10 Unsolved Problems in Physics

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Abstract— In early 1900s, the British physicist Lord Kelvin declared: “There is not anything new to discover in physics. All remains is to advance accurately measure its quantities.” In the same year quantum physics was born and three decades later it, and Einstein’s theory of relativity, had completely revolutionized and transformed physics. These days, hardly someone would dare to say that our knowledge of the universe, and everything in it, is almost complete. On the other hand, every new discovery appears to open a Pandora’s Box of larger and deeper issues. I have gathered some of today’s biggest unsolved problems in physics, and tried to list them in this research paper.

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I. Quantum Gravity

The biggest and the most unsolved problems in physics is how gravity and the quantum will be made to co-exist. Quantum Gravity is must to make whole of physics logically Persistence. The problem is that quantum physics and general relativity already overlap other domains, but do not fit it together.

The biggest challenge in quantum gravity, from a scientific point, that we cannot experiment which are really required. For instance, a particle accelerator based on present technologies should be larger than our whole galaxy to test the effects directly. This concludes that the quantum gravity today is not yet science in the proper sense. No experimental input exists that can inspire and control conceptual ideas, and historically we know that conceptual “progress” then it always occurs in completely wrong directions.

Legendary Einstein have a dream to describe the nature in a single theory. That dream is still not developed yet.

II. Practical Masses

The so-called standard model of particle physics, the most fundamental the- ory which is tested [2] and which we know is true (within the energies tested so far) contains 18 free parameters, and even more if neutrinos are not strictly mass less. These parameters cannot be calculated or predicted theoretically. One can see at them as 18 adjustments knobs we can twiddle to best adapt the theory to all known data. The problem is that this is just too many. The so famous mathematician John von Neumann once said: “With four parameters we can fit an elephant, and with five, I can make him wiggle his trunk.” The absolute majority of the 18 are related to the different values for the masses of the elementary fragment. From a theoretical point, then, the particle masses are a total mystery to us, they well have been random numbers drawn from a hat. The first generation - which contains the electron, the electron-neutrino, the up quark and the down-quark are followed by two additional copies which appear identical in everything except their masses. Ourselves and everything we know of, both on earth and in the cosmos, consist only of fragment from the first generation. What are the heavier ones for?

III. The Measurement Problem

In the strange world of electrons, photons and other fundamental fragment quantum mechanics is law. Fragment do not behave like little ball, but as waves spread over a large region. The fragment instead has countless opportunities, until one experimentally measures one of them location, for instance, then the fragment wave function “collapses” and, apparently at random, a single well defined position’s are observed. But how and why does a measurement on a fragment makes its wave function collapse, which in return produces the concrete reality?

According to study in quantum physics it should be impossible to get a certain value for anything. Why then do we don’t see ghostly super positions of objects even at our level? This problem is still unsolved. When can something be said to have happened at all? Without assumptions beyond quantum physics, nothing can ever happen! This is because the wave function mathematically is described by so-called linear equations, where states that have ever coexisted will do so forever. This, we know that specific outcomes are possible, and moreover happens all the time. Another strange thing is uncertainty in quantum physics arises in the measurements only. Quantum mechanics is deterministic as classical physics, because it is exactly linear and thus so simple.

IV. Conflict

Conflict or turbulence has been called the last unsolved problem of classical physics. The top physicist Werner Heisenberg has said on his deathbed to have uttered: “God! Why relativity? Why conflict?” One in general cannot solve the equations of the behavior of fluids air, water and other form of liquids and gases. In fact, the kind of chaos inherent in conflict- in both time and space - is still a mystery. One has to come to suspect it, for example, the weather is difficult to predict, but fundamentally impossible now a days. Does conflict exceeds the human physical understandings and mathematical abilities? or would it become intelligible if only we tackled it with the right methods?

V. Dark Energy

50 years ago it was self-evident that universe was dominated by matter. In early 1920s it was discovered that the universe is expanding rapidly, and as matter acts like brake, because of its attractive gravitational force, everyone agreed that the universe expansion rate should slow down. The surprise was therefore complete when the observational data instead seems like to indicate that universe is accelerating, i.e. increases its rate of expansion, as if the cosmos recently moved its foot from the brake pedal to the accelerator pedal.

The Best suit to the cosmological standard showed us that about 70% of the energy of the universe seemed to be of a completely unknown form, which has been named Dark Energy.

As so often, it was Einstein who introduced the concept first. He invented his cosmological constant, which represents a form of dark repulsive energy; already back in 1917's, but in a completely different context. The mystery is that no one still knows what dark energy is and does it really exists?

VI. Dark matter

Other observations show us that about 95% of the matter itself in the universe is made up of an unknown, exotic variety that neither absorbs nor emits lights. Dark Matter, cannot be seen, and is never discovered yet. Instead of this, the dark matter's existence is still hypothetical and its abundance derived from its gravitational effects on visible matter, radiation and structure formation in the universe. This strange invisible matter is thought to not only permeate the outskirts of galaxies, but the entire universe possibly, consist of weakly interacting massive fragment WIMPs, massive compact halo objects MACHOs. There are today several studies and experiments around the world in search of them.

VII. Complexity

Although the four known fundamental forces of nature that are electromagnetism, gravity, strong nuclear and weak nuclear are all relatively simple, it is almost impossible to directly in details predict the behavior for simple to even complex systems. Is this a real point of nature, or just the results of our theories that being formulated in non-ideal ways? The logical possibility also exist that the world is not reductionist (or rather, constructionist), that is, that a handful of fundamental laws are not sufficient to build up or re build all the complexity that we see around us, but rather then these have to be supplemented by unknown principles on different scales.

That some complex systems can exhibit surprisingly simple collective behavior, as when, for example, thousands of fire flies spontaneously start blinking in sync without any "conductor" to control them [9]. Disorder apparently sponta-neously self-organizes to order, in contrast to the traditional notion that the disorder/entropy must always increase. Many believe that this field of research will be essential for understanding and explaining phenomena such as the origin of life (and what life really is) and how consciousness seemingly miraculously can arise from mindless atoms in the brain.

VIII. The mater-antimatter symmetry

It is considered that the universe when it is born treats mat-ter and antimatter symmetrically. So that, the Big Bang should produce equal parts of matter and antimatter respectively. This should then have resulted in a total annihilation of the two: protons would have annihilated with antiprotons, electrons with anti-electrons (positrons), neutrons with antineutrons, and so on, which would have left behind a structure less sea of photons in a matterless void. For some reason there remained tiny excess of matter.

This has not yet any explanation. But that in turn means that the answer to this riddle must contain a fundamental time direc- tion, the universe cannot be run backwards because two completely different final states whether it is matter or antimatter would arisen from the same initial state. A complicated way of saying the same thing is that today's most fundamental theory is CPT invariant that is the same when simultaneously changing the particle charges (C), mirror reflecting their state (P) and reversing the direction of time (T).

IX. Friction

It may seem surprising that in physics we still do not understand how something is as obvious as friction arises. Since friction bleeds away energy from a process in the form of heat, it is very possible that this problem is intimately connected with some of our other unsolved mysteries

For example how structures can form and why time only flows forward. On a microscopic frictionless level, one can freely reverse the temporal direction and it still gets a perfectly possible behavior. If we imagine a movie where two electrons collide, it is impossible to say if it runs in the right direction or not. But if we instead see a hockey puck that glides along the ice and stops due to friction, we can immediately sense if the movie runs forwards or backwards.

X. The arrow of time

It is sometimes argued that time moves forward due to the fact that a prop- erty of the universe called entropy also defined as the degree of disorder, never decreases for a macroscopic system. There is no way to reverse increase in the total entropy after it has occurred. But the underlying and unresolved question then becomes: why was the entropy so low in the past? In other words, why is the universe is so ordered in the beginning, when a huge amount of energy was contained in a very small space? We have merely replaced one mystery with at least equally great. But this symmetry breaking is too weak to explain the time arrow and only operates on extremely short length scales, mainly inside atomic nuclei. As we have so far described it in our theories, is really just an illusion?

XI. Conclusion

Complexity arises in systems with nonlinear "feedback".

Dark energy is not needed to explain cosmological data. Matter in the universe is in reality not evenly distributed in contrast to the basics assumption in the standard model of cosmology (an idealized universe; perfectly homogeneous and isotropic) designed to make Einstein's strongly nonlinear equations much simpler and analytically soluble. There are aggregations of matter (galaxies, etc.) that violate this idealized image, also the difference between the voids and the lumps automatically grows as the universe is expanding, i.e. the non-linearity increases with time. So far there is no fundamental explanation of friction, again because the fundamental understanding of the transition linear nonlinear is missing. Similarly with the riddle of conflict- as flow increases a laminar (almost linear) behavior turns into a severely turbulent strongly nonlinear.

There is a chance to link everything to perhaps the greatest mystery of all the quantum measurements problem. How, when and why the indeterminate quantum world generates our concrete, definite macroscopic world, i.e. how what we call reality really arises. When a certain type of helium is cooled to almost absolute zero temperature it becomes super fluid and flows completely without friction; raise the temperature a bit and it behaves like a normal (non-linear) liquid

However, we should also remember Freeman Dyson's cautionary words: People are often asking me what's going to happen in next science that's important, and of course, the whole point is that if it's important, it's some-thing we didn't expect.

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