$$T^{\alpha}{}_{\beta;\gamma} = T^{\alpha}{}_{\beta,\gamma} + \Gamma^{\alpha}_{\gamma\delta} T^{\delta}{}_{\beta} - \Gamma^{\delta}_{\gamma\beta} T^{\alpha}{}_{\delta}$$

$$\Gamma^{\gamma}_{\alpha\beta} = \tfrac{1}{2} g^{\gamma\mu} \left(g_{\mu\beta,\alpha} + g_{\alpha\mu,\beta} - g_{\alpha\beta,\mu} \right)$$

$$\frac{\mathrm{D}A^{\gamma}}{\mathrm{d}\lambda} = \frac{\mathrm{d}A^{\gamma}}{\mathrm{d}\lambda} + \Gamma^{\gamma}_{\alpha\beta} \frac{\mathrm{d}x^{\alpha}}{\mathrm{d}\lambda} A^{\beta}$$

$$\frac{\mathrm{d}^2 x^{\alpha}}{\mathrm{d}\lambda^2} + \Gamma^{\alpha}_{\beta\gamma} \frac{\mathrm{d}x^{\beta}}{\mathrm{d}\lambda} \frac{\mathrm{d}x^{\gamma}}{\mathrm{d}\lambda} = 0$$

$$\frac{\mathrm{d}}{\mathrm{d}\lambda} \left(\frac{\partial L}{\partial \dot{x}^{\gamma}} \right) - \frac{\partial L}{\partial x^{\gamma}} = 0 \ , \qquad L\left(x^{\gamma}, \dot{x}^{\gamma}\right) \equiv \tfrac{1}{2} g_{\alpha\beta}\left(x^{\gamma}\right) \dot{x}^{\alpha} \dot{x}^{\beta}$$

$$\nabla_{\alpha} \left(\frac{\partial \mathcal{L}}{\partial (\nabla_{\alpha} \phi)} \right) - \frac{\partial \mathcal{L}}{\partial \phi} = 0$$

$$\left[\nabla_{\mu}, \nabla_{\nu}\right] v^{\rho} = v^{\rho}{}_{;\nu\mu} - v^{\rho}{}_{;\mu\nu} = R^{\rho}{}_{\sigma\mu\nu} v^{\sigma}$$

$$R^{\rho}{}_{\sigma\mu\nu} = \Gamma^{\rho}_{\nu\sigma,\mu} - \Gamma^{\rho}_{\mu\sigma,\nu} + \Gamma^{\rho}_{\mu\lambda}\Gamma^{\lambda}_{\nu\sigma} - \Gamma^{\rho}_{\nu\lambda}\Gamma^{\lambda}_{\mu\sigma}$$

$$R_{\rho\sigma\mu\nu} = -R_{\sigma\rho\mu\nu} = -R_{\rho\sigma\nu\mu} = +R_{\mu\nu\rho\sigma}$$

$$R_{\rho\sigma\mu\nu} + R_{\rho\mu\nu\sigma} + R_{\rho\nu\sigma\mu} = 0$$

$$R_{\mu\nu} = R^{\alpha}{}_{\mu\alpha\nu} \quad , \quad R = g^{\mu\nu} R_{\mu\nu} \quad , \quad G_{\mu\nu} = R_{\mu\nu} - \tfrac{1}{2} g_{\mu\nu} R$$

$$G_{\mu\nu} = 8\pi G T_{\mu\nu}$$

$$T_{\mu\nu} = (\rho + p) u_{\mu} u_{\nu} + p g_{\mu\nu}$$

$$ds^2 \ = \ -\left(1 - \frac{r_\mathrm{s}}{r}\right)\mathrm{d}t^2 + \frac{\mathrm{d}r^2}{1 - \frac{r_\mathrm{s}}{r}} + r^2 \mathrm{d}\theta^2 + r^2 \sin^2\theta \mathrm{d}\phi^2 \quad , \quad r_\mathrm{s} = 2G_\mathrm{N} M$$

$$\Gamma^0_{01} = \frac{r_\mathrm{s}}{2r^2}\frac{1}{1 - \frac{r_\mathrm{s}}{r}} \qquad \Gamma^1_{00} = \frac{r_\mathrm{s}}{2r^2}\left(1 - \frac{r_\mathrm{s}}{r}\right) \qquad \Gamma^1_{11} = -\frac{r_\mathrm{s}}{2r^2}\frac{1}{1 - \frac{r_\mathrm{s}}{r}}$$

$$\Gamma^2_{12} = \frac{1}{r} \qquad \Gamma^1_{22} = -r\left(1 - \frac{r_\mathrm{s}}{r}\right) \qquad \Gamma^3_{13} = \frac{1}{r}$$

$$\Gamma^1_{33} = -r\left(1 - \frac{r_\mathrm{s}}{r}\right)\sin^2\theta \qquad \Gamma^2_{33} = -\sin\theta\cos\theta \qquad \Gamma^3_{23} = \frac{\cos\theta}{\sin\theta} \ ,$$

$$\mathrm{d}s^2 = -\mathrm{d}t^2 + a(t)^2\left(\frac{\mathrm{d}r^2}{1-Kr^2} + r^2\mathrm{d}\theta^2 + r^2\sin^2\theta\mathrm{d}\phi^2\right)$$

$$3\frac{\dot{a}^2}{a^2} + 3\frac{K}{a^2} = 8\pi G_\mathrm{N}\rho + \Lambda$$

$$3\frac{\ddot{a}}{a} = -4\pi G_\mathrm{N}(\rho + 3p) + \Lambda$$

$$\dot{\rho} + 3H(\rho + p) = 0$$

$$\bar{h}_{ij}(t,\bar{x}) = \frac{2G_\mathrm{N}}{r}\frac{\mathrm{d}^2}{\mathrm{d}t^2}\int \mathrm{d}^3x' x'^i x'^j \rho(t-r,\bar{x}')$$

$$\mathcal{L}_{\underline{V}} g_{\alpha\beta} = V^\mu\partial_\mu g_{\alpha\beta} + \partial_\alpha V^\mu g_{\mu\beta} + \partial_\beta V^\mu g_{\alpha\mu}$$

$$\left(1 - \frac{r_\mathrm{s}}{r}\right)\dot{t} = k$$

$$r^2\dot{\phi} = h$$

$$\ddot{r} + \frac{1}{2}\left(1 - \frac{r_\mathrm{s}}{r}\right)\frac{r_\mathrm{s}}{r^2}\dot{t}^2 - \frac{1}{2}\frac{r_\mathrm{s}}{\left(1 - \frac{r_\mathrm{s}}{r}\right)}\left(\frac{\dot{r}}{r}\right)^2 - \left(1 - \frac{r_\mathrm{s}}{r}\right)r\dot{\phi}^2 = 0$$

$$u^\alpha = \gamma(1, v^i)$$

$$\gamma = (1 - v^2)^{-1/2}$$

$c = 1 = 3.00 \times 10^8\mathrm{m/s}$
$1\ \mathrm{pc} = 3.09 \times 10^{16}\mathrm{m}$
$1\ \mathrm{au} = 150 \times 10^9\ \mathrm{m}$
$1\ \mathrm{a} = 3.16 \times 10^7\mathrm{s}$
$(100\ \mathrm{km/s/Mpc})^{-1} = 9.78 \times 10^9\mathrm{a} = 3.00 \times 10^3\ \mathrm{Mpc}$
$1\ M_\odot = 1.99 \times 10^{30}\ \mathrm{kg}$
$G_\mathrm{N} = 6.67 \times 10^{-11}\ \mathrm{m^3\ kg^{-1}\ s^{-2}}$