Matter Power Spectrum Today

Until transition from RDE to MDE. $\ddot{D} + 2H\dot{D} - 4\pi G\bar{\rho}D = 0$ not valid at RDE, or outside horizon (no pressure)

RDE: $H^2 \sim 1/a^4$. $a \sim t^{1/2} \sim \eta$, $D \sim a^2$ — in fact no growth within horizon due to radiation pressure

MDE: $H^2 \sim 1/a^3$. $a \sim t^{2/3} \sim \eta^2$, $D \sim a$

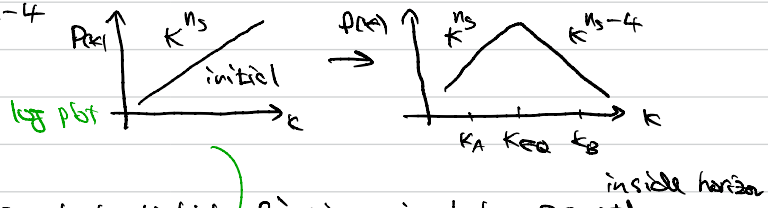
$\rho_m(t) = \rho_r(t)$ EQ $z_{EQ} \approx 3000$

i) $k_A < k_{EQ}$: outside in RDE. ∴ continuous growth $\delta(k_A, t_0) = \delta(k_A, t_i)\left(\frac{a_{EQ}}{a_i}\right)^2\left(\frac{a_0}{a_{EQ}}\right)$

ii) $k_B > k_{EQ}$: enter in RDE ∴ grow until entrance & grow in MDE $\delta(k_B, t_0) = \delta(k_B, t_i)\left(\frac{a_k}{a_i}\right)^2\left(\frac{a_0}{a_{EQ}}\right)$

$H_k = k_B \sim 1/a_k$ $\quad H \sim 1/t \sim 1/L \sim 1/a\cdot x$ $\quad \mathcal{H} \equiv aH \sim 1/x \sim k$

power spectrum $\frac{P(k_B)}{P(k_A)} = \frac{P(k_B, t_i)}{P(k_A, t_i)}\left(\frac{a_k}{a_{EQ}}\right)^4 \propto \left(\frac{k_B}{k_A}\right)^{n_s - 4}$



observations $P(k, t_0)$ → amplitude. n_s. k_{EQ}

in fact baryons: no growth. DM: no pressure. but Hubble friction ∴ ln k growth

comoving k: fixed physical scale change in time

all outside the horizon after inflation. horizon catches up in time. today all inside the horizon