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From the Beginning to the End: Towards the Precision Cosmology

The eternal goal of cosmology is to understand how the universe was created, how the universe is at present, and what is the final fate of the universe.



Thanks to the rapid progress of the observational technologies such as the large telescopes on the high mountains and the satellites, and the efforts on the theoretical side, such as the huge numerical simulations with billions of particles, a new paradigm of the universe is now about ready to be established.

In my talk, I would like to present the latest status of cosmology. It is known for more than a decade that about 90 % of the matter in the universe consists of something unknown spices, i.e., neither stars nor gas. Therefore, they are mysteriously called as the dark matter. On top of the dark matter, however, we now know there exists dark energy whose energy is more than factor 3 larger than the dark matter from the recent observations of distant supernova, which is one of the brightest sources of the universe. In other word, the universe is totally dominated by mysterious dark energy. This dark energy is a revival of Einstein's cosmological constant. Ironically, he later admitted that inclusion of the cosmological constant in his master equation was the biggest blunder.

On the other hand, recent observations of cosmic microwave background radiation, which is the oldest fossil of the hot big bang universe, reveal the geometry of the universe is flat, which may be due to the extreme expansion of the universe in its early stage, so called inflation. Moreover, recent continuous efforts to measure the redshifts of 200 thousand to million galaxies start to show the global structure of the universe.

Combing these observational results with theoretical works, we can extrapolate the present universe to the beginning and to the end.