Definitions, results, etc.

* $r = R(t)\ \varpi$

* $H = \frac{1}{R}\frac{dR}{dt}$

* *Densities:*

Matter: $\rho_m = \rho_{o,m} R^{-3}$

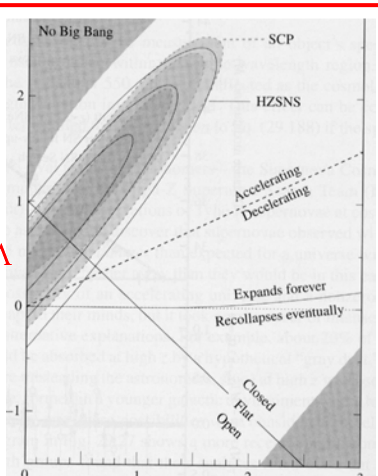
Radiation: $\rho_r = \rho_{o,r} R^{-4}$

Dark energy: $\rho_\Lambda = \rho_{o,\Lambda} R^{0}$

$$\rho_c(t) = \frac{3H^2(t)}{8\pi G}$$

$$\Omega(t) = \frac{\rho(t)}{\rho_c(t)}$$

$$\Omega \equiv \Omega_m + \Omega_{\rm rel} + \Omega_\Lambda$$



Ω_Λ

Ω_{matter}

$= RT(R)$ *

$= -\frac{P}{c^2}\frac{d(R^3)}{dt}$

$d^2R(t)/dt^2]$ … $R(t)/dt]^2$

$= w\rho c^2$

Physics

Per unit mass:

K.E. + potential E. = Total Energy

$$\left(\left(\frac{1}{R}\frac{dR}{dt}\right)^2 - \frac{8}{3}\pi G\rho\right)R^2 = -kc^2$$

$\rho = \frac{u}{c^2}$ *

*
$$(ds)^2 = (c\,dt)^2 - R^2(t)\left[\left(\frac{d\varpi}{\sqrt{1-k\varpi^2}}\right)^2 + (\varpi\,d\theta)^2 + (\varpi\sin\theta\,d\phi)^2\right]$$

*
$$\left[\left(\frac{1}{R}\frac{dR}{dt}\right)^2 - \frac{8}{3}\pi G\rho - \frac{1}{3}\Lambda c^2\right]R^2 = -kc^2$$

Cosmological Constant (a.k.a. *Dark Energy*)

Curvature $k = \frac{1}{R_o^2} \times \begin{matrix}+1\\0\\-1\end{matrix}$

$k = \frac{1}{\mathcal{R}_o^2} \times \begin{matrix}+1\\0\\-1\end{matrix}$

$dU = -PdV$ *

$$\frac{d^2R}{dt^2} = \left\{-\frac{4}{3}\pi G\left[\rho_m + \rho_{\rm rel} + \frac{3(P_m + P_{\rm rel})}{c^2}\right] + \frac{1}{3}\Lambda c^2\right\}R$$

* = you should be able to write these down from memory.