Robertson-Walker Metric:
$ds^2 = -c^2dt^2 + a(t)^2[dr^2 + S_\kappa^2(d\theta^2 + sin^2\theta d\phi^2)]$
$S_\kappa(r) = Rsin(r/R)$, $\kappa = +1$
$S_\kappa(r) = r$, $\kappa = 0$
$S_\kappa(r) = Rsinh(r/R)$, $\kappa = -1$

Friedmann Equation: $\left(\frac{\dot{a}}{a}\right)^2 - \frac{8\pi G}{3c^2}\epsilon(t) = -\frac{\kappa c^2}{a(t)^2 R_0^2} + \frac{\Lambda}{3}$

Friedmann Equation: $\frac{H^2}{H_0^2} = \frac{\Omega_{r,0}}{a^4} + \frac{\Omega_{m,0}}{a^3} + \Omega_{\Lambda,0} + \frac{1-\Omega_0}{a^2}$

Blackbody Radiation: $\epsilon_\gamma = \alpha_{RAD}T^4$, $\lambda_{max}T = 0.2898$ cm K

Fluid Equation: $\dot{\epsilon} + 3\frac{\dot{a}}{a}(\epsilon + P) = 0$

Acceleration Equation: $\frac{\ddot{a}}{a} = -\frac{4\pi G}{3c^2}(\epsilon + 3P) + \frac{\Lambda}{3}$

Equation of State: $P = w\epsilon$

Wien's Law: $\lambda_{max}T = 0.2898$ cm K

Radiation Energy Density: $\epsilon_{rad} = \alpha_{rad}T^4$

Deceleration Parameter: $q_0 \equiv -\left(\frac{\ddot{a}a}{\dot{a}^2}\right)_{t=t_0}$

$q_0 = \frac{1}{2}\sum_w \Omega_{w,0}(1 + 3w)$

Luminosity Distance: $d_L \equiv \sqrt{\frac{L}{4\pi F}}$

Angular Diameter Distance: $d_A\theta \equiv l$

$d_L = S_k(r)(1 + z)$

$d_A = S_k(r)/(1 + z)$

$d_p(t_0) \approx \frac{c}{H_0}\left[z - \left(\frac{1+q_0}{2}\right)z^2\right] + \frac{cH_0}{2}\frac{z^2}{H_0^2}$

$d_L \approx \frac{c}{H_0}z\left(1 + \frac{1-q_0}{2}z\right)$

$d_A \approx \frac{c}{H_0}z\left(1 - \frac{3+q_0}{2}z\right)$

Virial Theorem: $\ddot{I} = 2W + 4K$

Kinetic Energy: $K = \frac{1}{2}M\left\langle v^2\right\rangle$

Potential Energy: $W = -\alpha\frac{GM^2}{r_h}$, where $\alpha \approx 0.4$ for galaxy clusters

Rotation Speed: $v_c = \sqrt{\frac{GM(R)}{R}}$

Hydrostatic Equilibrium: $M(r) = \frac{kT(r)r}{G\mu}\left[-\frac{dln\rho}{dlnr} - \frac{dlnT}{dlnr}\right]$

Deflection Angle: $\alpha = \frac{4GM}{c^2b}$

Einstein Radius: $\theta_E = \left(\frac{4GM}{c^2d}\frac{1-x}{x}\right)^{\frac{1}{2}}$

Ionization Fraction:
$\frac{1-x}{x^2} = 3.84\eta\left(\frac{kT}{m_ec^2}\right)^{\frac{3}{2}}\exp\left(\frac{Q}{kT}\right)$

Neutron to proton ratio:
$\frac{n(n)}{n(p)} = \exp(-1.29 \text{ MeV}/(kT))$

Deuteron to neutron ratio:
$\frac{n(D)}{n(n)} \approx 6.5\eta(kT/(m_nc^2))^{3/2}\exp(2.22 \text{ MeV}/(kT))$

Dynamical Timescale (free fall): $t_{Dyn} = \sqrt{\frac{1}{4\pi G\bar{\rho}}}$

Jeans Length: $\lambda_J = 2\pi c_s t_{dyn}$

Jeans Mass: $M_J = \rho_b\frac{4\pi}{3}\lambda_J^3$

Sound Speed: $c_s = \sqrt{w}c$

Sound Speed (baryons): $c_s = \sqrt{\frac{kT}{mc^2}}c$

Ionization rate: $\Gamma(z) = n_e(z)\sigma_e c$

Optical depth: $\tau(t) = \int_t^{t_0}\Gamma(t)dt$

Linear Growth: $\ddot{\delta} + 2H\dot{\delta} - \frac{3}{2}H^2\Omega_m(t)\delta = 0$, where $\delta \equiv \frac{\epsilon-\bar{\epsilon}}{\bar{\epsilon}}$

Mass Fluctuations & Power Spectrum: $\langle\left(\frac{\delta M}{\langle M\rangle}\right)^2\rangle \approx P(k)k^3$

Luminosity Function:
$\phi(L)dL = \phi^*(L/L^*)^\alpha\exp(-L/L*)dL/L^*$

Halo Radius:
$R_h = (3M_T/(64\pi\rho_{m,0}(1 + z_c)^3))^{1/3}$

Halo Gas Temperature:
$T \approx 1 \times 10^6 \text{ K}(M_T/10^{12} \text{ M}_\odot)^{2/3}((1 + z_c)/5)$

Cooling time: $t_c \approx 13 \text{ Gyr}(10^{-27} \text{ g cm}^{-3}/\rho_{gas})(T/10^6 \text{ K})^{1/2}$

Fundamental Constants

gravitational constant: $G = 6.673 \times 10^{-11} \mathrm{m}^3\,\mathrm{kg}^{-1}\,\mathrm{s}^{-2}$
speed of light: $c = 2.998 \times 10^8\,\mathrm{m\,s^{-1}}$
reduced Planck constant:
$\hbar = 1.055 \times 10^{-34}\,\mathrm{J\,s} = 6.582 \times 10^{-16}\mathrm{eV\,s}$
Boltzmann constant:
$k = 1.381 \times 10^{-23}\mathrm{J\,K^{-1}} = 8.617 \times 10^{-5}\mathrm{eV\,K^{-1}}$
radiation constant:
$\alpha_{RAD} = 7.56 \times 10^{-16}$ J m^{-3} K^{-4}
electron rest energy: $m_e c^2 = 0.5110\,\mathrm{MeV}$
proton rest energy: $m_p c^2 = 938.272\,\mathrm{MeV}$
neutron rest energy: $m_n c^2 = 939.566\,\mathrm{MeV}$

Conversion of Units

astronomical unit: $1\,\mathrm{AU} = 1.496 \times 10^{11}\,\mathrm{m}$
megaparsec: $1\,\mathrm{Mpc} = 3.086 \times 10^{22}\,\mathrm{m}$
solar mass: $1\,\mathrm{M}_\odot = 1.989 \times 10^{30}\,\mathrm{kg}$
solar luminosity: $1\,\mathrm{L}_\odot = 3.846 \times 10^{26}\,\mathrm{J\,s^{-1}}$
gigayear: $1\,\mathrm{Gyr} = 3.156 \times 10^{16}\,\mathrm{s}$
electron volt: $1\,\mathrm{eV} = 1.602 \times 10^{-19}\,\mathrm{J}$
Absolute Magnitude: $M = m - 5\log\left(\frac{d_L}{1Mpc}\right) - 25$

Cosmological Parameters

Hubble constant: $H_0 = 70 \pm 7\ \mathrm{km\,s^{-1}Mpc^{-1}}$
Hubble time: $H_0^{-1} = (4.4 \pm 0.4) \times 10^{17}\,\mathrm{s} = 14.0 \pm 1.4\,\mathrm{Gyr}$
Hubble distance: $c/H_0 = (1.32 \pm 0.13) \times 10^{26}\,\mathrm{m} = 4300 \pm 400\,\mathrm{Mpc}$
critical energy density:$\varepsilon_{c,0} = 5200 \pm 1000\,\mathrm{MeV\,m^{-3}}$
critical mass density:$\rho_{c,0} = \varepsilon_{c,0}/c^2 = (9.2 \pm 1.8) \times 10^{-27}\,\mathrm{kg\,m^{-3}}$
density parameter in radiation: $\Omega_{r,0} = 8.4 \times 10^{-5}$
density parameter in baryons: $\Omega_{bary,0} = 0.04$
density parameter in dark matter: $\Omega_{m,0} = 0.26$
density parameter in dark energy: $\Omega_{\Lambda,0} = 0.70$
temperature of CMB: $T_0 = 2.73$ K

Table of Integrals

$\int \sqrt{\frac{x}{a-x}}dx = -\sqrt{x(a-x)} - a\arctan\frac{\sqrt{x(a-x)}}{x-a}$
$\int \frac{x}{\sqrt{x+a}}dx = \frac{2}{3}(x-2a)\sqrt{x+a}$
$\int \frac{x}{\sqrt{x-a}}dx = \frac{2}{3}(x+2a)\sqrt{x-a}$