The principle of measurement and the basis of Big Bang Cosmology

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A changing universe implies, by the definition of measurement, a non-changing basic unit of space framework. Otherwise the change is meaningless. This principle has profound implications on the physical world.

As we learned from Gauss, Riemann and Reichenbach[1], any measurement of distance imply the existence of a yardstick - a non changing fundamental measuring unit, which remains constant despite changes in the area to be measured. Measuring a distance is to find out how many yardsticks are included on that distance, whether it is done directly or by indirect methods, like redshift of light. These principles apply to any metric used, e.g. Robertson-Walker metric or any other.

Big bang Cosmology describes an expanding universe that began far smaller than an atom, and expands to the present size and beyond it in the future. The possibility to measure the expansion of the universe implies that such a yardstick actually exists. Otherwise, the expansion would not be measurable, and furthermore, would be meaningless, from the inside of the universe (of course, a *god like* view from outside the universe, will be able to see the expansion). Furthermore, the lack of such a yardstick makes every relation between constituents of the universe meaningless. Distance and time will not be defined the way they are now. So, we have to postulate that such a measuring unit, a non-changing basic constituent of the space fabric exists. That's what makes the expansion of the universe measurable and meaningful. This basic unit may be the doubly special relativity minimum-length[2] or the discrete lumps predicted by loop quantum gravity[3].

After the big bang, there was a period in the history of the universe, when its own size was smaller than the postulated basic unit of it. During this period, the interactions between the constituents of the universe, and time, were non-defined.
It can be said that physics laws as we know them did not apply during that period.
When the universe achieved this crucial size- a coherence phase transition occurred, and the laws of physics as we know them, began to rule. Since till that moment the only meaningful parameter was the size of the universe, it seems plausible to assume that the universe was homogeneous after the coherence phase transition. The

inevitable quantum fluctuations will provide the local inhomogeneity that seeds the formation of galaxies, stars and planets. In this sense, this mechanism provides an alternative to the inflation scenario- to solve the horizon problem. However, inflation is not excluded by the offered mechanism. The coherence phase transition may have occurred at the Planck time, or even at the symmetry break era.

The assumption that a basic non-changing unit is the basis of the space framework have profound implications on the interpretation of quantum mechanics, and may lead to a restricted Copenhagen description, because it implies a basic difference between the quantum size world and the normal world.

References

1. Hans Reichenbach , The philosophy of space and time
2. Giovanni Amelino-Camelia , *Nature* **418** (2002) 34-35
3. G V Vereshchagin, *Journal of Cosmology and Astroparticle Physics* **07** (2004) 013