MontePython exercise

Running of the Planck Mass

The IFT School in Cosmology Tools
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The problem

The Friedmann equations, within the ΛCDM paradigm are:

$$H^2 = \rho\,, \qquad H' = -\frac{3}{2}a\,(\rho + p)$$

They can be modified assuming that the Planck mass M_* can vary. The effective Planck Mass run rate is defined as (Huang 2016):

$$\alpha_M(a) \equiv \frac{d\ln\left(M_*^2\right)}{d\ln a} \qquad \alpha_M(a) = \alpha_{M0}\frac{\Omega_{\mathrm{DE}}(a)}{\Omega_{\mathrm{DE},0}}$$

The problem

Under this modification, the background equations become:

$$H^2 = \rho\,, \qquad H' = -\frac{3}{2}a\,(\rho + p) \quad \longrightarrow \quad H^2 = \frac{\rho}{M_*^2}\,, \qquad H' = -\frac{3}{2}a\frac{\rho + p}{M_*^2}$$

And the stress and Poisson equations:

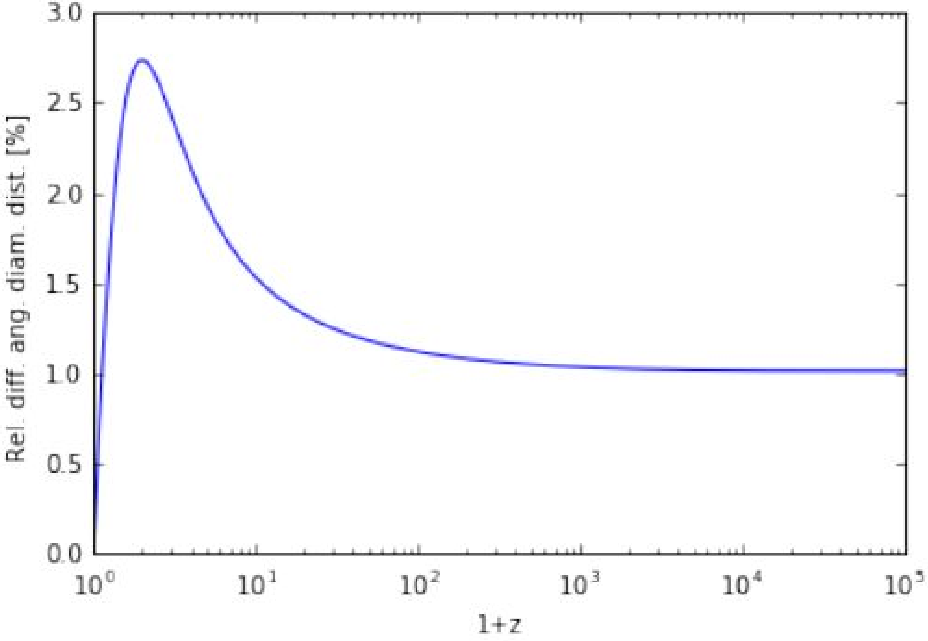
$$\Phi = (1 + \alpha_M)\Psi \qquad \frac{k^2}{a^2}\Phi = -\frac{\rho_m(1 + \alpha_M)}{2M_*^2}\delta_m$$

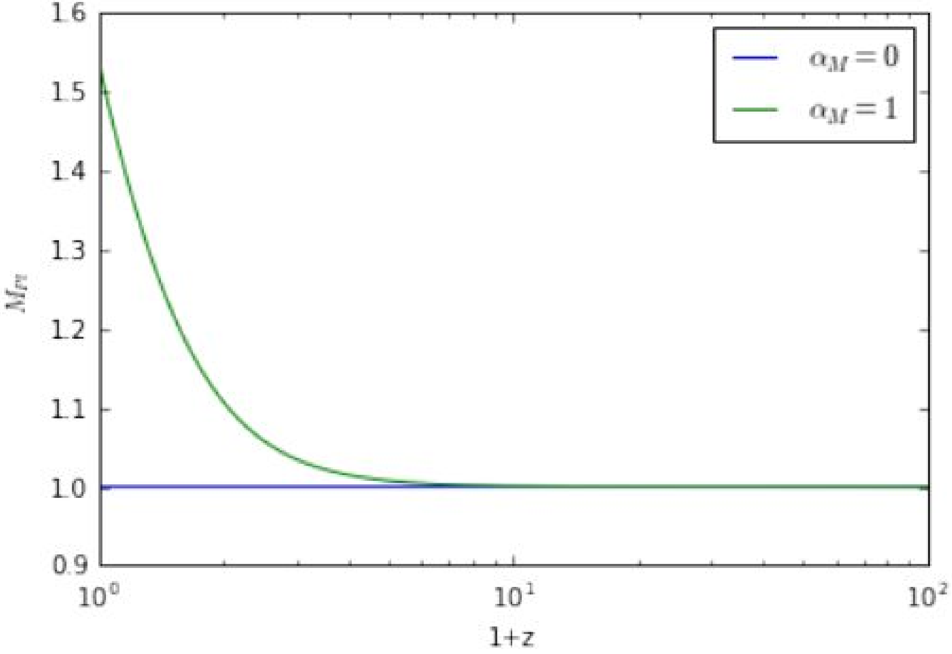
This is the so-called α_MCDM model

We recover the ΛCDM when setting $\alpha_M = 0$ and $M_* = 1$

Methodology and results

We have modified the **`hi_class`** code to implement the α_MCDM equations.
We obtain the relative difference with ΛCDM angular diameter distance and M_* as a function of z



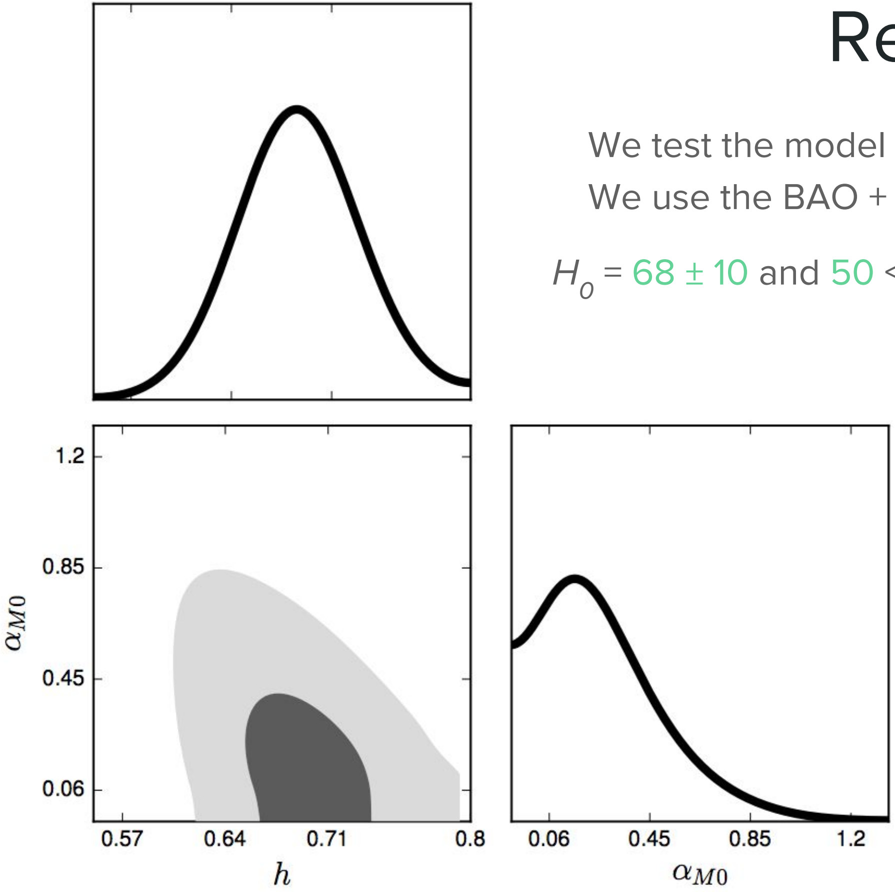


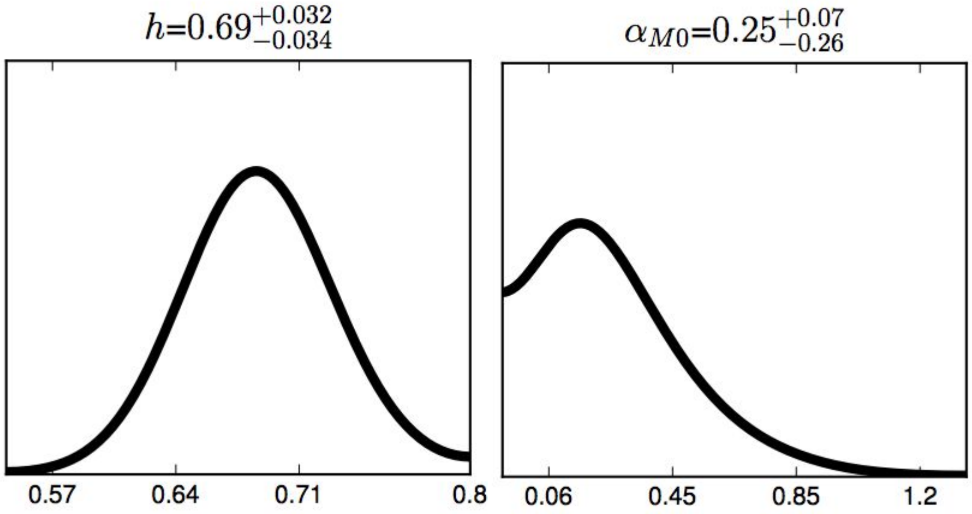
Results

We test the model with the data using MontePython

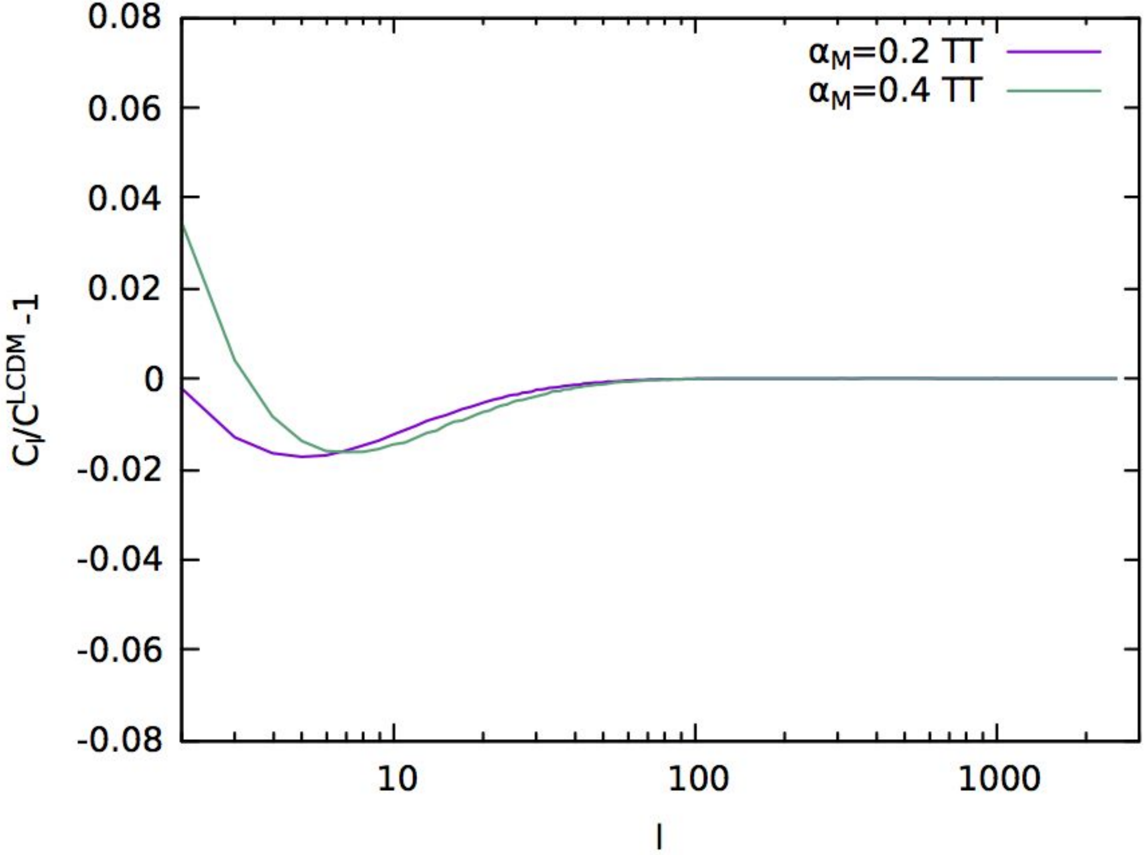
We use the BAO + SN likelihood, the initial stepsizes and flat priors:

H_0 = 68 ± 10 and 50 < H_0 < 80 (km s^{-1} Mpc^{-1}) α_M = 0.0 ± 0.1 and -2 < α_M < +2





Results



We obtain also the ratio between our TT power spectrum for α_M= 0.2 and α_M = 0.4 and the ΛCDM power spectrum

At low multipoles there is a significant difference with the ΛCDM model due to the ISW effect

Thanks