

# Search for Effect of Influence from Future in Large Hadron Collider

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## Abstract

We propose an experiment which consists of drawing a card and using it to decide restrictions on the running of Large Hadron Collider (LHC for short) at CERN, such as luminosity, and beam energy. There may potentially occur total shut down. The purpose of such an experiment is to search for influence from the future, that is, backward causation. Since LHC will produce particles of a mathematically new type of fundamental scalars, i.e., the Higgs particles, there is potentially a chance to find unseen effects, such as on influence going from future to past, which we suggest in the present paper.

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# 1 Introduction

In general, it is believed, because of causality, that backward causation [1], in the sense that what happens at a later time influences what happens earlier, does not occur.

However each time we surpass a new energy scale so as to produce, for example, a type of particle with new mathematical properties, we should retest our well-working principles of earlier experiments.

This model of ours is a model of the initial conditions of the Universe. It may be viewed as having a similar condition to the “no-boundary” initial condition postulated by Hartle and Hawking [2] at the moment of the birth of the Universe.

Our theoretical model building [3–5], in particular, calls for a retest. When the Higgs particles are to be produced, we must carry out a retest to elucidate whether there could be an influence from the future. For instance, the potential production of a large number of Higgs particles at a certain future time would cause a pre-arrangement such that Higgs particle production can be avoided. Such pre-arrangements may be considered an influence from the future. One of us (H.B.N.) has contemplated, through the past several years, the idea of an influence from the future on the other settings [6, 7]. One also finds such future influences on effective coupling constants in “Baby Universe Theories” [8–12, 14], and in some models of the “multiple point principle” [7, 13, 14].

In section 2 we review our model used in the present article of which action consists of real and imaginary parts. In section 3 we propose the experiment at LHC to verify some effects advocated by us. Section 4 is devoted to estimating the probabilities of various cases predicted by card game experiment. In section 5, we check our model numerically. In section 6 we investigate Higgs particles in terms of particle and field actions. In section 7 we explain why we consider the Higgs particle to be so special. In section 8, we estimate how the width of the Higgs particle is expected to be broadening. The last section 9 is devoted to the conclusions and outlook.

## 2 Our model with imaginary part of action

In our previous publications [3–5] we described our model by simply introducing a functional called  $P[\text{path}]$  depending on the path, which could be most easily thought of as a classical path of all the fields in the universe, and  $P[\text{path}]$  denotes the probability that this path is realized. The idea behind  $P$  should be that it is calculable from some physically reasonable formula involving the path, since we would like to let  $P$  depend on the path in such a way that it obeys the usual physical symmetries and principle of locality in space time. Thus it is expected to be such a form as

$$P \simeq e^{-2S_I[\text{path}]}, \quad (1)$$

where  $S_I[\text{path}]$  is the action given by the imaginary part of the Lagrangian  $\mathcal{L}_I$ ,

$$S_I[\text{path}] = \int \mathcal{L}_I(x) \sqrt{g} d^4x. \quad (2)$$

The formulation of our model is such as to simply allow the action  $S[\text{path}]$  in the Feynman path way integral  $\int e^{iS[\text{path}]} \mathcal{D}[\text{path}]$  to be complex,

$$S[\text{path}] = S_R[\text{path}] + iS_I[\text{path}], \quad (3)$$

and then assume that the imaginary part of the Lagrangian density  $\mathcal{L}_I(x)$  in (2) has much the same form as the real part  $\mathcal{L}_R(x)$  in, for example, the Standard Model or some extension thereof. The only difference between  $\mathcal{L}_R$  and  $\mathcal{L}_I$  is the coefficients, such as  $\frac{1}{g_N^2}$ ,  $Z$  and  $m^2$  of the various terms in (3):

$$- \frac{1}{g_N^2} F_{\mu\nu}^a(x) F^{a\mu\nu}(x) , \quad Z \bar{\psi} \not{D} \psi, \dots , , \quad (4)$$

However the forms of the field dependences are the same, since the renormalization factors  $Z$  and other coupling constants, are different in  $\mathcal{L}_R$  and  $\mathcal{L}_I$ . At first sight a model of this type seems to be obviously false, since  $S_I[\text{path}]$ , which gives the probability of the development of a path of the universe, would a priori depend strongly on what goes on today or at a later time. Such effects would appear as if that the universe were prearranged to achieve various goals that would be obtained by the largest possible negative contributions to  $S_I$ . However, we believe we have found some arguments that the importance of the inflation era should be much

more than the present era in selecting the path to be realized, and henceforth, the dependence on what goes on today is strongly suppressed. In this way, we claim to be able to obtain the second law of thermodynamics out from our model.

The mechanism of governing the development of the universe so as to avoid the production of Higgs particles was suggested in our previous works.

We have already proposed a model for unifying equations of motion and the choice of the initial conditions, or better, the selection of the solutions of the equation of motion to be realized. It is, at least, some unification to obtain the selection of the solution to be realized by some law. The very unusual feature of this type of model is that such an imaginary part of the action

$$S_I = \int \mathcal{L}_I dt, \quad (5)$$

which leads to the probability weighting

$$e^{-2S_I}, \quad (6)$$

depends not only on the happenings at the very first moment of the birth of the Universe, but also on what happens at all times. If we did not provide detailed speculations that the main effect on selecting the solution to be realized is from the big bang era, our model would be falsified by the upper bound on the occurrence of prearranged events, or by the second law of thermodynamics.

We have, however, some rather naturally working mechanisms [3, 4] that can make the effects of the imaginary part of the action negligible under some conditions that likely prevail until LHC starts colliding beams. In fact, we have, in earlier articles [3, 4], argued that the imaginary part  $\mathcal{L}_I$  of the Lagrangian would be constant - and thus unimportant - in one of the following three cases [3].

1) If particles are either

- (a) nonrelativistic and conserved or
- (b) massless (photons),

then the  $S_I$ -effect will be negligible.

2) Even with relativistic particles, the effect of  $S_I$  vanishes provided the Lagrangian  $L_R + iL_I$  is homogeneous in a field type and has only one independent coefficient by symmetry restrictions; for example, the Standard Model

Lagrangian with  $SU(3) \times SU(2) \times U(1)$  is homogeneous in the second order in the quark and lepton fields, and we only use one term unless Yukawa couplings are added. However, the latter can be chirally transformed to have no independent phase relative to one of the kinetic terms, e.g., the right-handed one.

- 3) In addition, the imaginary part of the Lagrangian  $L_I$  for a Yang Mills theory is forbidden provided there exist monopoles [3, 15].

In daily life, point 1) is sufficient to suppress the effects of influences from the future via  $L_I$ , so that no prearrangements would occur strongly there. However, high-energy physics machines dealing with their relativistic particles would, if it were only for 1), influence their past. For instance, such an influence could have meant that these machines would have met with bad luck by prearrangement, whereby their funds may have been cut so that they would not be in operation. Seemingly there were no such effects of bad luck for relativistic accelerators such as ISR, wherein the particles are even stored for long times. To rescue our model, which is already falsified by ISR, we could, however, make the very mild speculation that there exists fundamentally magnetic monopoles [15], which is allowed for the Yang Mills fields in the Standard Model. Such an existence of monopoles, together with the remark that the Lagrangian of the fermions - quarks and leptones - is homogeneous in the fermion fields, could provide, by means of 2) and 3), the argument for the fact that, even for the high energy experiments performed so far, no effects of bad or good luck have been observed.

However, the Higgs particles are the first fundamental scalar to be investigated and arguments 1), 2), and 3) above may very likely be insufficient for eliminating the effect of influences from the future related to Higgs particles.

Thus it is likely that our expectation of our model in the paper “Influence from future...” [3] might show up in the same experiment that first produce big amounts of Higgs particles.

Very interestingly, in this connection, the SSC in Texas [16] would have been the first machine to produce Higgs particles on a large scale. However, it's construction was actually stopped after one-quarter of the tunnel was built, which is almost a remarkable piece of bad luck.

### 3 Proposal for the experiment

If we just, in a very general way, consider a model in which the probability  $P(sol) = e^{-2S_I(sol)}$  for a solution, denoted by  $sol$ , of the equations of motion to be realized is a function of what happens to this solution  $sol$  at all different times  $t$ , we should be able to see influences from the future. If, as is suggested above,  $P(sol)$  depends on whether or not Higgs particles are produced in large amounts during the development of the world  $sol$ , then the actually realized development would either seek or avoid Higgs particle production. It seems most likely that the production of Higgs particles leads to smaller  $P(sol)$  than that for no Higgs particle production, since otherwise, there would already have been many Higgs particles produced in nature.

With this model, we expect that a machine for producing Higgs particles will be stopped by some accident or another if the effect is sufficiently large with having in mind that the probability should exponentially decrease with the number of Higgs particles produced. The ratio of the two probabilities,

$$\frac{P(sol_{\text{with machine}})}{P(sol_{\text{without}})} \sim C^{\# \text{Higgses}}, \quad (7)$$

may be obtained. Here,  $sol_{\text{with machine}}$  and  $sol_{\text{without}}$  indicate the solution with and without the machine, respectively.

The experiment proposed in the present article is to give “foresight”, a chance of avoiding forced closure of LHC due to lack of funding or other form of bad luck, as happened to SSC.

We imagine a big stack of cards on which are written various restrictions concerning the operation of LHC, for example “allow the production of only 10 Higgs particles”. On most of the cards there should just be written “use LHC freely” so that they cause no restrictions. However, on a very small fraction of cards, there should be restrictions on luminosity or beam energy or some combination of them. One card may even have “close (shut down) LHC”.

The crucial idea of this proposal is that if our model were true, then the most likely development  $sol$  with the  $P(sol) \simeq e^{-2S_I(sol)}$  factor included would be a development involving one of the cards which strongly restricts on the Higgs particle production at LHC.

## 4 Estimation of probabilities of each case: Probability of closing LHC

Before setting down the rules of the card game, one should carefully discuss what is the most economical and optimal probability value to choose for, for instance, the “close LHC card”.

In order to give an idea about what probability  $p$  to choose for closing LHC, while postponing partial closings or milder restrictions until the next section, we shall introduce the following symbols for the relevant probabilities.

$r$ : the probability that our model is correct so that there is a prearrangement mechanism ensuring that LHC will not come into operation.

$a$ : the probability that without any such mysterious interference, the LHC will accidentally fail and thus not start.

$d$ : the average excess damage that occurs under an accidental bad-luck event preventing LHC from working; it may be a larger value than that of LHC itself.

$p$ : the probability value for the “close LHC” card

The numbers  $r$ ,  $a$  and  $p$  should be very small, whereas the excess average damage, is presumably of order unity. One could, however, estimate that this extra damage involves even human lives. Thus several people may be killed during some explosion. In such a case the damage could turn out to be more severe than the pure loss of LHC itself. Hence we might take the probability  $d$  to be one order of magnitude larger than the value for LHC. A reasonable value may be  $d \approx 10$ .

In the case that probabilities  $r$ ,  $a$ , and  $p$  are all small LHC will most likely come to work as expected without any problem. There will only be the small probability  $a$  that it has a normal accident and the small probability  $p$  that it gets closed due to the card game proposed. In the case of probability  $r$ , LHC cannot be allowed to start up. It can fail in two ways: with probability  $\frac{a}{a+p} \cdot r$ , there will be a normal accident, and extra damage may be given by the factor  $d$ ; with probability  $\frac{p}{a+p} \cdot r$ , LHC will be stopped by the card “close LHC”. To estimate these probabilities, we considered that the two types of stoppage should occur with a relative probability  $a : p$ , as also if our theory were wrong.

We can now estimate the average cost due to the various failures in the natural units of the value of LHC.

Let us denote by  $\mathcal{C}$  the average loss due to severe failure in units of the price, for example,  $3.2 \times 10^9$  CHF (Swiss Francs), of LHC itself.

$$\mathcal{C} = p + a \cdot (d + 1) + r \left( \frac{p}{a + p} + \frac{a}{a + p} \cdot (d + 1) \right) \quad (8)$$

Here, we took the loss,  $(d + 1)$ , by natural failure as the sum of excess loss  $d$  and loss, 1, of the machine itself. Simplifying (8), we get

$$\mathcal{C} = (p + a \cdot (d + 1)) \left( 1 + \frac{r}{a + p} \right). \quad (9)$$

Since  $p$  is at our disposal, one would say that we should choose it on the basis of ethical and economical reasons so as to minimize the loss in LHC price units. This minimization occurs for the case,

$$\begin{aligned} \frac{\partial \mathcal{C}}{\partial p} &= \left( 1 + \frac{r}{a + p} \right) + (p + a(d + 1)) \left( \frac{-r}{(a + p)^2} \right) \\ &= 1 - \frac{ard}{(a + p)^2} \\ &= 0, \end{aligned} \quad (10)$$

which leads to

$$p^2 + 2pa + a^2 - ard = 0. \quad (11)$$

The solutions are given by

$$p = -a \pm \sqrt{ard}. \quad (12)$$

Of course, we must account for the chance that the closing card  $p$  is non-negative,  $p \geq 0$ .

If  $\sqrt{ard} < a$ ,

$$r < \frac{a}{d}, \quad (13)$$

i.e., if the chance of our theory being right,  $r$ , is less than the chance of a natural failure of LHC divided by the excess damage factor  $d$ , then it would not be optimal to play our card game for any possible value. It would cause damage to perform our experiment and one should only do it in order to confirm (or invalidate) our theory.

If, however, one judges that the chance of our model being corrected is so large that

$$r > \frac{a}{d}, \quad (14)$$



then, it would be uneconomic and unethical not to perform our card game.

In this case, supposing that we only compute the optimal value of  $p$  as orders of magnitude in order to avoid damage,, the value should be

$$p = -a + \sqrt{ard} \approx \sqrt{ard} . \quad (15)$$

This obviously means the following. Unless the chance of drawing the card “close LHC”,  $p$ , is at least as big order of magnitude as the chance of a normal failure of LHC, it is ineffective, for preventing damage, to play our proposed card game. This means that, if we choose  $p \ll a$ , even if our theory were right, LHC would be stopped by a normal failure rather than by our card game.

## 5 Consideration on checking our model

The purpose of playing the proposed card game is to carry out a very clear test of our model in addition to an economical or ethical attempt to rescue LHC from even worse fates. Crudely speaking, a superficially “normal” accident would already be strong support for our model. However, it would be even more valid numerically if LHC were stopped by a card play. Then one would have a very clear knowledge of the statistical accuracy with which our prearrangement effect had worked and had been tested. To know in advance a good estimate for probability  $a$  is not so easy. Therefore one could reason away such a natural failure and say that, in spite of it, one should not trust our theory. One could say “oh, it is an accident of bad diplomacy”. Drawing a single specific card from among 2 million cards could only be achieved either by a card magician or by a model like ours. In principle, such an unlikely occurrence would be possible but not in practice!

In order for our model to be safely confirmed, we must choose  $p$  to be so small that drawing the card “close LHC” would indeed be convincing. To suggest a value for  $p$ , we recall that the discovery of the Higgs particle is suggested to be performed with a 5-standard-deviation peak. A 5-standard-deviation peak occurs by accident in a band only with the probability  $5 \times 10^{-7}$ , i.e., one in 2 million. If one were to trust these 5-standard-deviation discoveries even if one had, for example, 10 mass bands in which to look for the Higgs peak, it would mean that one would accept a discovery even if an accidental reproduction of data were to occur with the probability  $10 \times 5 \times 10^{-7} = 5 \times 10^{-6}$  or one in 200,000.

An experiment of our proposed concept with a probability for stopping LHC of  $p \approx 5 \times 10^{-6}$  would mean on average an expense equal to  $5 \times 10^{-6} \times$  “cost of LHC” =  $5 \times 10^{-6} \times 3.3 \times 10^9$  CHF  $\approx 1.7 \times 10^4$  CHF. However, this average loss of 17,000 CHF would be compensated by the danger of a natural stoppage due to explosion or bankruptcy of CERN or other similar things caused by the effect of  $S_I$  in the case that our theory were valid. Compensation of the average loss would occur if the following is satisfied:

1. it is less possible than  $p = 5 \times 10^{-6}$  that LHC would experience a normal failure  
and
2.  $d$ , the “excess loss”, times the chance that our model is true,  $r$ , i.e.,  $d \times r$ , is larger than  $p \sim 5 \times 10^{-6}$ .

If you include the danger that the failure of LHC could be due to war between the member states of CERN, the extra damage  $d$  could be very large, but that sounds exaggerated. Presumably, we should take  $d \sim 1$  to 10, for example, 5. Then

$$d \times r \sim 5r \sim 5 \times 10^{-6} = p_{\text{suggest}} \quad (16)$$

for  $r \sim 10^{-6}$ .

In other words, if there were just one chance in a million that our model were right and if normal failure were extremely seldom, then the 17,000 CHF would already be paid for.

If our model has more than one chance of being right in one million, one might rather begin to worry that taking only  $p \sim 5 \times 10^{-6}$  might result in too great a danger. However, if this failure by itself  $a$  is bigger than  $5 \times 10^{-6}$ , our card experiment would fail in the sense that the card drawn would not be “close LHC” even if our model were true. Nevertheless we might believe our model in that case upon witnessing a natural accidental stopping of LHC. However, that would be less clearly convincing than our card game, and it could be appreciably more expensive.

We believe that it is essential to perform an honest estimate of the reliability of the LHC construction being completed such that the machine is operable, i.e., to estimate probability  $a$ . Such an estimate of  $a$  could be crucial for the decision as

to what value of parameter  $p$  to choose, i.e., the rules of the card game concerning LHC.

It would presumably pay to make not only the single card “close LHC” possibly be drawn, but also to include several cards specifying incomplete closings in the deck.

There could be many variants of the restriction cards, for example, limits on beam energy, luminosity and the lifetime of the machine, and postponement of the start of operation. However, all the cards of strong restriction should have only low probability  $p_0$ . Therefore, just pulling one of them should convincingly confirm the truth of our model.

## 6 Particle action from field action

In this article, we suggest that the Higgs particle, which we have not yet studied well, will lead to an influence from future effects while such an effect is not present for the particles already found: quarks, leptones, and gauge particles.

In order to explain the peculiarity of the Higgs particle, we shall here study the action for a classical particle approximation to a field theory. In the usual case of a real action for the field theory, one can identify particles as wave packets moving along in the field. Then, the action one should use is for a particle propagating in space time,

$$S_{\text{R part}} = 2\pi \# \text{“wave oscillations”}, \quad (17)$$

where these wave oscillations are the phase rotations in the wave packet represented on the field propagating in space time.

It may be a little surprising that the action for the particle description  $S_{\text{R part}}$  is not simply equal to the action contributing to the field theory action  $S_R$  from the wave packet.

Indeed it is easy to see that if the Lagrangian with respect to a certain type of field is homogeneous, for instance the  $\psi$ -involving part of the Lagrangian

$$\bar{\psi}(\not{D} - m + g_y \varphi)\psi, \quad (18)$$

then the Lagrangian can be constructed from the equation of motion

$$(\not{D} - m + g_y \varphi)\psi = 0. \quad (19)$$

It follows that in the classical field approximation, the action for  $\psi$  is zero (on the shell). Hence it is necessary that the effective action for the particle description is not simply the contribution to the field theory action  $S_R$ , because then, we would have only zero contribution from all the free particles (in between interaction points).

We have already seen that the main physical significance of the imaginary part  $S_I$  of the action is that a path under development is assigned the probability  $P \sim e^{-2S_I}$  so that  $S_I$  has the meaning minus half the logarithm of the probability weight. In shifting from the field description to the particle description with particles, the “wave weight”  $P$  and thus  $S_I = -\frac{1}{2} \log P$  should have the same meaning if we describe the same development in the two different languages. Thus, contrary to what we just claimed for the real part  $S_R$ , that

$$S_{R\text{part}} \neq S_R, \quad (20)$$

we need, for the imaginary part - due to its physical significance - to have the correspondence

$$S_{I\text{part}} = S_I. \quad (21)$$

However, it is easily seen that the argument for vanishing action in the homogeneous case works to make both real  $S_R$  and imaginary  $S_I$  and parts of the actions zero. Because phenomenologically we do not see any prearrangement effects involving quarks and leptones, we must take this to mean that in the particle description,  $S_{I\text{part}} = 0$  for particles described by the homogeneous action.

## 7 What is so special about the Higgs particles?

The special property of the Higgs particle that makes it such a favourite candidate for showing the effects due to our imaginary part of action  $S_I$  is that 1) it is not a gauge particle and so the argument of the nonexistence of the monopole can be used to exclude imaginary coefficients, and 2) in the free part of the Higgs Lagrangian, there are two terms, the kinetic term  $|D_\mu \varphi_H|^2$  and the mass term  $m^2 |\varphi_H|^2$ , of which coefficients have been unrestricted by symmetries, so that these independent coefficients could have different phases.

Also, for quarks and leptones, one has, at first, independent coefficients on the kinetic and mass terms, but for them, one can perform the chiral transformation

$$\begin{aligned}\psi_L &\rightarrow \psi_L, \\ \psi_R &\rightarrow e^{-i\delta}\psi_R,\end{aligned}\tag{22}$$

which can be adjusted such that the mass and the kinetic coefficients have the same phase. Thereby, the imaginary part of Lagrangian  $\mathcal{L}_{I \text{ quarks \& leptons}}$  is forced to be proportional to the real part  $\mathcal{L}_{R \text{ quarks \& leptons}}$ . Since the Lagrangians are homogeneous of the second order, one gets  $\mathcal{L}_{R \text{ quarks \& leptons}} = 0$  and  $\mathcal{L}_{I \text{ quarks \& leptons}} = 0$  using equations of motion. However, the Higgs Lagrangian,

$$\mathcal{L}_{\text{Higgs}}(x) = Z|\partial_\mu\varphi_H|^2 - m^2|\varphi_H|^2 - \frac{\lambda}{4}|\varphi_H|^4,\tag{23}$$

is not homogeneous because of the  $\frac{\lambda}{4}|\varphi_H|^4$  term, which is of the fourth order, contrary to the rest. This could be a further reason for the lack of an argument for  $\mathcal{L}_{I \text{ Higgs}}$  to vanish. The equations of motion,

$$Z\partial_\mu\partial^\mu\varphi_H - m^2\varphi_H - \frac{2\lambda}{4}|\varphi_H|^2\varphi_H = 0\tag{24}$$

and

$$Z\partial_\mu\partial^\mu\varphi_H^\dagger - m^2\varphi_H^\dagger - \frac{2\lambda}{4}|\varphi_H|^2\varphi_H^\dagger = 0,\tag{25}$$

obtained by multiplication with fields  $\varphi_H^\dagger$  and  $\varphi_H$ , respectively, and adding and subtracting, does not lead to both real and imaginary parts of the field theory action being zero. Rather the Lagrangian on shell values are given by

$$\begin{aligned}\mathcal{L}_R &= -\frac{\lambda_R}{4}|\varphi_H|^4, \\ \mathcal{L}_I &= -\frac{\lambda_I}{4}|\varphi_H|^4.\end{aligned}\tag{26}$$

Here, we have defined the self-coupling of  $\varphi_H$ ,  $\lambda$ , as the sum of real and imaginary parts:

$$\lambda = \lambda_R + i\lambda_I.\tag{27}$$

For the Higgs field, one should keep in mind that there is a big background or vacuum expectation value  $\langle\varphi_H\rangle$ . It is, in fact, only the *extra* contribution coming

from a true particle that is propagating through this vacuum and described by a wave packet in  $\varphi_H$ .

We may consider a single Higgs particle described by a wave packet in the Higgs field  $\varphi_{Hwp}$ . Then we obtain, in the well-known background field case with  $\langle\varphi_H\rangle = \varphi_{Hbg} = 246 \text{ GeV}/\sqrt{2}$ ,

$$|\varphi_H|^2 \approx |\varphi_{Hbg}|^4 + |\varphi_{Hbg}|^2 \cdot 4|\varphi_{Hbg}|^2 + \dots \quad (28)$$

This means that we get a contribution to  $S_I$  which again is identified with the particle  $S_{I\text{part}}$  given as

$$S_{I\text{part}} = -\frac{\lambda_I}{4} |\varphi_{Hbg}|^2 \int |\varphi_{Hwp}|^2 d^4x \quad (29)$$

The density in 3-space of genuine Higgs particles with energy  $E_H$  is

$$\rho = \varphi_{Hwp}^* \overleftarrow{\partial} \varphi_{Hwp} \sim |\varphi_{Hwp}|^2 \cdot E_H, \quad (30)$$

so that

$$S_{I\text{part}} = -\frac{\lambda_I}{4} |\varphi_{Hbg}|^2 \iint \frac{1}{E_H} \rho d^3\vec{x} dt \quad (31)$$

For one particle, we have the normalization

$$\int \rho d^3\vec{x} = 1 \quad (32)$$

For Higgs particles with reasonably well-defined energy  $E_H$ , the eigentime  $\tau$  differential

$$d\tau = \frac{m_H}{E_H} dt, \quad (33)$$

and thus we simply get

$$S_{I\text{part}} = -\frac{\lambda_I}{4} |\varphi_{Hbg}|^2 \frac{1}{m_H} \int d\tau \quad (34)$$

Therefore, the imaginary action in terms of Higgs particles is, as expected, the eigentime integral  $\int d\tau$  multiplied by the constant  $-\lambda_I |\varphi_{Hbg}|^2 \frac{1}{m_H}$ . We do not truly know the imaginary part  $\lambda_I$  of the self-coupling of Higgs particles, but a priori, the guess for it would be the dimensionless of order unity, or rather, the same order as the real part  $\lambda_R$  which is of the order  $\frac{1}{3}$ , for example.

## 8 Estimation of effect of Higgs particle

We see that the contribution to  $S_I$  from a Higgs particle seen from its rest frame with the lifetime  $\tau_\ell$ , i.e., with

$$\int_{\text{production}}^{\text{decay}} d\tau = \tau_\ell, \quad (35)$$

is

$$S_{\text{I part}} = -\frac{\lambda_I}{4} |\varphi_{Hbg}|^2 \cdot \frac{\tau_\ell}{m_H}. \quad (36)$$

Even if we set the Higgs width [17] as large as 1 GeV, for example, the order of magnitude of the exponent in the decreasing factor of the probability becomes of the order of 100. The exponentiated value of this becomes so large that no Higgs particles would be allowed to achieve so long a lifetime. Rather, we should expect the Higgs particles to be brought to decay much faster “by prearranged accident”. We expect an effective allowed width to be of the order

$$\frac{1}{\tau_\ell} \approx \frac{2\lambda_I |\varphi_{Hbg}|^2}{m_H}. \quad (37)$$

Looking for this broadening of the Higgs width according to the effect of our model might be in itself a very interesting prediction [3]. However, once the broadening takes place, the effective “decreasing factor of the probability” will only be of the order of unity or at least no smaller than of the order  $\frac{\Gamma_{\text{apriori}}}{2\lambda_I |\varphi_{Hbg}|^2 / m_H}$ . This would mean of the order of a factor of  $\frac{1}{\mathcal{O}(100)}$  rather than  $e^{-\mathcal{O}(100)}$ . Because of such a mechanism of making Higgs particle decay “miraculously” fast, the suppression by each Higgs particle by more than the order of unity may be avoided. Thus a few Higgs particles might be allowed, as may already have been seen at LEP, but huge amounts of Higgs particles should be completely avoided. Machines such as LHC, which makes many Higgs particles should be stopped quickly, before having made more than a few Higgs particles!

Particles other than the Higgs particles lack the self-interaction term of the fourth order, except in the Yang-Mills field. Indeed because of renormalizability requirements, the Fermion fields  $\psi$  and  $\bar{\psi}$  for quarks and leptones, respectively, cannot be allowed to be more than second order. For them, therefore,  $S_{\text{I part}} = 0$ ,

while we seek to suppress the Yang-Mills contribution to imaginary  $\mathcal{L}_I$  on the basis of our argument about assuming monopoles [3, 15]<sup>3</sup>

## 9 Conclusion and Outlook

In the present article, we have proposed an experiment at LHC for determining the effect of an influence from the future as proposed in our own model. The best description may be achieved by introducing an imaginary part  $S_I$  of the action  $S$ . The experiment is very primitive in as far as it consists simply of a card-drawing game arranged so that some severe restriction on the running of LHC - essentially closure - is imposed with a probability  $p$  of the order of  $5 \times 10^{-6}$ . If indeed a restriction card which has such a low probability as  $p \sim 5 \times 10^{-6}$  were to be drawn, it would essentially mean that our model must be true! If, however, just a normal card that gives no restriction is drawn, our theory would be falsified *unless a seemingly accidental stopping of LHC occurs!*

It must be warned that if our model were true and no such game about strongly restricting LHC were played, or if the probability  $p$  in the game for restricting were too small, then a “normal” (seemingly accidental) closure should occur. This could be potentially more damaging than just the loss of LHC itself. Therefore not performing (or not performing with sufficiently big  $p$ ) our proposed card game could - if our model were correct - cause considerable danger.

Of course, a priori - as just a proposed effect to look for - the chance  $r$  that such a model is right is very low. However, we have already published a few papers [3–5] on this type of backward causation model, and several predictions seem to be phenomenologically good: for instance, we can claim to have speculations that may lead to a cosmological constant of the same order as that of matter density [5]. That is to say, our model is promising with respect to solving the cosmological constant problem and the “why today” problems. Also, we claim that it is promising for explaining why there should be a bottom in the Hamiltonian [5]. A further consequence is the principle of many degenerate vacua [7, 12, 13] (MPP = multiple point principle), on which one of us (H.B.N.) has worked for many years with some

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<sup>3</sup>If we assume that our model implies MPP [7, 12, 13] we should get the lowest allowed standard model Higgs mass [18], which allows only  $b\bar{b}$ -decay and a much smaller width by a factor of 500.



success.

Finally, let us mention that we are working on an article which suggests that our type of model may be able to cope with the measurement problem in quantum mechanics [19]. If one wishes to set the eigenvalue of a measured quantity *before the enhancement of the signal in the measurement instrument has occurred* then some sort of backward causation seems to be called for: without the signal enhancement, can one really say if it is a genuine measurement?

We believe that before performing the proposed experiment, we should carefully discuss and evaluate the most optimal choice of the rules of the game. It is most important to choose  $p$  that gives the chance of closure of LHC in the game.

However, in the case of an essential closure, we might obtain interesting information about the details of our confirmed model if we include many cards with various partial closings, for example, how many Higgs particles can we allow LHC to produce before complete closure?

The allowance of such tiny amounts of Higgs particle production and the running of LHC could, if our model were true, provide some information on the details of our model. It is presumably very profitable to organize several possibilities of partial closings. Such possibilities might tell us about the size of  $\lambda_I$ , for example.

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