Concordance Model of the universe

Four observational evdence depicts the concordance model of the universe

Hubble Diagram

Redshifts of stars related to the receission velocity shows that more distant stars are leaving us faster.
`Hubble rate`, $100h\ \mathrm{km/s/Mpc}$, desribes this relation, implying that our universe is expanding.

Big Bang Neucleisythesis (BBN)

Observations of abundance of Deuterium and Helium perfectly align with the theoretic prediction of BBN, and agree with the limitation from Cosmic Microwave Background.
This shows that our universe used to be dense and hot, and strongly supports the big bang theory.

Cosmic Microwave Background

The observation of the CMB is a solid proof that our universe used to be hot, homogeneous, and isotropic thus greatly supports the big bang theory.

Large Scale Structure

Surveys of Large Scale Structure shows that our universe has structures and is not smooth which implies that there was primordial density perturbation thus supports the inflation theory.
‘Large’ means the scale is large enough to be estimated by linear theory.

LCDM Model and Beyond the Standard Model

Combination all these proofs comes out the LCDM model, which refers an Euclidean Universe dominated by cold dark matter and cosmic constant today with initial perturbations generated by infation in the early universe.

Three things are out of expectations of the standard model of particle physics

1. **Cold dark matter**
   The inhomogeneties of our universe indicates the existence of dark matter which need to be cold enough at $z \sim 10^4$ which is a very early stage that no such heavy particle is predicted by stndard model.

2. **Inflation**
   The infation theory implied by large scale structure; the source that can driven the inflation and thus share some features of our universe today is unknown.

3. **Cosmic constant**
   The energy scale of which anomously smaller than the vaccume energy we expected at the early stage of the universe, implies a more fundamental things (such particles, fields) that can cancel out all kinds of sources of vaccume energy to an extremely small number (that is the energy scale of dark energy today).
