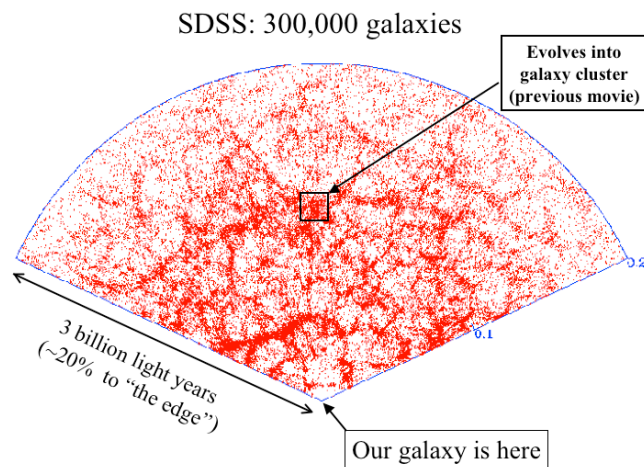


Distribution of Galaxies

Have you ever think that if galaxies in the Universe are distributed in random pattern ? If it is not, what can we learn from the distribution of galaxies? In our Universe, these galaxies are arranged into galah clusters, super-clusters, and voids; furthermore, these form what we call “Large Structure”.



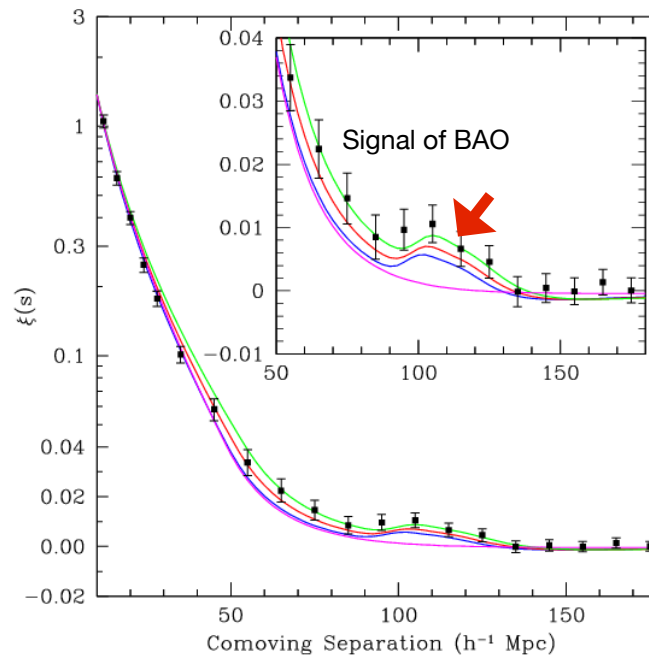
http://www.astro.virginia.edu/~dmw8f/BBA_web/unit16/unit16.html

One of major goal in cosmology is to understand the possible reasons of forming of Large Structure. From the Big Bang theory, our young Universe was full of hot and dense matter called plasma, for example, electrons , protons, any baryonic particles with mass, dark matter, photons, and dark energy.

Due to gravitational and pressure reactions of them, the it would cause pressure waves, or acoustic waves just like we observe in air of Earth's atmosphere. Acoustic waves spherically propagated outward in space; however they were imprinted as the Universe was cooled down around 400,000 years after the Big Bang. In current observations, the results of cosmic microwave background from COBE and WMAP can reveal the signs of ancient acoustic waves.

Baryonic Acoustic Oscillation

Eisenstein et al, 2005, result of BAO



Around 400,000 years after the Big Bang, the Universe became cooled, and the mean free path of photons became large enough to the million light year scale due to the lower opacity of surrounding; however, the baryonic particles and dark matter moved slower than photons, and those materials would gravitationally interacted with one another, and sound waves among them also affected the mass distribution so that it caused stellar clusters, or so called galaxy cluster we see today. In order to estimate the characteristic scale of baryonic acoustic waves on the background in night sky, statistical detection is a proper way to do that, and there is an estimation that these galaxies are slightly separated by 150 Mpc or 500 million light-years.

Standard Ruler

We can know how long a car is by using a ruler, but how could we understand the possible characteristic size of our Universe ? The detection of baryonic acoustic oscillation may be a key to answer this question; moreover, we can also know the expanding history of the Universe and the distribution of dark matter through its method, but how ? Let's research it !