Parameter Constraints for ΛCDM Model

Amogh Srivastav

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1 Introduction

I have reproduced the plots presented in the original paper by Farooq et al. for the ΛCDM model. The contour plots for this model were generated using Matplotlib's standard library functions. In the subsequent sections, I provide a detailed description of the method, compare my results with those of the original paper, and display both my plots and those from the original publication.

2 Method: Using Matplotlib's standard library function

Initially, I developed the code for the χ^2 function and subsequently minimized it using `scipy.minimize`. This process yields the minimized value of the function $\chi^2_{\min}$ and the optimal values of the free parameters Ω_{mo} and Ω_Λ, which minimize χ^2. After determining the best fit parameters, I employed Matplotlib's standard library function `matplotlib.pyplot.subplots.contour` to plot the 1σ, 2σ, and 3σ contours. The plots were based on the values of Ω_{mo} and Ω_Λ corresponding to $\chi^2_{\min} + 2.3$, $\chi^2_{\min} + 6.17$, and $\chi^2_{\min} + 11.8$. These best fit parameters were further used to calculate the z_{da} value, representing the deceleration-acceleration transition red-shift.

3 Result Comparison and Plots

In the table presented below, a comparison is made between the results of my work and those reported in the original paper. The computations were carried out for two values of H_0, namely $H_0 \pm \sigma_{H_0} = 68 \pm 2.8\,\mathrm{km\,s^{-1}}$ and $H_0 \pm \sigma_{H_0} = 73.8 \pm 2.4\,\mathrm{km\,s^{-1}}$. The values enclosed in square brackets ([]) correspond to $H_0 \pm \sigma_{H_0} = 73.8 \pm 2.4\,\mathrm{km\,s^{-1}}$.

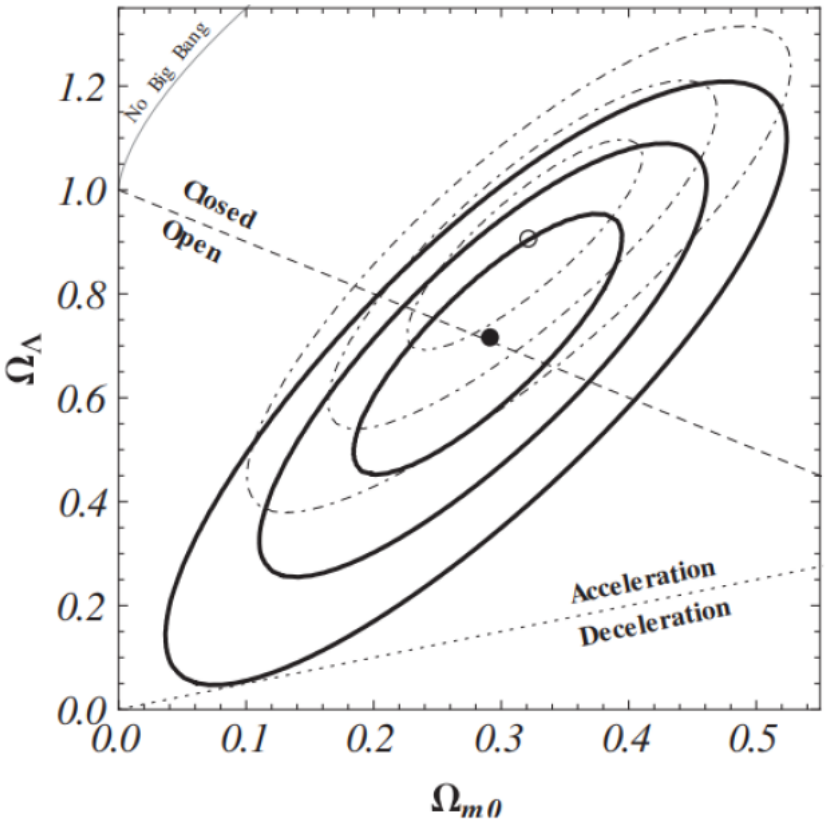

Figure 1: Original Plot in Farooq et al

Attribute	**Farooq et al**	**My Calculations**
Plots	Figure 1	Figure 2
Best Fit Point $(\Omega_m, \Omega_\Lambda)$	(0.29, 0.72) [0.32, 0.91]	(0.29, 0.72) [0.32, 0.91]
χ^2_{min}	18.24 [19.30]	18.07 [19.1]
2σ intervals	$[0.15 \leq \Omega_{mo} \leq 0.42]$ $[0.20 \leq \Omega_{mo} \leq 0.44]$ $[0.35 \leq \Omega_\Lambda \leq 1.02]$ $[0.62 \leq \Omega_\Lambda \leq 1.14]$	$[0.15 \leq \Omega_{mo} \leq 0.43]$ $[0.19 \leq \Omega_{mo} \leq 0.44]$ $[0.33 \leq \Omega_\Lambda \leq 1.01]$ $[0.60 \leq \Omega_\Lambda \leq 1.15]$

Table 1: Comparison of Results

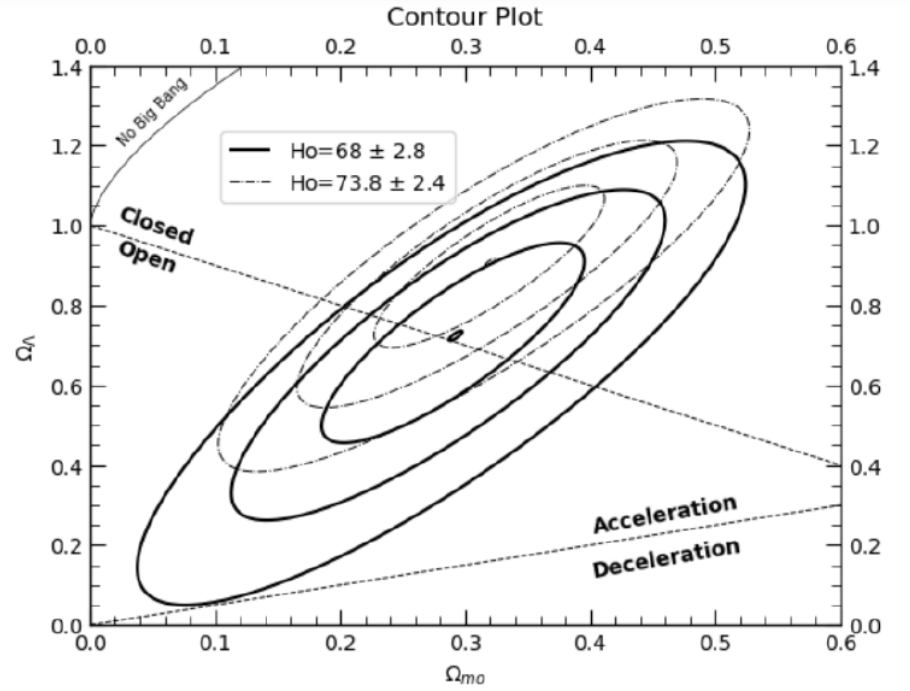

Figure 1: My Plot using Matplotlib's standard library function