Computing Our Universe

Cosmology V – Handout

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Temperature-Time-Redshift relation

$$z_{eq} = 2.4 \times 10^4 \Omega_o h^2$$

$$T(z) = T_0(1+z) = 2.73(1+z)\,K = 2.4 \times 10^{-4}(1+z)\,eV$$

$$\begin{aligned} t &= t_{eq}(z/z_{eq})^{-2}, & z > z_{eq} \\ &\approx 10^{12} z^{-2} (\Omega_o h^2)^{1/2}\,y \end{aligned}$$

$$\begin{aligned} t &= t_0(1+z)^{-3/2}, & z < z_{eq} \\ &\approx 10^{10}(1+z)^{-3/2}\,y \end{aligned}$$

$$\begin{aligned} T &\approx (t/1\,s)^{-1/2}\,MeV & T > T_{eq} \approx 1\,eV, \quad t < t_{eq} \approx 10^{12}\,s \\ T &= 2.73(t/t_0)^{-2/3}\,K & T < T_{eq} \approx 10^4 K, \quad t > t_{eq} \approx 50000\,y \end{aligned}$$

CDM Simulation Models

Many of the cosmological and structure parameters we talked about in the cosmology lectures are used in the simulations. Here is a quick reference table to the cold dark matter (CDM) simulations and the differences between the Standard (S), COBE normalized (C), Open (O), Lambda (L), and Tilted (T) models. The matter density is Ω, the cosmological constant density is Λ, the Hubble constant in units of km s^{-1} Mpc^{-1} is H_0, the baryon density is Ω_b (note that $\Omega_b h^2 = 0.0125$ as given by nucleosynthesis), the power or amplitude of the mass fluctuation spectrum at a scale of 8 h^{-1}Mpc is σ_8, and the primordial index of the density power spectrum is n. All models are COBE normalized in power except SCDM. The TCDM model is tilted, as is the LCDM (in order to match both cluster scales and COBE normalization).

Model	Ω	Λ	H_0	Ω_b	σ_8	n
SCDM	1.0	0.0	50	0.05	0.7	1.0
CCDM	1.0	0.0	50	0.05	1.2	1.0
OCDM	0.4	0.0	65	0.03	0.75	1.0
LCDM	0.4	0.6	65	0.03	0.8	0.93
TCDM	1.0	0.0	50	0.05	0.54	0.80