A Say About Wheeler-Dewitt Equation

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Abstract

An interpretation of Wheeler-DeWitt Equation on the basis of conservation laws has been presented.The static universe implied by WD equation seems quite obvious once one realizes that time is an emergent concept rather than the fundamental one.An isolated system is always static because its observables are bound to conservation laws.Concept of time needs a dynamics to be defined; for a static system it loses its existence.I have argued that whole universe as a system is static due to conservation laws and time-evolution of this system is meaningless.

Keywords: WD equation, Conservation laws

Perhaps the biggest puzzle of contemporary theoretical physics research is the absence of time in the Wheeler-DeWitt equation [1], the equation which is supposed to describe the evolution of whole universe and is the analog of Schrodinger Equation in Quantum Gravity.The equation says:

$$H\psi = 0 \tag{1}$$

Here H is the so called Hamiltonian constraint and ψ is the wave function of Universe.The absence of time on right hand side seems problematic since it implies that there is no evolution at all of our system, the whole Universe. Physically it means that the whole Universe as a system is completely static,nothing happens at all. This is obviously counter-intuitive.

In my view, there is no surprise in WD equation implying a static Universe. An isolated system is always static due to conservation laws. A system

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is characterized by observables like energy, momentum,charge etc. and to every observable there is an associated conservation law. For an outside observer, all these things remain constant for a given system. There are only two possibilities for a system to become dynamical - either it interacts with something external to the system or there is some violation of some conservation law. Consider,for example, a system of particles interacting with each other.Now the subsystems of this system may be dynamical since their momentum,energy etc.may be changing due to mutual interactions .But with respect to every observable,our system as a whole remains static. Its momentum,its energy,its charge etc. remains fixed And this static nature of an isolated system is just a consequence of conservation laws. In fact, I think, conservation laws are there only to preserve the original static nature of a system.

For whole Universe as a system,nothing remains external to it,which could interact with it to make it dynamical. The time evolution of the wave function of the Universe would then imply some violation of our trusted conservation laws.

WD equation is also a proof of non-existence of time, an idea of Leibnitz advocated by Julian Barbour [2] and in which I strongly believe. Time comes into existence only when a system becomes dynamical because it is defined, in first place, in terms of changes.If there is no observable change in a system, time loses its meaning. For whole Universe as a system,nothing remains external to it to make it dynamical and to bring time into existence.No time means no time evolution and hence no surprise in any implication of WD equation.

References

[1] DeWitt B S "Quantum theory of gravity. I. The canonical theory," Physical Review 160 1113 (1967).

[2] Julian Barbour gr-qc arXiv:0903.3489