EARLY UNIVERSE PHYS40772 2009 : Dr R.A. Battye

USEFUL CONSTANTS AND QUANTITIES

GRAVITY :

PLANCK MASS	:	$m_{\rm pl} = 1.22 \times 10^{19}{\rm GeV}$
NEWTON'S CONSTANT	:	$G = m_{\rm pl}^{-2}$

PARTICLE PHYSICS :

ELECTRON MASS	:	$m_{\rm e} = 0.511{\rm MeV}$
NEUTRON MASS	:	$m_{\rm n} = 939.6{\rm MeV}$
PROTON MASS	:	$m_{\rm p} = 938.3{\rm MeV}$
FINE STRUCTURE CONSTANT	:	$\alpha = 1/137$
THOMSON CROSS-SECTION	:	$\sigma_{\rm T} = 6.65 \times 10^{-25}{\rm cm}^2$

COSMOLOGICAL QUANTITIES :

HUBBLE'S CONSTANT	:	$H_0 = 100h{\rm km\,sec}^{-1}{\rm Mpc}^{-1}$
HUBBLE RADIUS	:	$H_0^{-1} = 3000h^{-1}{\rm Mpc}$
HUBBLE TIME	:	$H_0^{-1} = 9.78 \times 10^9 h^{-1}{\rm yr}$
CRITICAL DENSITY	:	$\rho_{\rm crit} = 1.88 \times 10^{-29}h^2{\rm gcm}^{-3}$

ASTRONOMICAL QUANTITIES :

ASTRONOMICAL UNIT	:	$1{\rm AU} = 1.50 \times 10^{13}{\rm cm}$
PARSEC	:	$1{\rm pc} = 3.26\,{\rm light\ years} = 3.09 \times 10^{18}{\rm cm}$
MEGA-PARSEC	:	$1{\rm Mpc} = 3.09 \times 10^{24}{\rm cm}$
SOLAR MASS	:	$M_\odot = 1.99 \times 10^{33}{\rm g}$
SOLAR LUMINOSITY	:	$L_\odot = 3.90 \times 10^{36}{\rm W}$

MEASURED QUANTITIES :

HUBBLE CONSTANT	:	$0.6 < h < 0.8, h \approx 0.7$
CMB TEMPERATURE	:	$T_{\rm CMB} \approx 2.728{\rm K}$
RADIATION DENSITY	:	$\Omega_{\rm r}h^2 = 4.17 \times 10^{-5}$
BARYON DENSITY	:	$\Omega_{\rm b}h^2 \approx 0.02$
MATTER DENSITY	:	$\Omega_{\rm m} \approx 0.3$
COSMOLOGICAL CONSTANT	:	$\Omega_\Lambda \approx 0.7$

EPOCHS :

EW PHASE TRANSITION TEMP	:	$T_{\rm EW} \approx 200{\rm GeV}$
EW PHASE TRANSITION TIME	:	$t_{\rm EW} \approx 3 \times 10^{-11}{\rm sec}$
EW PHASE TRANSITION REDSHIFT	:	$1 + z_{\rm EW} \approx 8.5 \times 10^{14}$
QCD PHASE TRANSITION TEMP	:	$T_{\rm QCD} \approx 200{\rm MeV}$
QCD PHASE TRANSITION TIME	:	$t_{\rm QCD} \approx 3 \times 10^{-5}{\rm sec}$
QCD PHASE TRANSITION REDSHIFT	:	$1 + z_{\rm QCD} \approx 8.5 \times 10^{11}$
NUCLEOSYNTHESIS TEMP	:	$T_{\rm NUC} \approx 0.1{\rm MeV}$
NUCLEOSYNTHESIS TIME	:	$t_{\rm NUC} \approx 120{\rm sec}$
NUCLEOSYNTHESIS REDSHIFT	:	$1 + z_{\rm NUC} \approx 4.25 \times 10^{8}$
EQUALITY TEMP	:	$5.64(\Omega_{\rm m} h^2){\rm eV}$
EQUALITY TIME	:	$3.15 \times 10^{10}(\Omega_{\rm m} h^2)^{-2}{\rm sec}$
EQUALITY REDSHIFT	:	$1 + z_{\rm EQ} = 23980(\Omega_{\rm m} h^2)$
RECOMBINATION TEMP	:	$T_{\rm rec} = 0.25{\rm eV}$
RECOMBINATION TIME	:	$t_{\rm rec} = 5 \times 10^{12}(\Omega_{\rm m} h^2)^{-1/2}$
RECOMBINATION REDSHIFT	:	$1 + z_{\rm REC} = 1060$