Calculating ΛCDM model parameters with data from CMB maps

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1 INTRODUCTION AND SIGNIFICANCE

The cosmic microwave background (CMB)(1) is the residual radiation from the big bang. At the beginning of the universe, there were rapid expansion, expansion, and cooling. CMB stands for heat leftover from that time, so it is an essential data source on the early universe. We can extract abundant information (like the density of dark matter at a point) from the distribution of radiation, for example, the basic parameters of the ΛCDMmodel or the Hubble's constant H_0. Hubble's constant is the expansion rate of our universe and is essential for Hubble's Law. It is close to 70 Mpc, which we can take as a reference. (2) For the basic parameters, we can tell some information about Big Bang, dark matter, and dark energy cosmology from them.

Taking about the ΛCDM model, we have used it in our early coding lab. It is a standard model of the flat universe. We fitted it with the data of the redshift of Supernovae, which can also generate the parameters we mentioned above. SO this is an excellent way to compare the precision and accuracy of the two models.

2 METHODS

(i) We can look for the raw data from Planck or WMAP. Example websites for Planck: Planck Legacy Archive and Planck from IRSA.

(ii) Use the ΛCDM as a model to fit the data with MCMC and get the model parameters. The `emcee` package from coding lab can be helpful (3)

(iii) Generate the corner plot, trace plot, multi-model plot, and the final mean parameter plot as in the lab.

(iv) Use the supernovae data and the model of `astropy` from lab2, repeat the above steps. Compare the H0 to see which one is closer to the official value.

(v) Give a try for other parameters of the model class of `astropy`. Maybe we can discuss the differences.

(vi) Instead of discussing the difference, we can anyhow combine the two models and get a more robust result by using the two posteriors of models as prior functions.

(vii) Discuss if it is possible to use the model of a non-flat universe. Thus the curvature parameter can not be 0 by default.

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