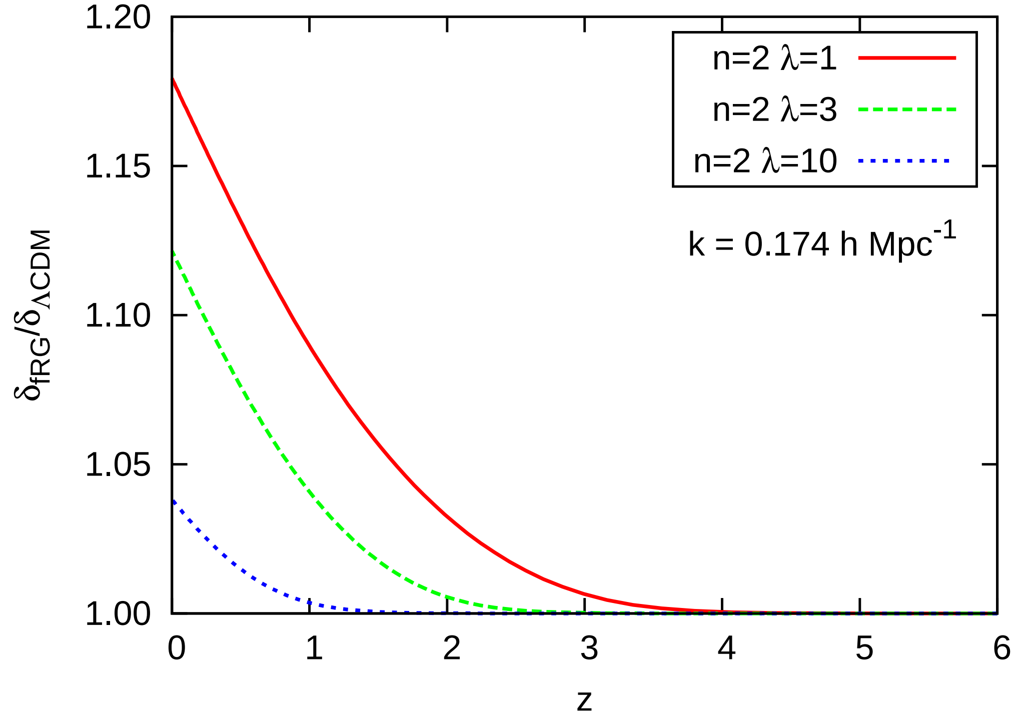

FIG. 3: The ratio of linear density perturbations $\delta_{\rm fRG}/\delta_{\Lambda\rm CDM}(k = 0.174h{\rm Mpc}^{-1})$ as a function of redshift for three different values of λ with $n = 2$.

$(\delta_{\rm fRG}/\delta_{\Lambda\rm CDM})^2(k = 0.174h{\rm Mpc}^{-1}) \lesssim 1.1$. Although we neglect non-linear effects here, the difference between linear calculation and non-linear N-body simulation remained smaller than 5% at the wavenumber $0.174h{\rm Mpc}^{-1}$[32].

Figures 4 represent $(\delta_{\rm fRG}/\delta_{\Lambda\rm CDM})^2(k = 0.174h{\rm Mpc}^{-1})$ as a function of λ for $n = 2, 3$, and 4. From the analytic formula (19), this λ dependence would have the form $(\delta_{\rm fRG}/\delta_{\Lambda\rm CDM})^2 \propto C^2(k) \propto \lambda^{-\frac{(2n-p_n+1)(\sqrt{33}-5)}{4(3n+2)}}$ which is depicted by a broken line in each figure. This curve, however, does not match the asymptotic behaviour $(\delta_{\rm fRG}/\delta_{\Lambda\rm CDM})^2 \longrightarrow 1$ for large λ. We find that an exponential function

$$(\delta_{\rm fRG}/\delta_{\Lambda\rm CDM})^2 = 1 + b_n e^{-q_n\lambda} \tag{29}$$

fits the numerical calculation very well with $(n, b_n, q_n) = (2, 0.47, 0.19)$, $(3, 0.43, 0.49)$, and $(4, 0.39, 0.70)$, respectively. From these figures, in order to keep deviation from ΛCDM model smaller than 10% at $k = 0.174h{\rm Mpc}^{-1}$, we find λ should be larger than 8.2, 3.0, and 1.9 for $n = 2, 3$, and 4, respectively.

From these analysis, we can constrain the parameter space as Fig. 5. The region which