20** (2011) 2049 [arXiv:1103.3812 [hep-ph]].
13. H. B. Nielsen and M. Ninomiya, *An Idea of New String Field Theory – Liberating Right and Left movers –*, in Proceedings of the 14th Workshop, "What Comes Beyond the Standard Models" Bled, July 11-21, 2011, eds. N. M. Borstnik, H. B. Nielsen and D. Lukman; arXiv: 1112. 542[hep-th].
14. H. B. Nielsen and M. Ninomiya, *A New Type of String Field Theory*, in Proceedings of the 10th Tohwa International Symposium in String Theory", July 3-7, 2001, Fukuoka Japan, AIP conference Proc vol.607, p.185-201; arXiv: hep-th/0111240.v1, Nov.2001
15. H.B. Nielsen and M. Ninomiya, "A Novel String Field Theory Solving String Theory by Liberating Left and Right Movers" JHEP_202P_05131 v2 (2013)

16. Wheeler, J. A.; Feynman, R. P. (1945). ”Interaction with the Absorber as the Mechanism of Radiation”. Reviews of Modern Physics 17 (2 3): 157 161. Bibcode:1945RvMP...17..157W. doi:10.1103/RevModPhys.17.157. Wheeler, J. A.; Feynman, R. P. (1949). ”Classical Electrodynamics in Terms of Direct Interparticle Action”. Reviews of Modern Physics 21 (3): 425 433. Bibcode:1949RvMP...21..425W. doi:10.1103/RevModPhys.21.425.
    J. A. Wheeler and R. P. Feynman, ”Interaction with the Absorber as the Mechanism of Radiation” Caltech Library of Authors
17. The Transactional Interpretation of Quantum Mechanics by John Cramer: Reviews of Modern Physics 58, 647-688, July (1986),
    John G. Cramer, “Quantum Entanglement, Nonlocality, Back-in-Time Messages, (April 3, 2010).
18. H. B. Nielsen and M. Ninomiya, *Degenerate Vacua From Unification of Second Law of Thermodynamics With Other Laws*, in Proceedings of the 14th Workshop, “What Comes Beyond the Standard Models” Bled, July 11-21, 2011, eds. N. M. Borstnik, H. B. Nielsen and D. Lukman.
19. C. D. Froggatt and H.B. Nielsen, Phys.Lett. **B368** (1996) 96-102.
20. C. Froggatt, L. Laperashvili, R. Nevzorov, H.B. Nielsen, *Noscale Supergravity and the Multiple Point Principle*, in Proceedings of the 7th Workshop, “What Comes Beyond the Standard Models” Bled, July 19-31, 2004, eds. N. M. Borstnik, H. B. Nielsen, C. D. Froggatt and D. Lukman; C. Froggatt, L. Laperashvili, R. Nevzorov, H.B. Nielsen, M. Sher, *The Two-Higgs Doublet Model and the Multiple Point Principle*, in Proceedings of the 7th Workshop, “What Comes Beyond the Standard Models” Bled, July 19-31, 2004, eds. N. M. Borstnik, H. B. Nielsen, C. D. Froggatt and D. Lukman.