System and Its Uncertainty Quanta: Theory of General System (I)

Zhen Wang
Physics Department, LiaoNing Normal University, Dalian 116029, P.R.China

Abstract

The concept of uncertainty quanta for a general system is introduced and applied to some important problems in physics and mathematics. EPR paradox gives new clue to the further understanding of particle correlation which turns out to be the nature of this world. Randomness in quantum mechanics, statistical physics and chaos is integrated. A picture for a new kind of mathematics is put forward.

I. Introduction

Our knowledge about the world has been greatly deepened with the developments in modern science. People now can have a very deep understanding of many phenomena in varieties of areas. As the basic science, physics has seen tremendous changes during this century. First the theory of relativity and quantum mechanics; then cross-disciplines marked with the researches for complexity. All these great breakthroughs of human knowledge are the proudest achievements in this century. But it should also be noted that neither can present physics provide an integrated and unified theoretical frame for other subjects, such as mathematics, astronomy, biology and even social sciences, nor can it get rid of the haunting of quite a few perplexing problems within its own area. Progress in cross-disciplines and frontier sciences in recent decades has given us a lot of inspiration. We can not help suspecting whether there is a common and tremendous truth lying under the minefield of the difficulties in physics and other subjects. This is the first thesis of my series of work, which aims to get an unified understanding of some basic problems in physics, mathematics and philosophy.

Science comes from experience. But we know that at any time of human history, human experience is always limited, even not worth mentioning relative to the vast universe. Science is the abstraction of the common part of human experience and can not include the experience of every individuals. We shall point out in our work that the differences between individuals are not only significant but also endless. Thus on one hand, it would be difficult to get further understanding about the principles of nature, if we do not differentiate individual experience and common human experience. On the other hand, scientific induction is always incomplete.
Thus man should not deny a special existence because of the lack of corresponding experience. The prevailing scientific method is to prove true or prove false within present theoretical frame. Apparently the conclusions got in this way would be under the influence of the limit of the frame. So all the conclusions are relative and should not be extended wantonly. In fact, in a theoretical frame with limitation, there must be things which can neither be proved true nor be proved false. They should not be regarded as fabricated imaginations, but as the key to break through the limitation. It is a serious defect in our epistemology that such obvious truth is often ignored. In this paper, I shall put forward the concepts of general system, the environment and its uncertainty quanta. We shall also use these concepts to discuss some important problems in physics and mathematics. The further meaning of these concepts will be discussed in detail in my third paper "Quantum Cosmology".

II. Uncertainty Quanta of A General System

1. System

Anything that can be viewed as a whole may be regarded as a system. Simple as a single particle or complex as the whole universe, these all can be regarded as systems. Each system has its own environment and has its own special synergistic function relative to the environment. You may also say, a system fixes its environment with its synergistic function. The level of this synergistic function depends on the inner order status of the system. The more ordered the system, the stronger its synergistic function. To some extent, the defining of a system is arbitrary. But a system is usually inconvenient for discussion if there are different kinds of synergistic functions within the system. For example, in a system consisting of a man and a chair, the synergistic functions within the man and between the man and the chair are apparently different. Therefore, such defining of system is not helpful in our discussion.

2. Synergistic Function and Environment

The synergistic function is the nature and also the way of being of a system. It’s a mark of the order status of a system. The synergistic function has two forms or works in two ways. One is the capacity to sense and differentiate the environmental changes, to respond to the influence of the environment, which we call responding capacity. The other is the ability to exert influence to select or fix the environment, which we call selecting ability. A system is more difficult to be affected if it has a stronger selecting ability, and so it is weaker in its responding capacity. They are the two sides of one coin. Obviously, a more ordered system has stronger selecting ability and weaker responding capacity. If only electromagnetic interaction involved, an electron has only one kind of synergistic function. It can only respond to and select environment with this kind of function. A more sophisticated system may have stronger selecting ability and weaker responding capacity, but generally its synergistic function is always limited. Thus for any system, there must be some parts in its
environment which it can not select but only to be influenced. The part of the environment to which the system can apply its selecting ability is called the inner environment of the system. Unless specially mentioned, we usually refer to the inner environment simply as environment. The part of the environment which the system can not fix but only have to respond to is called the outer environment of the system. A more ordered system has a stronger selecting ability, and so a more abundant inner environment. The inevitable existence of defect or limitation in a common system corresponds to its outer environment. System and its environment compose all objects in our research, and we can say nothing about things apart from these.

3. The Uncertainty Quanta of a System

The synergistic function of a system is usually limited. Therefore there must be some uncertainty in its environment. We define three uncertainty quanta to represent the uncertainty in the environment of a system. As will be seen, these uncertainty quanta also reveal some kind of quantum nature for the system.

- Mass quantum: $m_q$
- Space quantum: $l_q$
- Time quantum: $t_q$

The mass quantum $m_q$ is the smallest mass unit that the system can recognize. According to the relationship between mass and energy revealed in Einstein’s theory of relativity, we may also take the mass quantum $m_q$ to be the mark of the selecting ability of the system. The smaller the mass quantum of a system is, the more accurately and further it can fix its environment, thus the stronger its selecting ability is. The space quantum $l_q$ is the shortest length for the system, within which all points are absolutely equivalent. Viewed from the angle of relationship between different systems, $l_q$ reveals the degrees of quantum nature of space in the system and its environment. The time quantum $t_q$ is the shortest time interval for the system. It is the basic constructing brick of time. Time interval that is shorter than $t_q$ is meaningless to the system. These uncertainty quanta may change their values in the evolution of the system. In extreme cases, they may be zero or infinite. The more ordered a system, or the higher its synergistic level, the smaller its mass and time quanta, and the larger its space quantum. This means that the selecting ability as well as the quantum character of the system have been enhanced, the clock has been slowed down. Here, the changes of clock have nothing to do with the special theory of relativity. They are independent time transformations. The difference in clocks of two systems with no relativistic effect is determined by the two time quanta.

The speed of light (or the maximum speed) in the system and its environment can be expressed descriptively as (See a following chapter “Consideration on Mathematics” )
Different systems may have different space quanta and time quanta, so it is natural there may be different light speeds for different systems. The inside of $m_q$ and $t_q$ and the outside of $l_q$ represent the limitation of the system in its synergistic function. The uncertainty quanta are characteristic nature of a system. Some special systems in our study may have uncertainty quanta other than mass, space and time quanta. They may also have only one or two uncertainty quanta in its one or two special properties.

4. Self-centered System

When a part of the environment can not be fixed by the system, but only affects the system, then it is in the outer environment of the system according to our definition. It reveals the limitation in the synergistic level of the system. A specific environment belongs to a specific system, and each system has its own special environment, although there might be common or similar part of environment for different systems. So in principle, people can not talk about the environment of others who are also part of the environment of the subject. The division of system and environment endows a special role to what is defined to be the system: it becomes the subject. There is only one system, everything else are all things in the environment. The states of a system and its environment on a time quantum corresponds to each other. When we regard ourselves as systems, then the corresponding relation is the source of the onlyness in our world. The continuous and infinite correspondence between system and its environment is the evolution of the system and its environment. Therefore, in this sense, there is no evolution that belongs only to system or only to the environment. Evolution refers to the changes of relationship between system and its environment. The limitation in the synergistic function results in uncertainty in the evolution to the system. Thus we see that the uncertainty in the environment is caused by the system's own limitation. When the system applies its selecting ability, the state of the system determines its environment to the degree marked by its uncertainty quanta.

The physics property of the environment is determined by the synergistic function of the observer system. A constant light speed is a basic presumption in the theory of special relativity. It was introduced as a law of experience. In my opinion, light travels at constant speed because it is measured by the same observer, according to same theory, using same kind of device, with similar method and in like environment. Such presumption may describe the inner environment of mankind quite well, but it may also turn to be a obstacle for a deeper theoretical insight. I firmly believe that behind each law of experience in nature lies something deeper, more natural and more harmonic.

III. Discussion for EPR Paradox

After quantum mechanics was put forward, people were not satisfied with its proba-
bility character. A group of physicists headed by Einstein insisted that physics should be deterministic in principle, rather than mere probability description. That gave rise to the famous debate between Einstein and Bohr. In 1935, Einstein, Podolsky and Rosen designed a theoretical model in quantum mechanics which designated later as EPR paradox. In EPR paradox, a system composed of an electron and a positron with their spins polarized respectively in +/-z directions was set off collinearly with a photo. Since the total angular momentum and total spin were constant zero, there would be instant influence to the other particle if we measure the spin of one particle according to orthodox quantum mechanics, no matter how far apart they were. This, of course, does not comply with the sermon about constant light speed. Einstein regarded it as a mark of incompleteness of the theory, and Bohr explained it with quantum mechanics and pointed out that the cause of the paradox was a wrong viewpoint of natural philosophy we had been used to, i.e., measurement would not affect the object.

But there was something unusual in the explanation of quantum mechanics: the two particles were regarded as one object. What makes us take them as a whole? In my theory the two particles are considered as one system in the environment of the observer. They compose a system because they are ”correlated”, and this is in turn because they are created at same time. This means they are created within one time uncertainty quantum of the observer. Such a time interval, shorter than the time uncertainty quantum of the observer, can not be identified. So there must be some uncertainty in time. And uncertainty in time will result in uncertainty in space. Thus EPR paradox turns out to be a good demonstration of the limitation of the observer. It is straightforward to see from (1) that the observer may think the system has either infinite light speed or infinite space quantum, therefore is of distance. Actually these two cases are the same in this theory. When the observer measures the spin of one particle, the signal will travel to the other particle at a speed larger than light speed of the observer. You may also say, the distance relative to the observer between the particles is smaller than the space quantum of the EPR system. Therefore the two locales of particles are equal and indistinguishable in EPR system. This is why the EPR system is a whole to the observer.

EPR paradox is a very good example for superlight speed. But in it lie things which are more significant. Here we get a deeper understanding for correlation. When we say that a group of particles are correlated, it means that they are created within one time uncertainty quantum of the observer. Thus we can not decide their relative positions in space, just like the case in EPR system. According to modern physics, all matters in the universe, especially our physical body, have a common origin, the originating irregular point of the Big Bang. This means all the elementary particles were created within a time interval so short that we can not identify now. Thus according to my theory they were created in one time uncertainty quantum, and therefore correlated. So on one hand, we can not decide the distances between these particles in space in principle. On the other hand, everybody correlates with the world,
and together they form an inseparable whole. In this way, everybody, in fact every system, establishes an unusual corresponding relation between the states of his body and the universe. This is something very important but often ignored in the discussion of EPR paradox. We shall discuss its profound meaning from a brand-new angle in “Quantum Cosmology”, my third paper of this work.

IV. Discussion on the Basis of Statistical Physics

In recent decades, people began to show concern again for the basis of statistical physics because of the achievements in nonlinear sciences. Statistical physics applies statistics to physics problems, studies assembly of particles in a large number. Combining dynamical descriptions with statistics, it tries to explain the macroscopic properties of the system. Statistical physics assumes that the macroscopic properties of the system is the average of microscopic counterpart on all possible microscopic states under specific macroscopic conditions. The average is derived with the help of the concept of statistical assembly, which is a collection of a great number of imaginary assemblies, independent, with same properties and under same macroscopic conditions. When an isolated system reaches equilibrium, it can be on any of the microscopic state of the same energy with same probability. This is the so-called “postulate of equal probability”.

The postulate of equal probability, which actually has other profound implication (See the third paper "Quantum Cosmology"), got into continuous controversy as soon as it was born. Therefore, Boltzmann put forward the ergodicity assumption to take place of it. The ergodicity assumption assumes that the measure of non-ergodic orbitals in phase space of a conservative system with limited freedoms are approximately zero. Here ergodic orbitals are referred to those which linger in the same area of the energy surface for the same length of time. Many people hoped this assumption could work as a good basis for statistical physics. But it was not as good as expected. Since the 50s, with the progress in the research of KAM theorem and related problems, people have gradually come to know that the measure of the KAM constant ring is not zero in many cases, thus the ergodicity could not be realized. But statistical physics, which has already made great achievements, requires some kind of "state-mixing", which is a stronger prerequisite than ergodicity. How to understand the conflict? From the reversibility and certainty of microscopic dynamics to the irreversibility and uncertainty of statistical physics, what causes the mysterious change?

Another chronic problem perplexing statistical physics is the source of randomness. During the late scores of years, advances in chaos have changed the outlook of this problem to a certain extent. Now most people believe that both the large-number effect and the inner randomness in nonlinear system are all responsible for the randomness in statistical physics. But what are the natures of and relationship between the two kinds of randomness? What is their relationship with the uncertainty in quantum mechanics? Here, I shall put forward a picture based on this theory of general system to understand the problems above.
According to my theory, the uncertainty for a system can only come from the outer environment of the system, i.e., the finite uncertainty quanta. This is the intrinsic nature of the system. And it is this intrinsic nature that gives rise to all kinds of uncertainty existing in forms appropriate to the situations. Apparently, the higher the synergistic level of the system, the smaller the uncertainty in its environment, and thus the less likely to be affected by the environment the system will be. You may also say, its degeneracy is higher in this case (degeneracy is the ability of a system to correspond to the abundance of its environment, see the third paper “Quantum Cosmology”). Reversely, systems of lower synergistic levels, e.g. systems in quantum mechanics, have lower degeneracy and therefore larger responding capacity, thus are more likely to be influenced by the environment. In such cases, because of the limitation in our observer systems, we can not get to know all the influence on the system exerted by its environment (e.g. our measurement). Therefore it is destined we’ll have to face uncertainty and randomness. Generally, observer system has its own inner environment and outer environment. Changes invisible to us observers might be strong enough to cause notable effect in simple systems. Thus comes the uncertainty and randomness. So we can conclude that limitation of the observer is the direct cause for the randomness in quantum mechanics.

As we said above, there is an one-to-one correspondence relation between the system and its environment. With this viewpoint we can have an integrated understanding of the randomness in quantum mechanics, statistical physics and classical physics. Obviously, for a macroscopic statistical system we’ll still have to face randomness as in quantum system because of our own limitation. But here with the higher degeneracy of the system, it has got some independence and we have lost some information. Thus the increased degeneracy in the system corresponds to the decreased degeneracy in the observer system, and thus will add to the uncertainty of the latter (See the third paper “Quantum Cosmology”). When an isolated system evolves from non-equilibrium to equilibrium, it is divested of its order and so assimilated by the observer system (See the second paper ”Where Has Entropy Gone” ). In this process of assimilation, the system loses its order or negative entropy, and at equilibrium it has lost its independence and become part of the observer. Its degree of order is lowered down below the limit of the observer, which is revealed by the fluctuation in the system. Except for the special case of the perfect system, fluctuation is inexorable.

This results in a special state-mixing. In the next paper “Where Has Entropy Gone”, I’ll show that the order of the system and its environment can be transformed into each other, while their total entropy remains constant. In the evolution of an isolated system, the observer deprives the system of its order. This makes the observer system more ordered or more degenerated, and thus the clock of the observer system slower. The state of the system that is farther away from the equilibrium has smaller weight thus corresponds to less ordered state of the observer system, or state with faster clock. Actually, it is not very difficult to understand this, if we can accept the idea that different systems may have different time
quanta, thus different clocks. Though we haven’t got a definite formula for the relation between the entropy of the system and clock of the observer system, it seems that within the above frame we can visualize that the time of relaxation is finite, assembly averages can give most of the experimental results and fluctuations from the average are incidents of small probability.

It is lopsided to consider the problem of re-establishing foundation for statistical physics just as to explain its probability feature with deterministic feature of microscopic dynamics. The reason is that uncertainty in our environment is inexorable if our own system has limitation. Even if we finally found such deterministic equations, we would still be unable to grasp the complete meaning of them because of our own limitation. Researches in chaos have given good examples in this aspect. While most of the systems in quantum mechanics and statistical physics are simple systems that have only simple synergistic functions, sophisticated systems usually have some kinds of nonlinearity for their relatively stronger synergistic functions. The innate randomness of system described by deterministic equations, or chaos, is an effect in which nonlinearity functions. Commonly, there are two possible explanations for the origin of probability in a dynamical system, either because we are somewhat ignorant of the initial conditions, or because of a non-local description that might exist and can take place of orbitals in dynamical system. It is a mistake to think that we will only agree on the former because of the feature of uncertainty quanta. In my opinion, the two possibilities are the same, because both of them are resulted from the uncertainty quanta in the researcher (observer) system. It is these uncertainty quanta that make us unable to see the transformation and unification of space and time.

It should be noted here that although chaos is so popular in classical areas that it almost turns to be a fashion, it has not been found in quantum mechanics yet. This striking contrast gives a lot for thought. Obviously, since we have limitations ourselves, we should find uncertainty no matter in classical or quantum systems. Yes, we have. But uncertainty gives different manifestations in the two kinds of systems. Quantum mechanics admitted uncertainty from the very beginning and takes it as a basic principle, from which it has developed its special arithmetical rules. Though such frankness of confessing its own limitation is not endearing, it has not only put our understanding for the world a big step forward, but also, to be greatly arousing, wiped out the uncertainty in the form of chaos because of its open and well-defined uncertainty feature. In classical systems, reversely, we suppose to be omnipotent observer and adopt mathematics with transinfinitely divisible feature. But still we can not get rid of uncertainty. It may appear as the difficulty to grasp a great number, or as being incapable to get all initial conditions. Whether we like or not, the subjective limitation of the observer is destined to be involved. Then why don’t we include it in a more advantageous way? When you finally read through my work, especially when you understand my third paper ”Quantum Cosmology”, you will see that this theory is just the right theory for the purpose.
Three systems are involved in the studies of chaos, i.e. phenomenon system, theory system and observer system. Each system has its own characteristic synergistic function, thus there might be some mismatch among the corresponding uncertainty quanta. The mismatch in some cases can show the observer its limitation in its synergistic function. Take weather forecast as an example. Here the phenomenon system is a very complicated one involving lots of factors and mechanism, so that the contributing factors for different weather may be well within the outer environment of ordinary people. This is to say that there must be some uncertainty in the weather changes for ordinary people. Strictly speaking, there might be significant difference even among mankind (See the second paper "Where Has Entropy Gone" ). The ordinary people here are referred to those human observer system with most common cultural and physiological feature. Meteoric research apparatus may change the synergistic level of the observer system but not our conclusion. The theory system in the research of weather forecast is the group of integrated differential equations, which are based on the real set in mathematics. Researches in chaos tell us that long-term weather forecasting is impossible. This is because of the "Butterfly Effect" in phenomenon system, and because of extreme sensitivity of the dependence of the mathematical model on initial conditions and the transfinite divisibility in theory system. Suppose our theory system can describe the phenomenon system well enough, then the "Butterfly Effect" and the sensitivity on initial conditions are of the same nature. Both of the two reveal the limitation of the observer system whose uncertainty feature can not match with the transfinite divisibility of the theory system. We can not grasp the delicacy of mathematical model, just like we can not grasp the complexity of the environment. In such examples we see the uncertainty in our world through mathematics, the common intelligence of mankind. Though the mathematical system has only one uncertainty quantum(see the following chapter), it is a more sophisticated system than ordinary people. To get further understanding on this point, we have to make some consideration on mathematics.

V. Consideration on Mathematics

One reason that science has deeply rooted in the hearts of human being is its speculative philosophy and distinctive quantitative feature best embodied with mathematics. If the world could really be determined quantitatively from a few simple rules, we would be really the master in the world. In the nineteenth century and even at the beginning of the twentieth century many scientists had such beautiful dreams. A century has pasted since then. When we turn round to review today’s science, we find regretfully that there are very few areas in the varieties of natural sciences in which such dreams have come true. Even in physics, which is the underlying subject for other sciences, such dreams have turned out to be soap bubbles. Quantum mechanics was the greatest achievement that the science of the twentieth century could be proud of. With its brand-new characters like the uncertainty principle and probability explanation of wave function, it perplexed many idealistic physicists. It had
been not long since people generally accepted quantum mechanics, when another magician came on the stage quietly. That is the nonlinear science. It has brought about a lot of new achievements and given a big shock to old ideas. Although both quantum mechanics and nonlinear science have given deadly blows to the dream to determine the world from only a few simple rules, the latter seems more complicated so that some people think the chaotic delicacy is beyond human comprehension. In my opinion, this is because that the mathematics plays a special role in it.

The original and direct source of mathematics was human experience. Man is the most popular and important system. Every man has his own Inner and outer environment, his own uncertainty quanta. This is why the natural set, with apparent quantum character, was the simplest and therefore the first mathematics to come into being. The natural set is in accordance with individual experience and thus a system simpler than individual human system. But with the efforts of many mathematicians, mathematics turns to be, it seems, an independent system which goes further and further beyond individual experience. In this system, there are the infinite and the infinitesimal, infinitely divisible real set, transfinite ordinals and cardinals and so on. Even if the significance of these work is not completely clear, it should not be refuted because it has brought about abundance of ideological fruits for human being. Because of the development of the linkage between human individuals, mathematics today has long become a large system parallel to the whole human being. It has gained a certain independence, occupied more and more domains, and tried to find advancing motivity from within its own consistency. Such trend culminated in the wave of axiomization of the twentieth century, during which formal descriptions were too highly praised, the ties between mathematics and physics was weakened, and practical source of mathematics was concealed. It seems that mathematics has gained some vitality from human being and also motivity for its own development. Unfortunately the mansion of formal mathematics is not perfect and still haunted by randomness. This reminds us that there is still limitation in today’s mathematics or in the way we understand it. Today mankind has become a closely related whole and almost every individual has some character of the whole human culture to some extent. There may be no infinite in the experience of an individual, but human being can accept it because the experience and therefore the intelligence of the whole human being are infinite by themselves. Though science and culture today are truly to be proud of, they are still systems with limitations. So it is with mathematics. It needs to get new vitality from the innovation of physics ideas.

Most of the mathematics we use today are based on the real set, which has the property of transfinite divisibility that is contradictory to the quantum feature of human individual system, so there must be some results beyond our comprehension. In linear mathematics people can always presume that the change of a variable is in quantum (no matter how small the quantum is), which is in accordance with our experience. But nonlinear calculation has completely lost the familiar feature of quantum. It is iterative, accumulative and
divisible. The transfinite divisibility of the real set is a mathematical idealization. Not only is it different from experience of human individual, but also it is related in a profound way to many famous problems which symbolize the mystique of the nature of mathematics. In fact, most systems have uncertainty in their synergistic functions so that they can not fix its environment with infinite accuracy. Thus very perhaps the infinitely divisible delicacy of mathematics has complicated many problems, thus made it incapable of providing clear insights. This is why I think it necessary to promote the research for a new kind of mathematics characterized with uncertainty quantum. In this new mathematics there will be new definition for limit and new algorithm. The infinite and infinitesimal, which have been strange to each other in present mathematics, will be linked together in a wonderful and profound relation. I believe such mathematics will reveal a new scene of the world for human being.

Apparently, just as quantum mechanics admitted its uncertainty openly and frankly, the new mathematics should have certain fuzzy feature. We know that the classical mathematics, which is based on ZFC axiom set theory, does not cope with fuzzy objects because of its clarity in the way it constructs its sets. So the set theory in common sense can not form the basis for the new mathematics. Though the present fuzzy mathematics has obtained a certain fuzzy feature with the introduction of the concept of membership, there are still two points in its nature which shackle it well within the domain of classical mathematics. That is the transfinite divisibility and the law of excluded middle. The present fuzzy mathematics gives no criticism to the law of excluded middle. And its logic, multi-value logic, is still in the sense of classical mathematics. As we pointed above, the transfinite divisibility is not in accordance with the reality. It is not difficult to visualize that the law of excluded middle is incorrect whenever and wherever the transfinite divisibility fails. The reason is that the empty set in such case is not really empty. There is an axiom for empty set in the ZFC system which says that there exists an empty set that contains no element. In fact, such empty set is available only in the real set which has the character of transfinite divisibility suitable for describing ideal case rather than reality. When the transfinite divisibility is futile, there must be a smallest unit (uncertainty quantum). If such smallest unit is taken to be the empty set, then there must be structure within the empty set which we can not know by nature. And because we can not know, we can not exclude the possibility that there might be infinite and transfinite structure in it. That is, we can not exclude the possibility that there are divergent structures inside the empty set. As a matter of fact such cases have already been seen in fractal geometry. On the other hand, according to the definition of the empty set, because we can know nothing about the structure beyond the infinite, all structure beyond the infinite is also related with the empty set. Thus the infinite and the infinitesimal will integrate harmonically in the new mathematics. The classical mathematics, with its transfinite divisibility feature, will turn to be a special case in the new mathematics when the empty set is really empty. Thus I believe, the first step to construct the new set
theory, which will serve as the basis for new mathematics, is to find a reasonable definition for empty set.

Of course, nobody can deny the great achievements of classical mathematics. What I give here is only the most tentative idea about the new mathematics. It will have non-local, integrated and systematic character. Our understanding for the world will be greatly deepened with the development of the new mathematics. Like in quantum mechanics, we will not lose quantitative advantages because of the fuzzy feature of the new mathematics, but will we can have a panorama of the uncertainty that we can not see with classical mathematics. Thus as a matter of fact we will have more certainty than before in a broader sense. On the other hand, once we get all the qualitative conclusions we need, why do we still need quantitative description? Quantitative or qualitative, this may be the ideological difference between local and integrated mathematics.

Here we shall also put forward a picture to understand the continuum hypothesis (referred to as CH in the following). In 1878, Cantor conjectured that the weight of the continuum was the second transfinite cardinal. But until his death forty years later, the great mathematician did not give a proof for the conjecture. That is the well-known continuum hypothesis. In 1900, the great mathematician Hilbert listed in a report twenty-three outstanding difficult mathematical problems, the first of which was to prove the CH. But the proof here degenerated into such requirement as to show the problem is unsolvable in the given sense under consideration. After the work of Gdel and Kohn, many mathematicians realized that the CH was undecidable in the common axioms of set theory, the difficulty might be not purely mathematical and the solution would depend on innovations in the basis of mathematics. In our theory, the weight of a set is comparable to the abundance of environment for a general system (See the second paper "Where Has Entropy Gone"). As I showed above, the real set is transfinitely divisible. Because of this property, the null is a real empty set without any structure. But in ZFC system and also other formal axiom systems, there are surely independent proposition. So they are systems with outer environment, their empty sets are not really empty. Therefore compared with ZFC system, the continuum is a more sophisticated system with higher synergistic level. Obviously, in principle a low-levelled system can not understand, let alone prove, propositions in a higher-levelled system, because the former has more uncertainty. So we see that the reason that no solution for the CH has been found yet is indeed having been under insufficient prerequisites or in an incorrect sense. But the effort in solving the problem as well as the thinking aroused in the process is a very splendid page in the history of human ideology. It still gives us inspiration today.