PHYSICS 227: Cosmology

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Office Hours: Fri. 10-12
Homework no. 2
Due: Thurs. April 30

1

An important cosmological test that we will consider is the angular diameter of the "sound horizon" with linear diameter 0.06 Mpc on the surface of last scattering that emits CMB radiation at redshift z_{ls}=1200. We wish to distinguish between competing cosmological models by comparing distance by apparent size d_A.

(a) First compute $d_A(z_{ls})$ and the corresponding angular diameters for spatially flat (K=0) matter dominated (Ω_R=0) models with Ω_M=0.0, 0.25, 0.50, 0.75, and 1.0.

(b) Next repeat (a) for Ω_Λ=0, but with with open geometry, i.e., with Ω_M=0.25,0.5, and closed geometry; i.e., and Ω_M 1.25 and 1.5

(c) Will the observations of the angular diameters be more sensitive in distinguishing between spatially flat models, or between models of differing geometry? Explain.

2

In class we computed an expression for proper horizon radius as a function of time for an Einstein de-Sitter model (Ω_M=1.0, Ω_Λ=0.0)

(a) Compute the mass enclosed within the horizon as a function of redshift for this model. Assume H_0=100 km s^{-1} Mpc^{-1} to get your result. h

(b) Repeat part a for a radiation dominated model (i.e., $\Omega_M = \Omega_\Lambda$=0) with K=0.

Hint: Since spatial geometry is flat, you can use standard expressions for computing volumes. Also, ompute the masses in solar masses ($M_\odot$=2×10^{33} g).

3

A type IA supernova has an absolute magnitude of M=−19.5

(a) Assume the supernova is observed in the Blue band (wavelength= 4550 $\AA$, and that the spectrum of the supernova is given by $L_\nu \propto \nu^{-1}$. Compute the K correction as a function of redshift for z=0 to z=1.5.

(b) Compute the apparent Blue AB magnitude as a function of redshift. for (i) standard flat cosmology Ω_M=0.3, Ω_Λ =0.7.

(c) Repeat (b) for the Einstein-deSitter model (Ω_M=1 and Ω_Λ=0) and an open model Ω_M=0.3 and Ω_Λ=0. Assume H_0= 100 km s^{-1} Mpc^{-1}.

(d) Compare and comment on results.