Does Future Influence Us Back ?

Talk in Bled 2014 by

Holger Bech Nielsen

Does the Future Influence Us?

- In several works I and my collaborators have attempted with models/theories in which the future acts back and influences the past.
- 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, some of which may not immediately seem to be relevant, such as my work with Masao Ninomiya on A Novel String Field Theory.
- 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.

Plan of talk about Influence from future?

- 1)Introduction: Symmetries as Time reversal and CPT suggests that even initial state ought to be time reversal symmetric, but of course we do not believe that.
- 2)Why should we NOT unite initial state information with equations of motion?
- 3)The finiteness of String Theory may hide – in mine and Ninomiyas Novel String Field Theory - an influence from the future and that might be the reason for it being stringtheory..
- 4)Bennett's and mine argument that at the time the Cosmological Constant must already have hat its value densities so low as the present were unknown/did not occur.

Plan for Influence from Future Continued:

- 5)The Multiple Point Principle being successful means influence from future.
- 6)Some fine-tunings as if ``God’’ hated the Higgs squared field
- 7)If we count optimistically do we have sufficient evidence for a planned universe development?

Listing of Arguments

- Funny that many religious people imagine, that there is a Governor of the world, if the principle preventing such government were truly valid.
- Strange that the laws about the initial conditions and equations of motion behave differently under the CPT-like symmetry (or under time-reversal)
- Cosmological constant were very small compared energy density in the beginning, how could it then be selected so small, no significance then.(with Bennett).
- Several evidences for antropic principle, but mostly physicists do not like it.

Listing of Arguments for Influence from Future (continued)

- Multiple Point Principle (almost) successful: Higgs mass, top Yukawa coupling, and Weak scale relative to Planck scale.
- Our Complex Action model with Higgs field square taken to dominate gives:
  1) n and p+e+antineutrino suppress Higgs field equally much (within errors).
  2) The ``knee'' cut cosmic ray spectrum down close to effective Higgs threshold.
  3) Nuclear matter has low binding ener
  4) Higgs field in vacuum at lowest Higgs square.
  5) Smallness of weak scale/Higgs field in

Listing of Arguments for Influence from Future

- 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 future influence?
- General Relativity allows closed time-like loops...
- Horowich and Maldacenas influence backward inside the black hole.
- The bad luck of SSC and the too litlle bad luck of LHC would follow from Higgs machines getting bad luck.
- With large extra dimensions there appear in principle a frame dependence of which moments are earlier than which, the frame i the extra dimension directions.

Listing of Arguments for Influence from Future yet continued

- Wheeler space time foam and baby universes imply almost unavoidably at least small influences from near future.
- Baby universes make effective coupling constant depending on very far away influences in e.g. Time.
- 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!

Listing very theoretical speculation arguments for influence from future

- 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.
- Was the many e-foldings in inflatonal organized in order to get a big universe (a miracle) ?

Introduction, Arguments from Symmetry as Time reversal

- The usual picture: The laws concerning the timedevelopment – the equations of motion – are perfectly invariant under the CPT-symmetry. Nevertheless the initial conditions determining the actually solution to these equations of motion is chosen in a way that looks 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 one can say almost nothing in simple way; but 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.
- 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)

- Since Newton we have distiguished between initial state information and the laws for the timedevelopment.
- 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 litterature.
- 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!

Possibilities for Initial State Versus Equations of Motion Symmetries

- 1 Possibility) CPT symmetry could be the more fundamental and the assymmetry 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 spontaneus 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.

Possibilities Continued

- 2. possibility) The time direction assymetry might be the more fundamental and the CPT symmetry just some effective result comming out of an a priori time and even CPT noninvariant theory. So the initial state CPT noninvariance were the more fundamental and the CPT for laws of nature some sort of effective or ``accidental'' symmetry. It is wellknown that CPT largely follows from Lorentz invariance, so that if were right as I have claimed for years that Lorentz invariance could be low energy approximation (only for the ``poor physicists''), then also CPT would be an effective ``only for poor physicists'' law.

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

- Presumably the best argument for believing, that String Theory should be the theory of everything, 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 wonderfull cut off of loops behavior is remarkable good!

Transverse Momentum Cut Off in the Optic of Mine and Ninomiyas SFT

- As an orientation let us look at the tarnsverse 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,\Pi), i.e. 24 momenta J and their conjugates, and the total momentum of the open string is proportional to the sum of the even ``objects'' because the momentum contribution from theodd ones become due t their construction as difference of conjugate momenta of the two even neighbors.
- The scattering is in our SFT-model 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.

Limiting Transverse Momenta in the Optic of Our Novel SFT

- 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, except for the momentum assigned the total strings.
- So if we only split the chains of objects into 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. It is this restriction that means that we get in Veneziano model the exponential of the squared momentum falling off amplitudes.

Transverse Momentum Limitation in our Novel SFT (continued)

- The limitation – actually exponentially with the square of the momentum in the exponent, i.e. Gaussianly – of 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 effectively – (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 assumed.

The Limitation of Momenta and Loop Cut Off Effectively in Ninomiyas and Mine SFT(continued)

- For each limited loop order corresponding in our novel SFT to splitting the ``cyclically ordered chains'' of ``objects'' 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).
- Roughly this relevant correlation corresponds to the stringness in the sense that it is also this correlation 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 scale – so needed to make a chance of having a cut off effectively – is in our model only put in as an initial state ``continuity'' condition.

String Theory Cut Off from Where

- 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) – momentum into the scattering.
- Via Heisenberg uncertainty this is turned into extension of the strings due to quantum fluctuations.
- But it is crucial 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.

Effective Cut Off in String Theory (continued)

- 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.

Even More Thoughts on String Convergence Achievemnts

- 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.

Where Led When Looking for 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 may modify 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.

Keeping Flat Space Time Seeking Cut Off

- Where are we led, if we seek a cut off of the untraviolet 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.
- 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 are what cause the divergencies)

Seeking Cut Off in Direction of Bound States

- Let us now think along the line, that we replace the particle 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.
- We may talk the language of Bjorken x being the fraction of longitudinal momentum carried by a ``parton''.

Looking for Cut Off the Bound State Way

- 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 exist and we are back to the point particle play: there will finally result divergencies again.
- So we are looking for avoiding divergencies 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.

The Bound State Way for Cut Off

- 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 of large numbers(infinitely many) partons.
- This means we are driven towards a picture, in which a scattering is mainly an exchange of some part one composite particle with part of another,
- But none of the constituents (=partons) truly interact.
- Rather the constituents individually just continue undisturbed as if not interacting at all!

Bound State Way Towards Cut Off

- 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 consituents or partons, we are driven towards, are of course to be identified with the ``objects'' in Ninomiyas and mine novel SFT; precisely these ``objects'' of our theory do not change at all.

``Even Objects'' as Partons

The "even objects" in Ninomias and mine novel SFT are each characterized by a pair of really only 24 vectors (but extended by some rules to 26 vectors)

$$(J^i, \Pi^i) \text{ where } i = 1, 2, ..., 24. \qquad (1)$$

Here the J^i simply contributes to the total momenta of the open string in the sense that

$$P^i_{string} = \sum_{objects} \frac{J^i}{2\pi\alpha'}, \qquad (2)$$

and we can let the average position of the open string be proportional to the average over the to the J^i's conjugate momenta Π^i.

So it is practically as if the "even objects" were partons from which the string were composed. In the interpretation, we make in the string theory it is not exactly so, in as far as the momentum on a little bit of the string gets contribution from TWO "objects" -

Does it Matter Whether we Consider our ``Objects'' as Constituents or the True String Interpretation

In mine and Ninomias SFT our "objects" are not simply constituents - although it looks that we could essentially look at them as so -. Rather these "objects" are connected with the left and right mover parts of the position field on the string:

$$X^{\mu}(\sigma, \tau) = X^{\mu}_{R}(\tau - \sigma) + X^{\mu}_{L}(\tau + \sigma). \quad (3)$$

Here the string time track is parametrized with a parameter σ along the string,and essetially a time τ. Such a parametrization of the string time track can be made in infitely many ways. A class of parametrizations is selected by "conformal gauge choice". With such a special choice you can solve for the position field $X^{\mu}(\sigma, \tau)$ by the above equation in terms of "right mover"X^{μ}_{R} and "left mover" X^{μ}_{L}, each depending on only ONE variable.

Definition of the ``Objects'' J from Discretizing Right and Left

In Mine and Ninomiyas SFT we rather define our "objects" J^μ in terms of the "right" $X_R(\tau-\sigma)$ and "left mover" components $X_L^\mu(\tau+\sigma)$ of the position field $X^\mu(\sigma,\tau) = X_R^\mu(\tau-\sigma) + X_L(\tau+\sigma)$ in the conformal gauge. In fact we put for the J's corresponding to a small (discretizing) intervals $[\tau_R(I-1/2), \tau_R(I+1/2)]$ and $[\tau_L(I-1/2), \tau_L(I+1/2)]$ for the Ith discretized pieces

$$J_R^\mu(I) = X_R^\mu(\tau_R(I+1/2)) - X_R(\tau_R(I-1/2)) \quad (4)$$
$$J_L^\mu(I) = X_L^\mu(\tau_L(I+1/2)) - X_L(\tau_L(I-1/2)). \quad (5)$$

Here $\tau_R = \tau - \sigma$ and $\tau_L = \tau + \sigma$ and e.g. $\tau_R(I-1/2)$ is the lower end of the discretization interval $[\tau_R(I-1/2), \tau_R(I+1/2)]$ corresponding to the "object" number I.

On the Definition of the ``Objects''

- Since the ``objects'' are defined as the difference between the values of say the right mover component 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 tey are different.

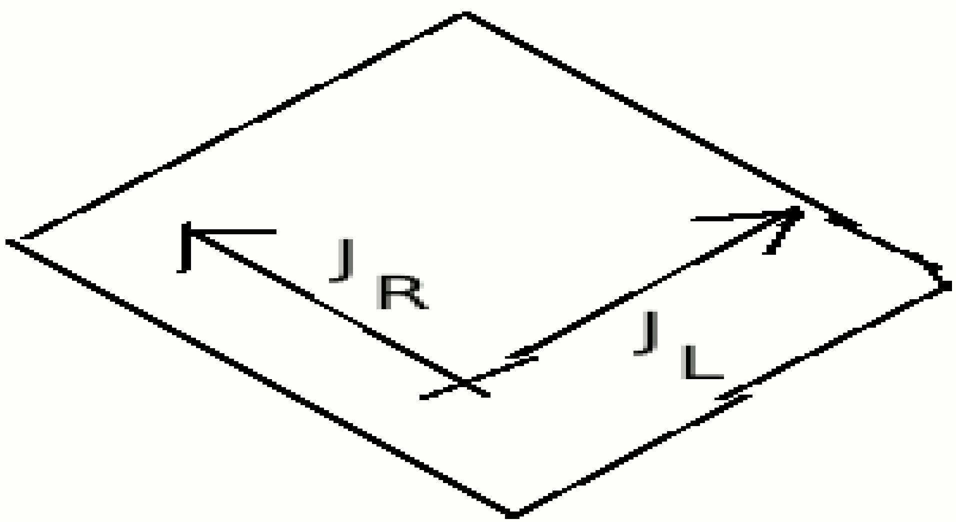
A Few More Details on Our SFT

- After we have identified the right and 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 oreder 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 distribution of momenta to the ``objects'' we can consider the ``objects'' constituents.

Can We Forget the String and Only Think on Our ``Objects'' ?

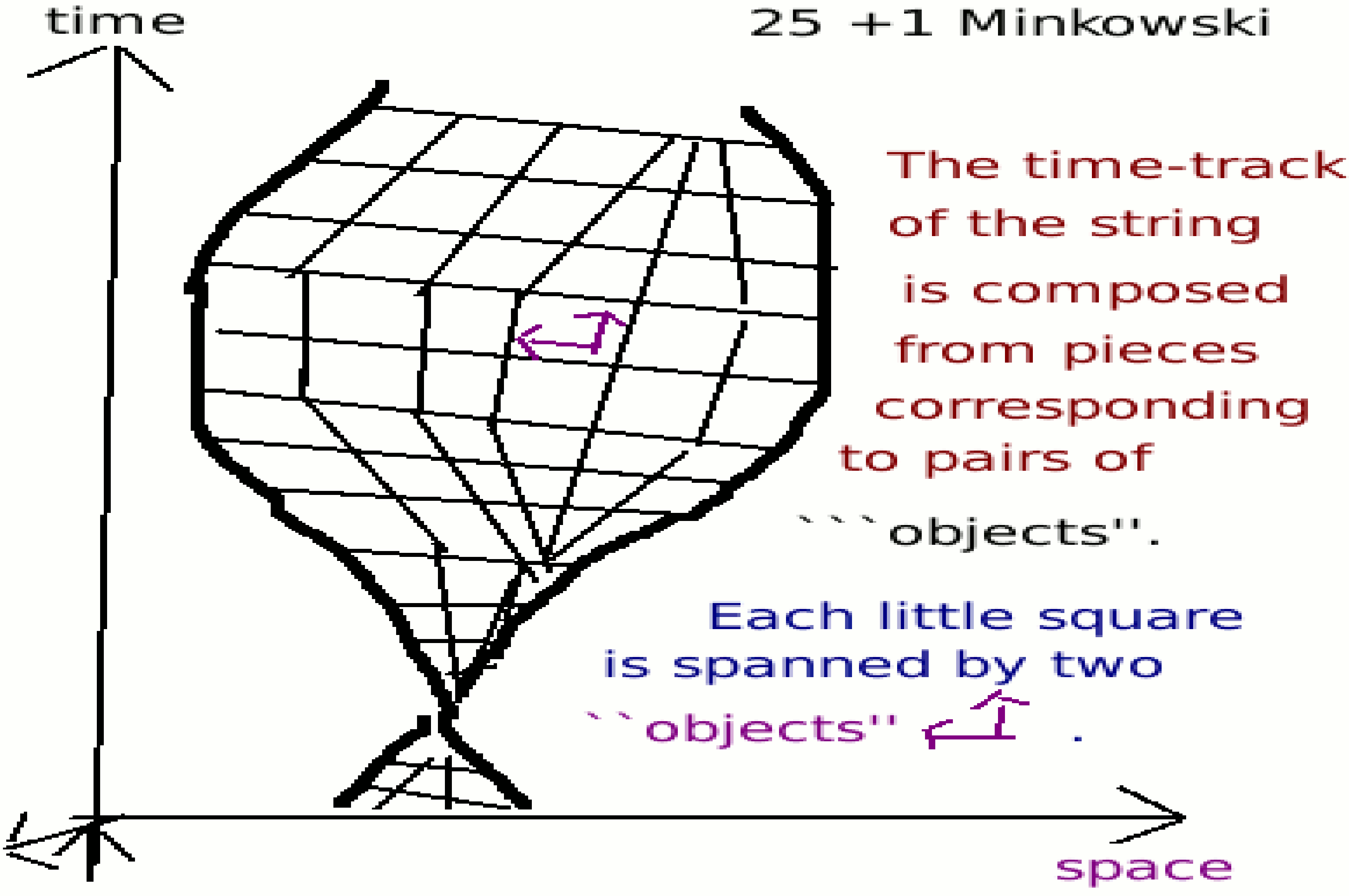
- If you go over to considering the ``objects'' of ours as constituents of the composite particle(described as the string), you ignore the string as not the right way of thinking o the same theory.
- Contrary to the string point of view, in which the string moves internally as it moves along, the ``objects'' are stale and just do not change.
- The ``objects'' fit with the constituents not interacting but just being exchanged en block from bound state to bound state.

Connection of String to ``Object''s

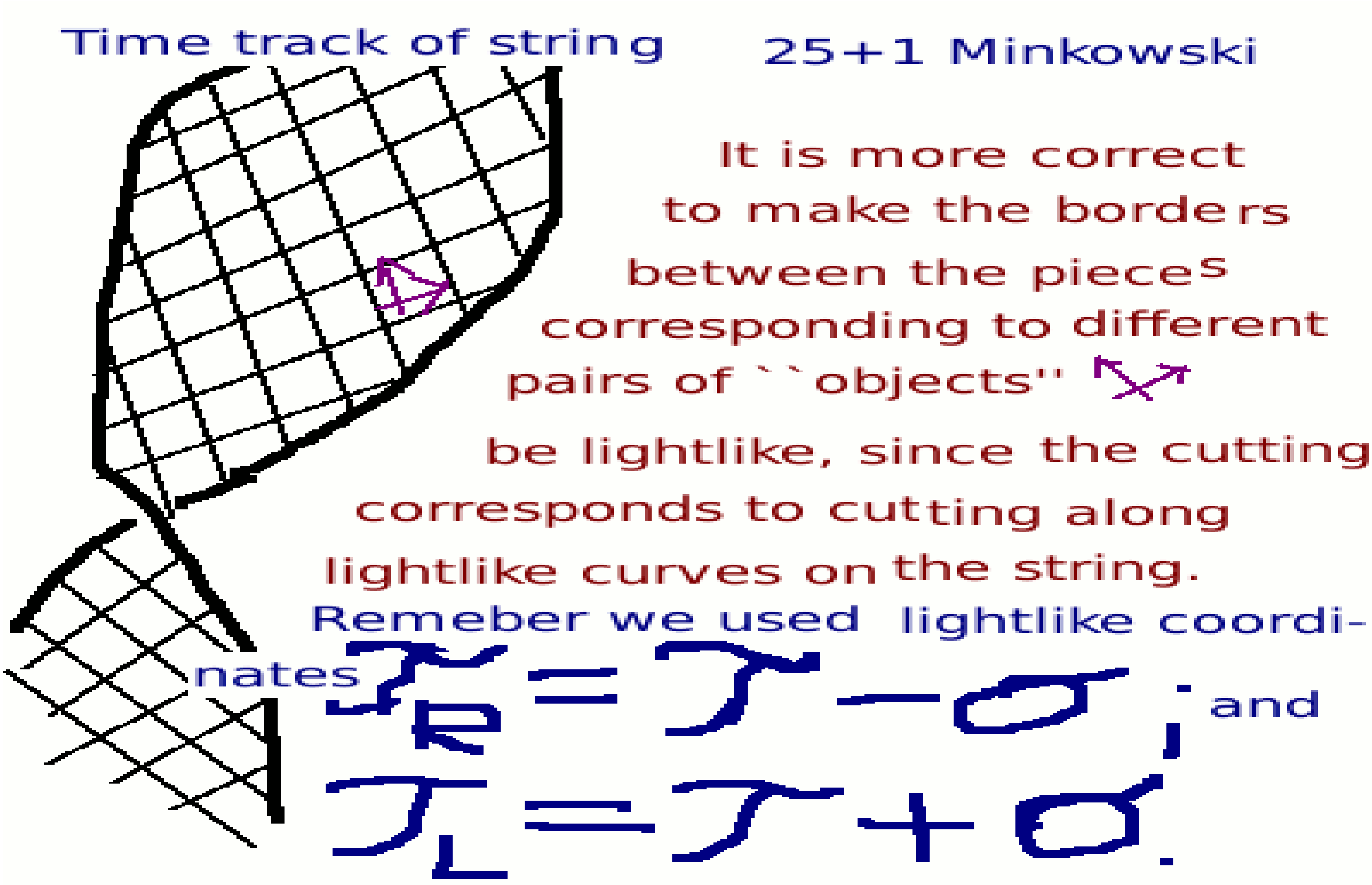


A small piece of the string time track in Minkowski space time is spanned by a couple of ``objects'' J_R and J_L. For open string they are from same sample.

Relation in Our SFT Between ``Objects'' and the String



Pieces of String Time Track per Pair of ``Objects" with Lightlike Sides



Time Track of String from Pieces per Pair of ``Objects" Lightlike Sides

25+1 Minkowski

It is more correct to make the borders between the pieces corresponding to different pairs of ``objects'' be lightlike, since the cutting corresponds to cutting along lightlike curves on the string.

Remeber we used lightlike coordinates

$$\tau_R = \tau - \sigma \text{ ; and}$$

$$\tau_L = \tau + \sigma .$$

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 with x different from 0 is allowed in order to make a well 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)

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 are distributed between the particles, that change in the scattering.

Hagedorn Temperature Surprising in Novel String Field Theory of Ninomiya's and Mine

When our Novel SFT looks like free massless scalar bosons, how can it have a Hagedorn temperature so that $T \leq T_{Hagedorn}$? Free massless would have thermodynamic properties like electrodynamics and show the Planck behavior:

$$E = \text{``}energy\text{''} \propto T^4 (\text{for fixed volume}) \tag{1}$$

This is not at all looking like the Hagedorn behavior at all. With Hagedorn temperature it should never be possible to exceed theHagedorn temperature $T_{Hagedorn}$!

Hagedorn Temperature in String Theory

Wellknown that the spectrum of strings for high mass has the Hagedorn maximal temperature behavior:

$$\rho(m) \propto \exp(m/T_{Hagedorn}) \qquad (1)$$

High Dimensions give Ultraviolet Divergences

Divergence Problem

In a quantum field theory with continuum space

you rather unavoidably get a number of states

raising with energy like Energy to the power of

the spatial dimension, meaning that the density

raises as the energy to the power one less than the spatial dimension

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

- In the Standard Model one has 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

- 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 dualF.

Anomaly way of Looking at No-Go

The simplest anomaly expression - in 3 +1 dimensions - is

$$\partial_\mu j^\mu(x) = \frac{1}{(2\pi)^2} F_{\mu\nu}(x)\tilde{F}^{\mu\nu}(x). \quad (3)$$

The chiral fermion is produced in the region where the contraction of the gauge fields in question $F_{\mu\nu}$ and its dual $\tilde{F}^{\mu\nu} = \epsilon^{\mu\nu\rho\sigma} F_{\rho\sigma}/2$ happen to be non-zero. **In a properly regularizes theory with conservation of the fermion how can a fermion suddenly be produced or disappear?** It should be impossible! So it should only be possible to make regularised models in which it is guaranteed that no such impossible production of fermions occur.

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 Mankoc Borstnik's and mine attempt to cope with Wittens no go theorem we propose to have non-copact extra dimensions:
- Then the superfluous or missing chiral fermions may be pushed out or be brought in from the infinitely far in the extra dimensions.
- You almost bring them out to 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.

Easy to Get Times Mixed Up with Exchange Station for Chiral fermions

- 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 netto zero without some influence back from the future?

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

- From dimensional arguments we 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.
- 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''.
- But then ``He'' should love the particles suppressing in there neighborhood the Higgs field? And fill the whole Universe with the most favoured ones.

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:

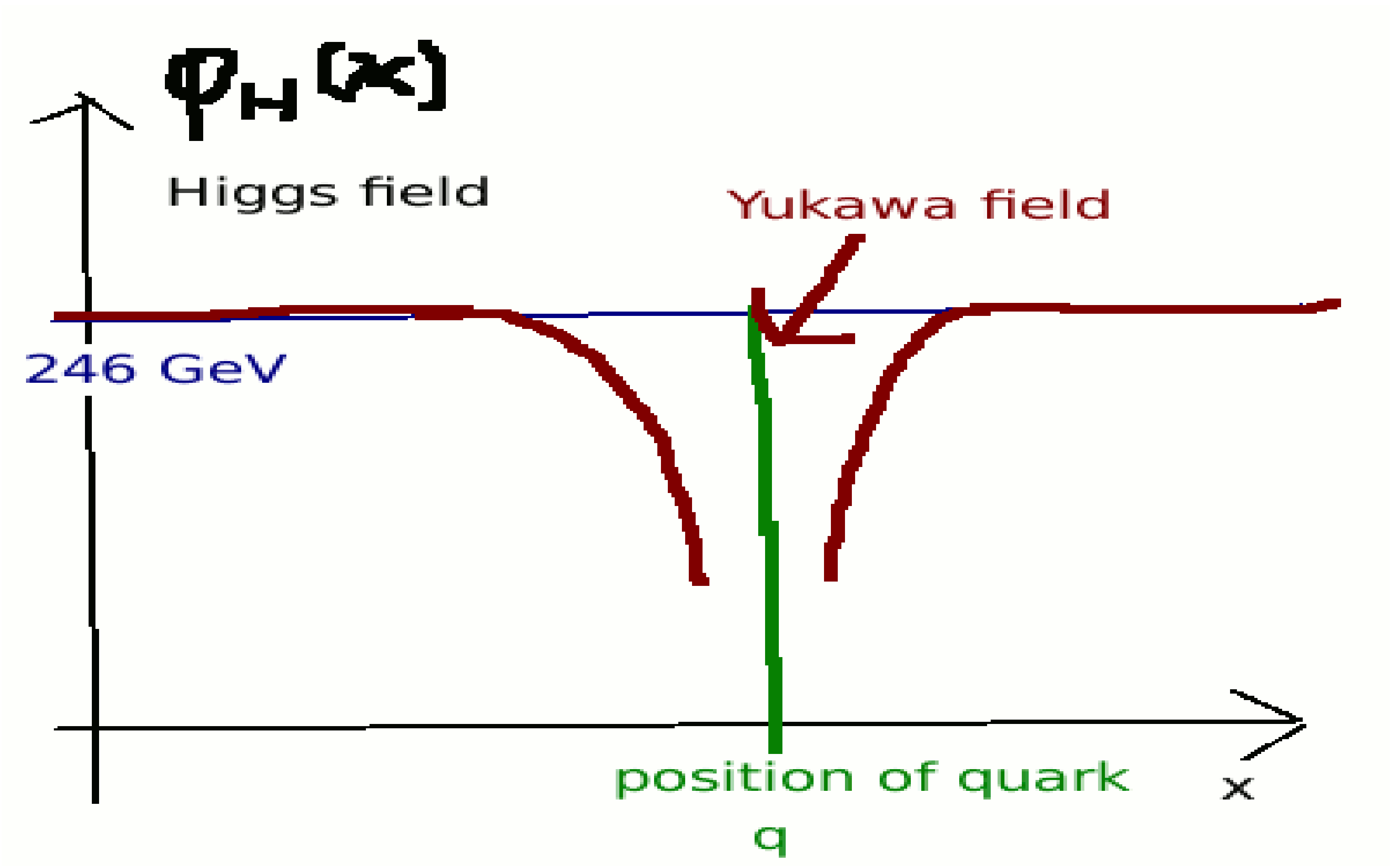
  Why do we not have either?:

  1) Only neutrons n and no protons nor electrons, or

  2) Only protons with their elctrons 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!

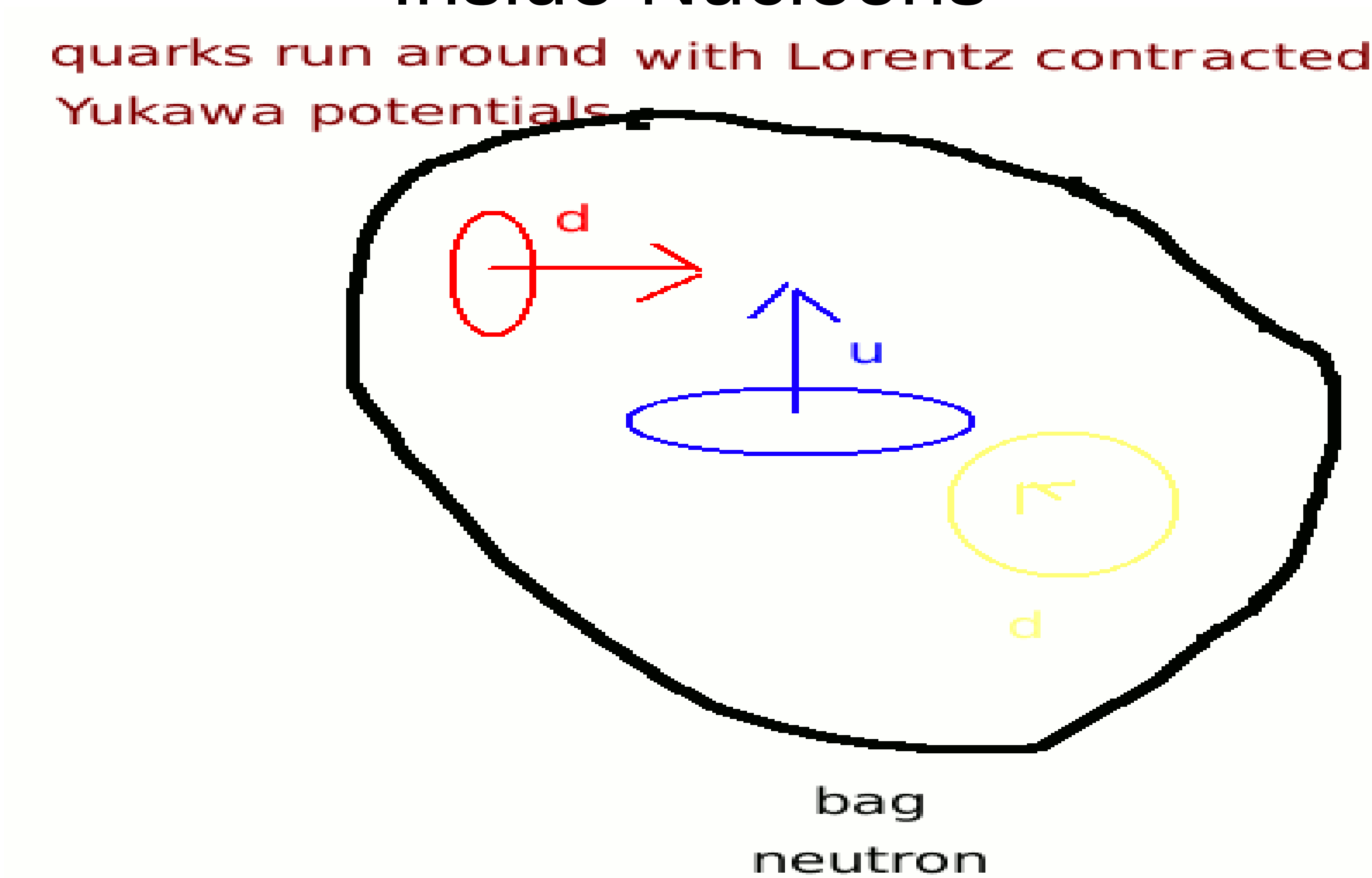
Yukawa potential a Suppression of Vacuum Higgs Field



Higgs Yukawa Potential Proportional to Yukawa Coupling, but Lorentz Contracted

- The various types of quarks have 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 Lorentz contracted
- 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 m/E.

Yukawa Potentials for Quarks Lorentz Contracted due to Motion Inside Nucleons



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 ellipse given by the Higgs mass.
- The proton is almost identical to the neutron except that one up-quark has replaced one down-quark.
- To keep Universe chargeless a proton should be accompagnied by an electron.
- A neutrino typically runs so fast that its Yukawa potential is much less extended than those of quarks and charged leptons.

Contributions to See whether Neutrons or Non-neutrons Favored

The suppression contributions to be compared are

Contribution from d-quark in neutron

$$\propto g_d < \gamma^{-1}(d) > \; = \; g_d * < m_d / E_d >$$

$$= g_d * m_d / < E_d > * < \gamma_d >< \gamma^{-1} > \; =$$

$$=< \phi_H >_{vac} g_d^2 / < E_d > *(< \gamma_d >< \gamma_d^{-1} >) \; \propto \; \frac{m_d^2(< \gamma_d >< \gamma_d^{-1} >)}{< E_d >}$$

and

Contribution from u quark in proton + electron e

$$\propto g_u < \gamma_u^{-1} > + g_e \; = \; g_u * < m_u / E_u >$$

$$= g_u * m_u / < E_u > *(< \gamma_u >< \gamma_u^{-1} >) + g_e \; =$$

$$=< \phi_H >_{vac} g_u^2 / < E_u > *(< \gamma_u >< \gamma_u^{-1} >) + g_e \; \propto$$

$$\propto \frac{m_u^2(< \gamma_u >< \gamma_u^{-1} >)}{< E_u >} + m_e$$

My Prediction from Future Influence

Our relation needed to not predict either only netrons or only its decay products:

$$\sqrt{m_d^2 - m_u^2} = \frac{\sqrt{E_q m_e}}{\langle \gamma^{-1} \rangle_{(d)}}$$

where the quark masses are

$$m_d = 4.1 \text{ to } 5.8$$

MeV

$$m_u = 1.7 \text{ to } 3.3$$

and

$$\langle \gamma^{-1} \rangle \cdot \langle \gamma \rangle \approx \left\{ \begin{matrix} 2.37 \\ 2.05 \end{matrix} \right.$$