Special Topics in Cosmology (Spring 2013)

Problem Set 1

1) Using SuperNova Type Ia data from the Union2 Sample,
from "$Amanullahetal.(TheSupernovaCosmologyProject), Ap.J., 2010.$" $arxiv.org/abs/1004.1711$,
compare the three models below using χ^2 analysis:

a) Standard Cold Dark Matter Model: (SCDM) $\Omega_m = 1.0$
b)ΛCDM Model: $\Omega_\Lambda = 0.7$, $\Omega_m = 0.3$
c) The Open Universe: $\Omega_m = 0.3$, $K = -1$,
d)ΛCDM model based on WMAP9 years data release: arXiv:1212.5226
In all the cases above assume $h = 0.7$.

Due to: 24 Feb 2013

2) Assuming the friedman-Robertson Metric, in general case

$$ds^2 = -dt^2 + a^2(t)\left[\frac{dr^2}{1-Kr^2} + r^2(d\theta^2 + \sin^2\theta d\phi^2)\right],$$

and unisng the Einstein equation $G_{\mu\nu} = 8\pi G T_{\mu\nu}$ (Assume: a perfect cosmic fluid) Find out the Friedmann Equations.(calculate yourself, if you did this before redo the calculations by using Maple, Mathematica,...)

Due to: 17 Feb 2013

3) Discuss why neutrinos approximetly have the same energy density as photons. Are there any room for increasing the radiation portion in Energy density of Universe?

Due to: 17 Feb 2013

4)Show that, in any universe which is homogeneous and isotropic, it is possible to choose a coordinate system in which the metric has the FRW form.

Due to: 24 Feb 2013

5) Using the definition of Comoving distance, define the cosmological redshift patameter. And by that show why Planck distribution of radiation retains its form in an expanding Universe.
Due to: 24 Feb 2013