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The Lessons of Quantum Mechanics and Cosmology

It is well known that one of the biggest difficulties for cosmology is to explain why the constants of nature have the values that they actually have. In other words, why the universe has the matter and large-scale structure it actually has. It is also well known that this problem has to do with the existence of life and of human beings (the anthropic principle). The concern is understandable, since physicists look for symmetries and try to explain why there are symmetry breaks. For this reason, a theory of multiversum is born, that is the idea that actually any possible combination of the constants values is instantiated in some universe. This would represent, indeed, a huge symmetry, especially taking into account the number of these universes.

An analogous symmetry problem was born in quantum mechanics, related with the measurement problem. Here, one could not understand why a given possible value of a measured observable is realized at random. For this reason, Everett proposed in 1957 that all values are realized simultaneously (each one for a different observer). Later on, de Witt fulfil this approach by speaking of different universes, and such approach is known now as Many World Interpretation (MWI). This approach is also sometimes connected with the cosmological proposal of the multiversum.

However, quantum-mechanically this proposal is not tenable (as shown by Zurek), since it does not solves the most fundamental problem of the quantum measurement, namely the fact not that one value is instantiated but that one observable is measured. In fact, before measuring, many possible expansions of the same state are possible, that is, many possible observables are measurable. However, these observables, due to the uncertainty relations, are in general incompatible, and therefore are not jointly measurable. In other words, any mmeasurement requirs the "choice" of agiven observable. Since the MWI rejects such a choice and tries to interpret measurement as a process that does not change the initial state, either we would have no measurement at all or we would run into contradiction.

This is the reason why the MWI was later combined with decoherence (an interpretation due mainly to Zurek himself), but this, for many reasons, was not a happy solution.

Therefore, the multiversum's proposal cannot take recourse to quantum mechanics. Moreover, the randomness of quantum events seems not reducible. This leads us to the most difficult problem. Many proponents of the multiversum see in such hypothesis not only the solution of the symmetry of the nature constants but also and mainly the solution of the problem why such and such events actually happen. In other words, they see in such a proposal the solution of the contingency problem. If possible, this solution were possible, would be the mother of any symmetry. In this way also the problem of the origin of life and existence of humans would also be solved. However, this is a faux pas. Quantum mechanics teach us that probably all quantum systems of our world are somehow entangled (interrelated). This means that it is impossible to change only one event locally, but that such a change would probably affect trillions of other events and systems. If so, it is impossible to find an universe that is exactly the same as our one but with only one change, say that there is a photon less in this room. For this reason even if there are 10500 or 101500 universes, they will never cover the huge see of all abstract possibilities, that is of all alternatives to each single event, which all together would exhaust everything that is conceivable and therefore eliminate the problem of contingency.

In my opinion, the physicists who reason in this way have not reflected sufficiently on the nature of quantum laws. Quantum laws do not govern properties of systems but only probabilities of properties, and, for this reason, they do not rule singular events but are general in nature. As Charles Peirce already understood, any lawful explanation is general in nature and cannot account for the fact that, for instance, a pen is here on the desk.

Therefore, contingency constitutes a irreducible feature of our universe, and I will hope that philosophers and theologians will work in the future in order to point out its nature. This would be a service even for science.