Imaginary part of action, Future functioning as hidden variables.

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Abstract

A model - by myself and Masao Ninomiya -, which in principle predicts the initial conditions in a way as to minimize a certain functional of the history of the Universe through both past and future - a functional conceived of as an imaginary part of the action - is suggested to be also helpful in solving some problems for quantum mechanics. Especially as our model almost makes it possible in principle to calculate the full history of the universe, it even makes it in principle calculable, which one among several measurement results in a quantum experiment will actually be realized!

Our “complex action model” thus is a special case of superdeterminism - in Bells way - and does not have true causality, but rather even in some cases true backward causation. In fact we claim in our model that the SSC(Superconducting Supercollider) were stopped by the US Congress due to the backward causation from the big amounts of Higgs particles, which it would have produced, if it had been allowed to run. The noumenon (“das Ding an sich”) in our model is the Feyman path integrand or better some fundamental quantities determined from second order effects of the latter integrand.

1 Introduction

Since about 1974 I and my collaborators have worked on the very ambitious project or dream of Random Dynamics[1][2] [3][4][5], which intends to realize the hope of argueing, that almost whatever very complicated theory were true, it should almost certainly (in the mathematical sense of modulo a probability null-set) lead to the laws of nature as we know them. That is to say we want to show that an essentially random complicated world-machinery would lead to mainly the Standard Model.

In realizing this project in the logically first steps we have in mind to think of the world machinery as some very complicated - but still with eneourmously many regularities - “mathematical structure”. Then we propose to make some general considerations about,
how one describes some of the features of such a structure by defining - or at least think of - “substructures” which could then be counted in principle, so that the numbers of the various possible substructures could give rise to a description. This description would now be expressed in a more general language, i.e. not so specific to the (by God) given complicated mathematical structure, which makes up the world machinery or the world, but rather in the terms of numbers as just suggested. Note how we here made an attempt to argue that very very generally we could tell our description so as to get the language of the original “complicated mathematical structure with a huge amount of regularity” replaced by some counting terminology, which we have ourself introduced from the human culture of mathematics. If we continue steps of this sort we might hope to have at the end almost talked the original model (Gods model) out and got it replaced by our own - from mathematical culture say - reformulation so that at the end we may get a result essentially no more dependent on the original input “mathematical structure” but rather on how we have chosen to describe it approximately. You should have in mind that in this way we would say we have hope that the end is (almost at least) independent of the original God-given model!

Since we already know phenomenologically, that the world we live in is described by quantum mechanics causing the wellknown troubles in finding a good ontological basis for the world, it seems to be a bad proposal to make a world machinery model in which the structure is in a certain way, like our “mathematical structure”.(So it would suggestable not use such an ontological picture but rather say take symmetries to be the foundation [6]) We would namely in quantum mechanics rather think of the wave function - which is what we might at first think of as an ontological basis - as a mathematical object describing in a mixed way both the world and what we know about it, rather than just the genuinely existing world. One would therefore a priori think that in order that our proposal of imagining an ontologically truly existing - complicated or not - mathematical structure to be what the world is made from, should have a chance to match with quantum mechanics we would have to somehow modify it so as to say that it also has some information not really about the world proper, but about what we know about it. But with such an interpretation of a combined information about “das Ding an sich” and our state of knowledge would not really be a 100% fundamental world machinery. We shall in the present article consider such an interpretation of the information on the “Ding an sich” and the knowledge of ours being combined in a non-seperable way as not being so estetically attractive, and thus we want to truly think of our “complicated mathematical structure” as being only “das Ding an sich”. But hen it seems that we have almost brought our model to being killed immediately by making itself open essentially to a nogo-theorem, saying that such a type of model cannot match with quantum mechanics.

One might say that the EPR[7] argumentation is precisely that at least in a local theory with such existing features cannot exist.

The way we shall solve this problem below is by letting the “complicated mathematical structure” or the worldmachinery represent the whole time development of the universe and not just the status at a specific moment of time. Then we even open up for effects going backward in time. Under such conditions locallity is no longer fully valid and informations about what really happens could sometimes be determined from information hidden in the future somehow. You may at least see easily that once we in principle
open up for laws fixing the future so that it has to be arranged to happen to fulfill some requirements in the future, then we have “backward causation” (i.e. things may happen in order that something having to happen in the future), and then locality makes little sense. A momentary exchange of information faster than light could namely then be realized by the information going to the future, from where it then by “backward causation” went back in time but to (or at) a different place than from where it came.

That the quantum mechanics troubles put by Bell’s theorem[8] are avoided once we have a time perspective, in which all the time development is already settled, were already explained by Bell himself on BBC [9] and is known as “superdeterminism”. In fact it is in the model[11] presented in the present article even suggested that we in principle - but not in practice - except for very special cases e.g.involving Higgs particles as we shall see - can calculate everything that happens, because we have in principle a model for the initial conditions, too. Rather we should say that the model of Ninomiya’s and mine predicts in principle, what really happens! Stated in this way it obviously means that even the outcome of a measurement - which in usual quantum mechanics is supposed to be something only predicted in a statistical way - gets by us in principle calculable. We must of course seek to deliver some arguments for that we in practice can use statistics, and what statistical distribution we predict (we so to speak must derive the Born probability distribution from some reasonable arguments) in much a similar way as to, how one argues for statistics to be applied to the amount of people coming into a railway train or to the distribution of probability for the various numbers of eyes on a thrown dice. In this way we may bring in a kind of unification of the use of statistics in quantum mechanics and in other more practical and classical applications of statistics. Remember that in other philosophies of quantum mechanics the statistics of quantum mechanics is a fundamental fortuitousness [6] contrary to the classical cases of statistics, which may be a practical approximation to what could sometimes in principle have been calculated.(With the appropriate knowledge of the starting conditions of the thrown dice one could calculate the number of eyes being shown at the end. But a rather tiny uncertainty makes the distribution expected a statistical distribution; by some argument of (practical) ergodicity one might show that the in this way calculated probability soon would approach the usually assumed one, that all the six possibilities for the number of eyes become of probability just 1/6).

1.1 The problems

The real problem for quantum mechanics might be thought about like this: If one takes the point of view, w.r.t. the concept of time, expressed by slogans like “the future does not exist”; the future rather only develops from the present, then you may uphold still the Schrödinger equation for developing the wave function. But really inconsistently with the Schrödinger equation do we have in the case of a measurement a different development, in which a single measurement result gets statistically selected to be the only one realized. It is a machinery for delivering the extra information selecting which measurement results that shall be provided by the hidden variables in hidden variable models.

One can say, that it is the point of the present article[11] to use a system of degrees of freedom placed in future in the sense it is determined via calculations involving potential
futures, to settle what result of the measurement shall come out as realized. This come about like this: We use in our model the Feynman-Wenzel-Dirac path way integral - which in our model has an action with an imaginary part of the action too, and it is indeed this imaginary part that is important here - and then the imaginary part of the action will provide different weights to different potential future histories. Then those potential futures that get the highest weight - and that means really the smallest $S_I[\text{path}]$, because the integrand (that get squared to give the probability) is $\exp(\frac{i}{\hbar} (S_R[\text{path}] + iS_I[\text{path}]))$, will be selected as the realized one - will be the ones that should be conceived of as the ones realized. This is supposed to mean that essentially only one measurement result gets selected. We shall return to the estimate that indeed the difference in $S_I[\text{path}]$ between paths for different measurement results will be so big, that one measurement result indeed takes practically completely over. This has to do with that a measurement enhances the effect so that different results of the measurement cause quite different futures. (This means, that we have a model with future influencing past, an idea we have had in connection with baby universe theory [14] and the present author earlier[15][16] especially w.r.t. coupling constants getting influenced).

Let us here mention that such influence from the future easily pops up in models with time machines for instance caused by worm holes. An example of worm hole effects popping up even at the LHC machine is found by the work of Volowich[18] in this very proceedings.

Another problem related to the first mentioned is, that as may be seen from the unusual type of logics, that is used to describe quantum mechanics, it is not possible to identify a quantum state with a state of a system of classical objects about which everything can be described by answers to yes-no-questions. This means that we cannot describe the state of a quantum system by some “das Ding an sich” description. We cannot have a model as an existing object describable without mixing up with the information about the system with our knowledge about it. Thus if we should indeed attempt to have a model description by some mathematical object - “a mathematical structure ” - to describe a quantum system, we are in the trouble, that we cannot do that without including into the description some information about our knowledge about what we know about the system.

So wanting, as I want in the project of random dynamics, - a major subject in the present article -, to have a description of the noumenon (= “das Ding an sich”) to be a “mathematical structure” (being fundamental and without any knowledge about our knowledge about it included), we have essentially a no-go w.r.t. to having consistence with quantum mechanics!

The way out suggested in this article is indeed this attempt to a way out: The problem with the state of a quantum system not being a state that can be identified with a system being a welldefined mathematical structure, may be due to that we assume that we shall consider only the state at a certain moment of time. If we, however, think about rather than to want to describe only the state of the world or a system in a special moment of time to describe the whole time development from the beginning to the end, i.e. including also the future, then a priori there might be a chance of a description by a mathematical structure. That is to say that we should decide to be satisfied to have a “das Ding an sich” model only for the development through all times, but give up to have a “das Ding
Let us immediately reveal, that it is our idea to let the Feynman-Wentzel-Dirac pathway integrand - or rather some quantities being proportional to the square of this integrand - be the noumenon or “das Ding an sich”. In principle we should then be able to see from such a theory that in practice we should get effectively the usual quantum mechanics with its statistics - basically the Copenhagen interpretation hopefully.

That there is indeed good hope, that giving up to require the existence in a “das Ding an sich”-sense (i.e. completely objectively) of the world or the system at a specific moment of time, and only require it for the development through all times, may be helpful to solve the problems of the EPS-discussion, may be seen by thinking about that the time concept is quite crucial in the EPR-discussion. In fact there would be no problem in the EPR if we had a theory with backward causation fundamentally. It is clear, namely, that if indeed we had fundamentally a theory with the future influencing the past or arranging the past, then there would be no trouble in information seemingly being transferred faster than the speed of light. The information could in principle go forward into the future and then back again by the backward causation. May be the best way of seeing that this kind of EPR-related problems disappears in the case of a model with backward causation is by referring to the Bell-type superdeterminism[9]. Indeed if we have a model like Ninomiya’s and mine with the complex action, in which all what happens is in principle calculable, then the argumentation in EPR or say in Bell’s theorem[8] of one being able to choose to measure different things (depending on some “free will”, one could almost say) disappears. This is simply because the experimentalists cannot do anything else than, what they could in principle have been calculated in our model to have to do. Everything is in principle calculable, both what the experimentalists will choose to measure -on both of particles which were prepared in the entangled way - and what will be the result of those measurements. Thus the discussion of the contrafactual possibilities for measurements are out of question; you could just have calculated what would be measured and what is not measured in reality, but only in a contrafactual history, is not relevant.

2 Random dynamics, first very speculative start

Let us at this point give a quick review of the project of Random Dynamics, which is dreamt to be a theory of everything (T.O.E.). It is based on the speculation that we can assume almost whatever theory it should be, if it sufficiently complicated, and then we should be able to show that the effective model resulting will almost not depend on any details. Actually it is hoped that almost any complicated theory would turn out to be the physics, we know from experiment. You could put it as the slogan: Almost all theories would turn out right with respect to the effective laws predicted.

To at least give an idea about the start of this project (random dynamics) let us mention, that I usually call the start-assumption “a random very complicated mathematical structure”. To make this concept just a bit concrete let us describe it by the following computer-set-up:

Imagine we have a relatively simple computer (but it hopefully does not matter how it precisely is) and give it a very long random input string (a random tape), from which it
then produce an output tape, which is supposed to be exceedingly much longer than the input one. Both the input and the output strings are supposed to be enourmously long (enourmously many bits), but we assume that the output-string to be really enourmously much longer than the input-string, not only by a moderate factor, but rather so that likely the output-string may have a length, that could be like an exponential of the length of the input-string. Then it is clear that there must be an enourmous amount of regularities in the output-string. Even though the input-string is completely random, just noice, then this amount of noice is compared to the information on the output-string extremely small. Thus most information on the output-string must be regularities, a kind of repetition of the same again and again in different variation of the theme so to speak. It is now our point with this computer-analogy to identify this output-string with the “random mathematical structure” which in turn is identified with the world (or as we already alluded to strictly speaking rather the whole development of the world).

According to the discussion already alluded to we shall indeed let the output-string describe not the world at a given moment but rather the development of the universe all through times. In this sense the output-string should represent all what happens at all times in some way which of course could be not totally trivial.

2.1 Second step in Random Dynamics

The hope of Random Dynamics now is, that we by arguing little by little can find something on such an a priori difficult to read output-string to identify with features of the known physical world. The success of random dynamics would mean, that we could propose such a series of identifications of features of the output-string structure with features in the physical world, that we would get rules among the physical features from the rules deduced from the corresponding features in the output-string, and then the hope is, that it would turn out, that these rules were indeed identifiable with (some of) the laws of nature already known. That is to say, we hope that with the appropriate identifications of physical concepts with features of the output-string we can deduce the various branches and laws of physics. In fact we hope that we shall find a series of deductions of the various elements in the physical theory we know, of laws let us say, so that we at the end we would have deduced essentially all and stand say with the Standard Model as a derived result.

In the second step[5] - just after having assumed the huge output-string being the fundamental structure - we search to realize the hope of the starting point not being important (remember: we hope in Random Dynamics to get the same resulting effective emerging theory almost independent of the starting model!) by finding a way of formulating the output-string into a language, that could be used on “practically everything”. We seek to realize this formulation in terms of a notation, that can be used on (almost) “everything” by starting by using some of the most fundamental mathematical concepts - the numbers - for the general description of the output-string.

Actually we can even very easily argue, that having to make a description of the enourmously big output-string - so as to bring at least some order in it to be recognizable - the first thought would be in such an as already mentioned very repetitive structure to characterize it by talking about and defining some “substructures” - i.e. some large combinations or patterns defined some way or an other, so that they do not have to be
localized to special regions on the output-tape - and then count those so as to describe
the whole output-string approximately by delivering the numbers of each of the many
different types of “substructures” found. The reader should notice that just by making
this choice of using a description in terms of numbers of “substructures” one has achieved
to represent the information about the output-string, that is being kept, by a point in
coordinate system. In fact the coordinates of this point are in correspondance with the
various recognizable “substructures”, and the coordinate value should essentially describe
the number of substructures of the type in question. At first of course the numbers
of the various “substructures” must be non-negative integers. Then, however, we shall
successively almost follow the introduction of the variation types of numbers: natural
numbers, integers, real numbers, complex numbers. That is to say we come with argu-
ments, that although we started by the description of just non-negative integer numbers
of “substructures”, then we can develop the description by slightly changing it so as to
get successively the integers proper etc in. The first step in this argumentation is e.g.
that one argues: Let us go to a description wherein we only consider the deviations of the
numbers of “substructures” relative to some “normal number of them”. That is to say we
imagine some “relativly simple” “background state of the system” in which the number
of “substructures” have some background values. Then we redefine to consider instead of
the absolute number of a “substructure” as the coordinate the difference of this number
relative to the number of the same “substructure” in the “background” situation. In this
way we can get the new coordinates to be allowed to be both positive and negative. So in
this way we introduce the full set of integers rather than the only non-negative integers,
from where we started.

The step from integers to real numbers may be just argued by saying, that of the
interesting types - namely the dominant ones - of “substructures” there are so many, that
we would naturally take a unit which corresponds to a very large number of them, and
thus the number of units would in practice be a real number.

The transition from real to complex we shall not truly make except in one case:

We have to have in mind that these “substructures” are themselves enourmously com-
plicated and we have to wonder how the numbers of a species of “substructure” will vary
with variations in of for what “substructure” we want the number. For the copious types
of “substructure” we might imagine that just that type of “substructure” got copious, be-
cause it were able - in analogy to biological survival of the fittest - to make many replica
of itself. We might think of some rather similar, but still a bit different “substructures”
forming a kind of family with the first one and that they would collaborate with each
other in making those types be replicated and replicated again and again - we can say
under the running of the random program in the computer model above. To be correct
we should think of some prestates, in the intermediate memory of the computer, for the
structures on the output tape being what is replicating itself in collaboration with the
“family members” of related prestates. If it now is the case, that such a replication plays
a dominant role in getting the numbers of “substructures”, which are copious and thus
interesting, then going from considering one type of “substructure” to an only slightly
different type the change in ability of replication might change slightly. But since they
replicate to an enourmous degree even a small change in ability to replicate will cause
a change in copiousness, i.e. in the number of substructures on the final output-string,
in an exponential way. By this we mean that the number of “substructures” is changed by the same factor roughly for a given change in the replication-ability. If it makes - as we may assume- sense to talk about two similar modifications of two different types of “substructures” the modifications of the numbers of these two types would be changed by about the same factors. This means that we would think that the logarithm of the number of a given kind of “substructure” occuring in the output-string would be a more smoothly varying function as function of what can be varied in the definition of the class of “substructure” counted, than the number straight away.

The just given argumentation would be right, if we just had one type of “substructure” replicating alone, but if we take into account that they collaborate with neighbors in the space of types of “substructures”, then the number of a ‘substructure” occuring at the end could get a more oscillating behavior in addition to its “exponential” form. One could imagine that a couple of family members under the calculation of the computer were replaced back and forth by each other - A made B and B made A - so that the number of A’s say would come to oscillate, more like a sine or cosine than like a exponential. In addition of course it might grow up exponentially. When finally the number of the “substructures” come out on the final output-string, the number would best be described - in order to be smooth and nice - as a function which is of the character of sine or cosine shape function multiplied by an exponential. But that is precisely how one get by using (the real part of) a complex number exponential. So we have here argued, that the number of a specific type of “substructure” should be most smoothly given as (the real part of ) a complex exponential of the features of the structure in question described by numbers.

2.2 Series of affine spaces, basis in one, points in the next

In the foregoing subsection we argued for that a natural way to describe our “mathematical structure” (actually taken there to be the output-string) were to describe it by counting and to give the numbers of a large number of “substructures”; then by comparing to a standard or background one might in stead count the difference in these numbers compared to this background, but that were not so important again. But once we may have convinced ourselves is this procedure, we might immediately perform the same procedure in describing one of these “substructures”. That is to say we should describe the “substructures” by giving how many “subsubstructure”s of a given type there are in the “substructure” in question. In this way we would also after having introduced a “background” and a “unit” end up with having a type of “substructure” described by a point in a vector space or perhaps better an affine space, in which the coordinates count - relative to the back-ground-“subsubstructure”s in the unit (of certain large numbers the number of “subsubstructure”s) in the “substructure” in question. We make indeed in this way every “substructure”-type being described by the numbers of its different “subsubstructure”s.

Let us summarize that we first proposed to extract as the main features to be described in the “complicated (random) mathematical structure” identified with the output-string the numbers of “substructure”s of different kinds. Secondly we then describe these “substructure”s by the analogous technology, by describing them by means of the number of “subsubstructure”s of various kinds inside the “substructure” to be described. The “substructure”s thus becomes identified with the basis vectors in the affine space or vec-
tor space in which the “complicated (random) mathematical structure” corresponds to a point (namely to the set of coordinates, each of which describe the number of the “substructure”’s corresponding to that coordinate or basis vector). But it (= the “substructure”) is also on another - but analogous - affine space (or vector space) a point; it is namely a point on the affine space in which the coordinates or basis vectors correspond, each of them, to a “subsubstructure”. We thus have now in our description two affine spaces, and the basis vectors in the first have come into correspondance with the points on the next.

The reader can imagine, how one can make an analogous description now of the “subsubstructure”’s in terms of numbers of “subsubsubstructure”’s and so on.

In this way we have argued for that one gets almost any complicated enough mathematical structure - or we could say theory - may get described by a series of affine spaces or vector spaces connected one to the next by the coordinate basis for one affine space being in correspondance to the points on the next affine space in the series.

It is in the Random Dynamics project now made an identification of these successive affine spaces with similar spaces in the phenomenologically known physics picture.

Crudely the identification should run like this:

The types of “substructure”’s in the affine space in which the full output-string is represented by a point should be identified with the Feynma-Wentzel-Dirac-paths from the path way integral formulation of quantum mechanics. Then the coordinates of the point corresponding to the output-string (or equivalently the “complicated (random) mathematical structure”) are to be identified with the Feynman-Wentzel-Dirac-pathway integrand

\[
\text{“coordinate” (related to numbers of “substructure” path) } = \exp\left(\frac{i}{\hbar} * S[path]\right)
\]  

where we have of course written as usual formally at least the integrand in the functional integral as the exponential of \(\frac{i}{\hbar}\) times the action \(S[path]\).

The reader can probably easily by himself see that, if the “substructure”’s correspond to (get identified with) paths taken in a field theory as thinkable developments of the fields through all times and space, then the coordinates by which such a path is described must be in correspondance with a cross product of the usual say Minkowski space (or its general relativity analogue) with some discrete set, corresponding to specifying the type and components of the field. In fact the point is that a path being a field development through time is represented by a number- the field value - for every combination of a space time point (a Minkowski space point) and an index-value telling which type of field and which component is concerned. Thus the path is indeed given by a number for each such combination of an index and a Minkowski space point (= event). Apart from the detail with the component and type of field specifying index it is thus the affine space the points of which are the “subsubstructure”’types that is identified with our ordinary space-time (manifold).

You may note that we here have included time on an equal footing with space and that at this in the Random Dynamics fundamental way of looking at it all times are already there. There is here no talk about the future not existing (yet) but rather that we first a bit late begin to find some parameter to identify with time. Following the series of affine spaces suggested the time would be a coordinate in the space(-time) of the
“subsubstructure”-types. But that would then mean that the time \( t \) as a number would correspond to and be proportional roughly to the number of (relative to some background) the number of a specific type of “subsubsubstructure”s in the “subsubstructure” corresponding to the event in question. There is no time in the deep fundamental level of “das Ding an sich” before we get a certain “subsubstructure” identified as being the special one that by its number of occurrences make up the time \( t \). In really developing the model we should presumably say that this number of the specific type of “subsubstructure”s is rather a sort of pretime because it could get modified by some dynamical metric tensor like in gravity which we hope to get out almost unavoidably although we may admit that we should not claim that we really succeeded in getting it out convincingly yet.

But we have at least reached a suggestive model in which the time concept does not come in immediately at the most fundamental level. Thinking close to our fundamental picture one should best think in a timeless way: all times exist and thinking from the almost God-way of our fundamental, all times are real. Then at some level one identifies a prototime as the number of a certain special “subsubstructure”, and then we must imagine that the conditions end up being so that we as being present in terms of “subsubstructures” with this prototime number having a given value only have good information about “subsubstructures” with say a lower number of this specific “subsubstructure” representing the time. Then we might “at that time” easily say that the future meaning “subsubstructures” with a bigger number of the specific “subsubsubstructure” representing time concept is so unknown that we would consider it “not yet existing” psychologically.

Already at this way of thinking you might see that the Bell-superdeterminism [9] looks not so far out: How the whole complicated mathematical structure comes to be is a result of the calculation in our computer model with the random input-string, and there is at this fundamental level no time and no restriction for how things develop in time at first. We must hope and work on a way to derive “in practice” such restrictions that the whole things come to look as a system developing in time from a relatively simple start. We must hope that we can derive that people living in such a world will get a time feeling and might even come to believes due to their practical experience that the future hardly exist in some way which one can call it does not exist yet. But all this is to be derived later in the logical development; if one cannot derive it, it would mean that the hoped for Random Dynamics project failed. But we have not given up yet, but rather claim it to look promising that we shall derive it.

### 3 The lack of reason for the action being real

Even with a great amount of optimism concerning the above dream of deriving as almost unavoidable a complicated mathematical structure being identifiable with a Feynman-Wentzel-Dirac pathway formulation of a quantum field theory there were one thing, we did not derive at first: we got the action complex, but in usual theory the action is real.

Actually in the argumentation above for having to excuse making complex numbers come in in order to describe as exponentials the oscillatory sine or cosine like behavior meant that the intergand (1) were argued to be complex rather than real; but that means
that what we had to argue especially for were that the action $S[\text{path}]$ became complex rather than just purely imaginary! So even if this special argument for finding that the action would be complex rather than just imaginary were wrong we would not get the action real as needed for phenomenological success but rather get it purely imaginary instead.

Phenomenologically having a purely imaginary action would of course be without any hope of working, while having a complex action which at least has the observed real part has a better chance than that at least. Indeed we shall argue that it is quite imaginable that if the action in nature had indeed both a real and an imaginary part then it could so that in practice we would almost only “see” the real part, and the imaginary part would rather fix the initial conditions, but even that in a way is not necessarily in disagreement with what we see.

4 Essential fixing of the whole history of the Universe

At first it looks that having an imaginary part of the action in say the Standard Model might drastically change even the equations of motion, and that might be catastrophic for our model phenomenologically. However, we think that we can at the end get the effects of the imaginary part be talked down to be small, even if they at the first are as big as expected from the phase of the coefficients on the various terms being roughly random. The argument may not be quite watertight and we still work on it. It contains the following ingredients:

1) If the imaginary action were small of first order then the deviation of the effective classical equation of motion from the one obtained alone from the real part of the action alone would be only of second order.

2) In addition to the modification of the equation of motion (which is expected at the end to be small) the imaginary part of the action has the effect of determining the (say the classical) solution among the possible ones obeying the equations of motion to be realized. In fact the result is approximately that the solution being realized is that one which has the smallest (rather most negative) value of the imaginary part $S_I (\text{solution})$.

3) Such a determination of the realized solution - meaning that the initial conditions gets determined from our model - in a way that even depends on what in the solution goes on at all times, both past and future, means that the model tends to make arranged events happen, if they somehow can produce a big negative contribution to the imaginary part of action $S_I$. In this sense our model tends to have such arranged events, which would look like miracles (or anti miracles, if they are bad events).

4) But experimentally miracles and anti miracles are very seldom - if they occur at all - and now we have an argument to explain them to be indeed seldom: Because of the era of times in which we can truly recognize when miracles or anti miracles occur is very small compared to the total time over which the universe exist very many miracles are likely to occur at times different from the times in which we would be able to know about it and recognize it as miracle or anti miracle. We must namely understand that because of the need for the equations of motion being satisfied (determinism) the initial conditions cannot so easily be adjusted to make miracles or anti miracles in all the many
rather small eras in which we may detect them. Thus we must admit that the number of
arranged event that can be detected in practice will be depressed the longer the total life
time of the universe is compared to the human scale. Further this possibility for getting
observable arranged events (miracles or anti miracles) is reduced by the likely speculation
that in some era close to the big bang era, or in the inflation era say, the contribution to
the imaginary part of the action has a very high order of magnitude. If so then namely
such an era could contribute so strongly to the imaginary action that it becomes what
happens in this era that determines almost the whole initial condition. This of course
would be phenomenologically the best scenario since what we see phenomenologically is
that only the very early time, “the beginning”, is the era in which the initial state is fixed
in a simple way. When I here have put the word “the beginning” in quotation marks,
it is because a bouncing Universe starting at time being minus infinity with a hugely
big universe which then \textit{deminizes} become relatively very small and then grows again
towards our time and then even further, is in our model more attracttive than in other
models. While we have the second law of thermodynamics as a derived law that only
may work during the expanding era, a theory with the second law of thermodynamics as
a fundamental assumption to be valid even in the universe decreasing era would make it
very difficult to have a working scenario.

The question whether we can indeed get our model make the phenomenologically
attracttive result that the era, when the Universe were small - i.e. crudely around big
bang time (if there really were a singularity of course a little after big bang) - to dominate
the selection of the solution to be realized depends on whether this era around big bang
time gives the order of magnitudewise biggest contribution to the imaginary part of the
action $S_{I}[\text{history}]$. It is namely suggestively argued that what determines the possible
history that shall be realized is this imaginary part, in fact the realized solution is seen to
be the one that causes the imaginary part to be minimized. One may see that it is such
a minimization of the imaginary part that gets realized without even going into details
in how we shall interprete our model with complex action. It is enough if we just think
as we suggest to interprete our model with complex action by means of the Feynman-
Wentzel-Dirac-path way integral formulation. In fact we only have to have in mind that
the integrand in this path-integral $\exp(i\hbar S[\text{path}]) \propto \exp(-\frac{i}{\hbar}S_{I}[\text{path}])$ goes exponentially
down the more positive the imaginary part $S_{I}[\text{path}]$. This would, almost whatever the
interpretation might be, mean that unless the imaginary action is so small (so negative)
as possible, the contribution to the Feynman-Wentzel-Dirac path way integral will be
very small. Thus only the smallest possible $S_{I}$ achievable will without other reasons for
severe supression be the dominant contribution. Thus we see, that what can come to be
important, and that must correspond to what we shall conceive as being realized, must be
the contribution - among the say classical solutions possible - with the smallest imaginary
part of the action.

One shall imagine that it is at the end a rather strong selectiion of almost only one
classical solution to be the realized one. That is a very welcome prediction from the
point of view of our usual experience that essentially only one history of the universe gets
realized. Here of course we must admit that although we all essetially feel that only one
thing happens, then we know that somewhat seldomly though there are the double slit
experiments. In some experiments it is not possible to say through which slit say a certain
particle has passed. Even in hind sight - i.e. after the experiment has been completely finished - we cannot say through which of the slits the particle went.

So we may form ourselves the following picture of our model prediction:

Due to the minimalization of the imaginary part of the action an almost unique classical solution is selected as the realized one. Estimates of the likely distance in $S_I$-values for the various possible classical solutions that do not follow each other along long time interval is that they are so big, that the next to lowest $S_I$ cannot compete at all with the lowest one. Only in the case that a couple of solutions follow each other through almost all times shall we expect that the imaginary parts of the action could be so close that both partners in such a pair could be significant (together).

4.1 But we can still have some almost classical paths interfere

When we have such mostly each other following classical paths contributing bunches of paths, then it will function as interfering paths and can deliver the interference in such experiments as e.g. the double split experiment. In this way our model should achieve to make almost a classical history being selected uniquely, but with a somewhat seldom possibility of this classical path being split a bit for shorter periods.

5 The reason why a measurement causes no more interference

Now of course we want to see what happens in a measurement: Let us first note that a typical measurement consists in an enhancement. In some way or another a small effect - a single particle or so - is arranged by the constructor of the measurement instrument to be enhanced and make a big effect. Typically some system is set up, which is in some metastable state, which then by being touched rather weakly can go into a different state, that deviates a lot, so that the effect of the quantity being measured gets a very big effect (later). It is of course also so that depending on the result of the measured quantity the cascade will go differently, and so the difference between the state of the universe after different measured results will be very different.

This now means that the development reached after different measurement result are quite different, and thus the future contributions to the imaginary action will depend on the measurement result. It does not depend on the result necessarily in a systematic way, but we shall rather think of it that each possible result value (= eigenvalue of the measured operator) gives an in practice big random number for the future contribution to the imaginary part of the action. In this way it will almost certainly be only one of the eigenvalues, that will in practice contribute to the total Feynman-Wentzel-Dirac path way integral. That means that in the philosophy of “what really happens” being determined by some second order effect of the path way integral integrand, all that gets realized will be what corresponds to one single measurement result. The just given argument is supposed to be the argument in our complex action model for the from a pure Schrödinger equation point of view rather mysterious phenomenological fact that only one measurement result gets realized. In this way we want to say that our selection of an or a few surroundings of
classical solution tracks (system of paths) by the effect of the imaginary part of the action in fact leads to - from the argument of the strong dependence on the measured result due to the enhancement - that only one result gets realized. This fact of the Copenhagen interpretation is thus here claimed to come out as an approximate result (actually in an extremely good approximation).

If however, two solutions almost follow each other through almost all times and only deviate in a very tiny time interval, then there is a better possibility that they could have indeed very close or practically the same imaginary parts of the action. So in such cases the appearance of contribution to the functional integral from both solutions is not totally excluded. In this sense interference is possible in our model. It could be that two classical solutions could come so close, that they have a chance to give competitive contribution and thus to make interference occur.

5.1 Quantum mechanics support of our model

We would like to come with the remark, that indeed something much like our type of model is almost called for, if one does not accept the many world interpretation and want to make a picture with reductionism be consistent. The point is to think about that the property of certain process being indeed a measurement will not necessarily be obvious from the start. A measurement so to speak takes time. Nevertheless we should also imagine that the measured particle so to speak has the measured eigenvalue as its position or momentum or whoever were measured from the time, that the measurement has begun. Otherwise we have to live with the many world intepretation and a superposition of two parts of the measurement apparatus being excited in an entangled way at least as long time as the important part of the measurement takes place.

If one want to avoid such problems one has to allow for the effect of whether we have indeed a measureent or not to propagate backward in time! To have to have such a knowledge about whether it ends with a measurement preferably propagate backward in time really is a strong call for a model like ours in which there are backward causation effects. We simply claim to need such effects in the case of slowly going measurements if we shall avoid the many-world-scenario.

We want to claim that the fact that we get in our model an easier picture for the measurement problems should be taken as a point of evidence for our model.

6 Conclusion

We have reviewed some initial steps in the ambitious project of Random Dynamics leading at least to the possibility of the hope for getting out naturally from almost any starting “complicated (random) mathematical structure with a lot of regularites though” a Feynman-Wentzel-Dirac- path-way formulated quantum mechanics model. However, and that is a very important part of our work: We fail at first at one point: although we have some argument for how to get the functional integrand \( \exp(\frac{i}{\hbar} S[path]) \) become complex, we lack an argument for why the action \( S[path] \) should be real at first.
This lack of success in the Random Dynamics project we take as the suggestion to study what would happen, if the action were complex.

It turns out, that we can essentially get the effect of the imaginary part get both suppressed and largely restricted to make this imaginary determine the initial conditions rather than the equations of motion.

But this acceptance of that there is an imaginary part of the action being different from zero, although we have mechanisms that can suppress it, has great significances:

1) Our model becomes “superdeterministic” in the sense that everything that happens get in principle calculable, not only after having got the information about the beginning, but rather calculable from scratch provided we just know the various complex coefficients in the (complex) Lagrangian density. So everything is determined “in advance” (our picture is in the first levels ontill a time concepts is found, timeless, and it is best to imagine in our model that “God” thinks in a timeless way, so that both future and past and present exist).

It should be admitted though, that there is allowance for a little loophole, if one thinks classically in this total preditivity of everything:

There is an opening for paths not representing different maesurement results of any measurement to be seperated for some (not too long) time. In fact for instance the famous double slit experiment in which we never shall know through, through which of the two slits the particle went (if it were not measured) we shall even in our model even in principle not be able to calculate through which slit it went.  

2) Especially it is in principle calculable which detector will click, i.e. what will be the outcome of a quantum measurement. On the contrary in the usual theory it is supposed to be given completley randomly,by statistics only.

3) But this also means, that it is explainable due to the enhancement connected with having a measurement instrument for elementary particles, atoms etc. that (with very high accuracy) we only get one measurement result. This result of only one measurement is the only possibility that will occur with any significant contribution in the Feynman-Wentzel-Dirac-path way integral (from which the variables counting as noumenon depend as second order expression). Thus our model can be claimed to explain the fact that only one measurement result occurs, a fact often considered rightly quite mysterious.

It is our main point, that the from the usual theory and time concept point of view strange model of ours is actually advantageous w.r.t. consistency with quantum mechanics. So we would claim that the problems of quantum mechanics are actually indicators in the direction of precisely our model.

Only if the contributions to the imaginary part of the action get exceptionally large, do we expect that they will give so strong effects that we would e.g. see that to some extend the initial conditions have been finetuned so as to arrange for events with exceptionally high negative imaginary action or prevent events with exceptionnally high positive imaginary action. Neverheless we believe to have spotted cases of such prearrangement

\[1\] We might though define what we could call the hindsight point of view: Instead of asking for useful information you ask for the metaphysical one and accept that just when the position of a particle were measured, I could still pretend in words, that it would have the momentum with which it were prepared. However, even in such a hindsight point of view sometimes the slit, through which the particle past, will not be definite.
in connection with production of Higgs particles, and we also think that one might very easily put up phenomenological couplings for the inflaton-field say such as to make the inflation periode become a case of prearranged very negative imaginary action comming about. Indeed our speculation is that due to that the imaginary part of the coefficient $m^2_{Higgs}$ to the numerical square $|\phi(x)|^2$ of the Higgs-field $\phi(x)$ - let us call it $m^2_{Higgs}|I|$ - is much bigger than the corresponding real part $m^2_{Higgs}|R|$ (which is suppressed we think due to some mechanism solving the “scale problem”, closely related to the hierarchy problem). We here have put $m^2_{Higgs} = m^2_{Higgs}|R| + im^2_{Higgs}|I|$. And then we easily get that the supposedly effective huge term $i*m^2_{Higgs}|I|\phi(x)|^2$ in the Lagrangian density only in practice shows up, when we have genuinely produced Higgs particles, in an accelerator say. Because it seems that genuine flying around Higgs particles are not favoured to be present in Nature - we did not see any so far - presumably the sign of the term, that is huge is so, that Higgs particle production get disfavoured on the realized history of the universe. Thus our prediction becomes, that accelerators, that produce large amounts of Higgs particles, should have bad luck and for instance be prevented from working by the US-Congress, as it happened in the case of the SSC(=Superconducting Super Collider.). About 21 km of tunnel is still there, so it were a rather remarkable case of closing an expencive machine at that stage, it were almost an anti-miracl. Also LHC(=Large Hadron Colliderat CERN) had bad luck just in the month it were about to start up, Oktober 2008. An explosion has now delayed the start by at least a year.

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