

Cosmology: from theory to observations - I

Wednesday 26 April 2023 09:00 (40 minutes)

These two pedagogical lectures are aimed to bring attendees up to date with the basic concepts and key results in current theoretical and observational cosmology. The focus is on building physical understanding and making links to modern observations where possible.

The lectures shall begin with an overview of the accelerating universe model (Λ CDM), from the Big Bang and Inflation to the current era of accelerated expansion. Then we discuss cosmic times, distances, masses and densities and their standard units in order to develop familiarity with the scales of cosmology.

Since General Relativity is not assumed, we use a Newtonian framework to motivate the Friedmann equation. Together with the energy conservation equation, this allows us to solve for the evolution of the universe through the radiation, matter and accelerating eras.

We use basic ideas of Special Relativity to describe the past lightcone of the observer, and thus derive the comoving, angular diameter and luminosity distances. This leads to qualitative descriptions of supernova cosmology and of the baryon acoustic oscillation scale. It also lays the basis to analyse number counts in galaxy surveys.

I will also discuss in some detail two of the most urgent problems to be sorted by any cosmological model: the dark energy explaining the cosmological accelerated expansion and the dark matter responsible for many astrophysical phenomena.

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