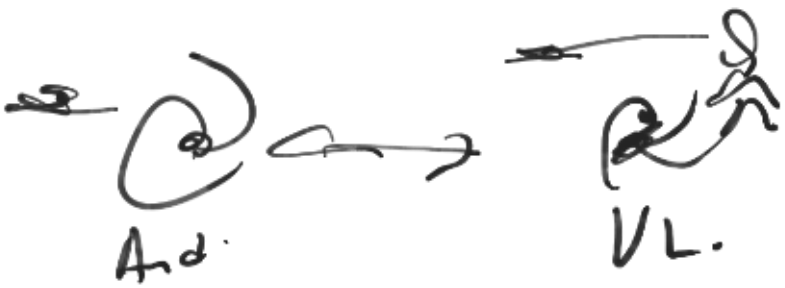
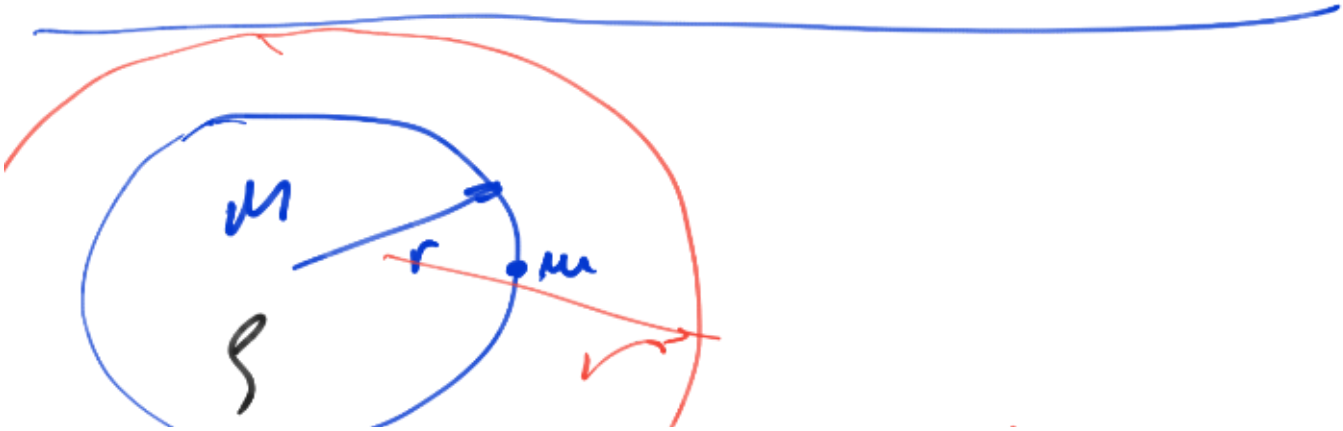
dist. Vía láctea y Andromeda

$\sim 2 M_{g.l.} \sim 0{,}6 M_{pc}$.

$v = H_0 \cdot d = 67{,}3 \frac{km/s}{Mpc} \cdot 0{,}6 Mpc$

$v = 40{,}38 \frac{km}{s}$





$$\frac{1}{2}\mu v^2 = \frac{GM\mu}{r} \Rightarrow r_e = \sqrt{\frac{2GM}{r}}$$

$$v = H_0 r$$

$$V = \frac{4}{3}\pi r^3 \Rightarrow \rho = \frac{M}{V} = \frac{M}{\frac{4}{3}\pi r^3}$$

$$\Rightarrow M = \rho \cdot \frac{4}{3}\pi r^3$$

$$r_e = \sqrt{\frac{2G\rho\frac{4}{3}\pi r^3}{r}}$$

$$r_e = \sqrt{\frac{8}{3}\pi G \rho r^2}$$

ρ_c = Densidad Crítica.

$$v = H_0 r$$

$$H_0^2 r^2 = \frac{8}{3}\pi G \rho_c r^2$$

$$\rho_c = \frac{H_0^2}{\frac{8}{3}\pi G} \Rightarrow \boxed{\rho_c = \frac{3H_0^2}{8\pi G}}$$

$\rho_c = 6$ protones/m^3

$$\Omega_i = \frac{\rho_i}{\rho_c} \quad y \quad \Omega_{tot} = \sum_i \Omega_i$$

Abierto — Perpetuo

$\Omega_{tot} < 1 \Rightarrow \rho < \rho_c$ — Expansión

$\Omega_{tot} = 1 \Rightarrow \rho = \rho_c$ Asintótico

$\Omega_{tot} > 1 \Rightarrow \rho > \rho_c$ — Colapso

→ Cerrado

Plano.

ΛCDM

$$\Omega_{tot} = 1{,}001 \pm 0{,}001$$

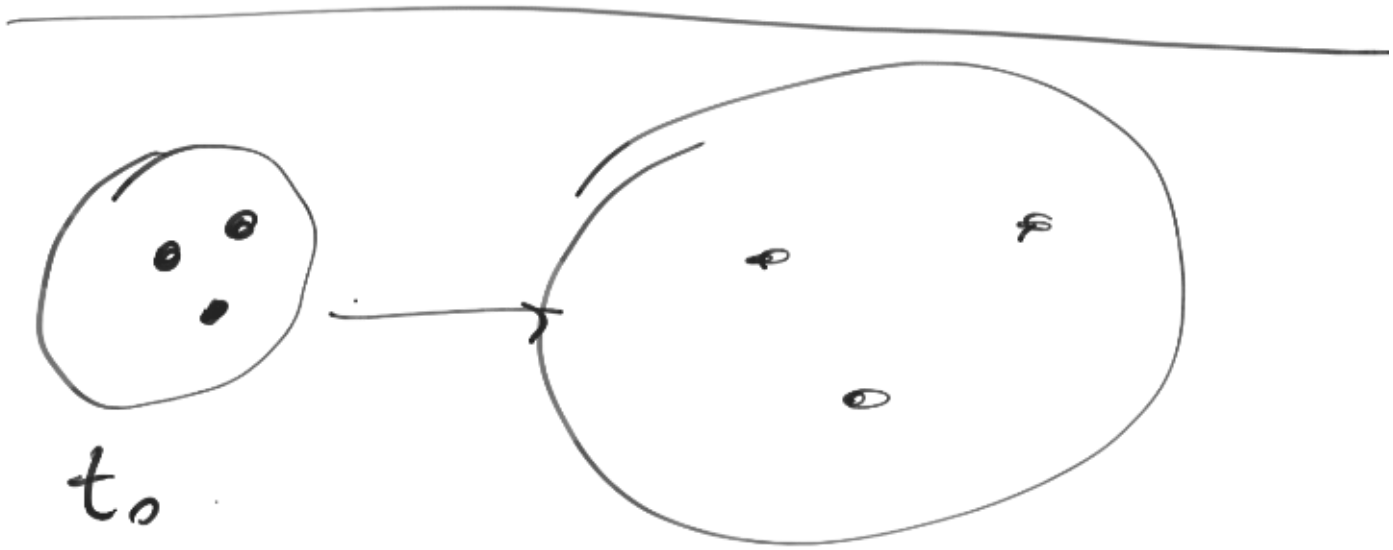
Ω_K

Ω_m

Ω_γ

Ω_ν

$\Big\}$ $\Sigma = 1$



$$\frac{F}{} \propto \frac{1}{\lambda}$$

$$\rho_M \sim 1/r^3 \sim \frac{1}{t^3}$$

$$\rho_\gamma \sim 1/r^4 \sim \frac{1}{t^4}$$

$\Omega_{tot} = 1.$

$\Omega_{tot} = \Omega_k + \Omega_m + \Omega_\gamma + \Omega_{desc.}$

$10^{-5} + 0{,}05 + 0{,}002 + 0{,}95$

Cold

ΛCDM → Materia Oscura

Energía Oscura

$\Omega_M = 0{,}259$ $\Omega_\Lambda = 0{,}68$

Dark Matter

Dark Energy

Modelo estándar Cosmológico

$$8\pi G^{\mu\nu} = R^{\mu\nu}$$

↓

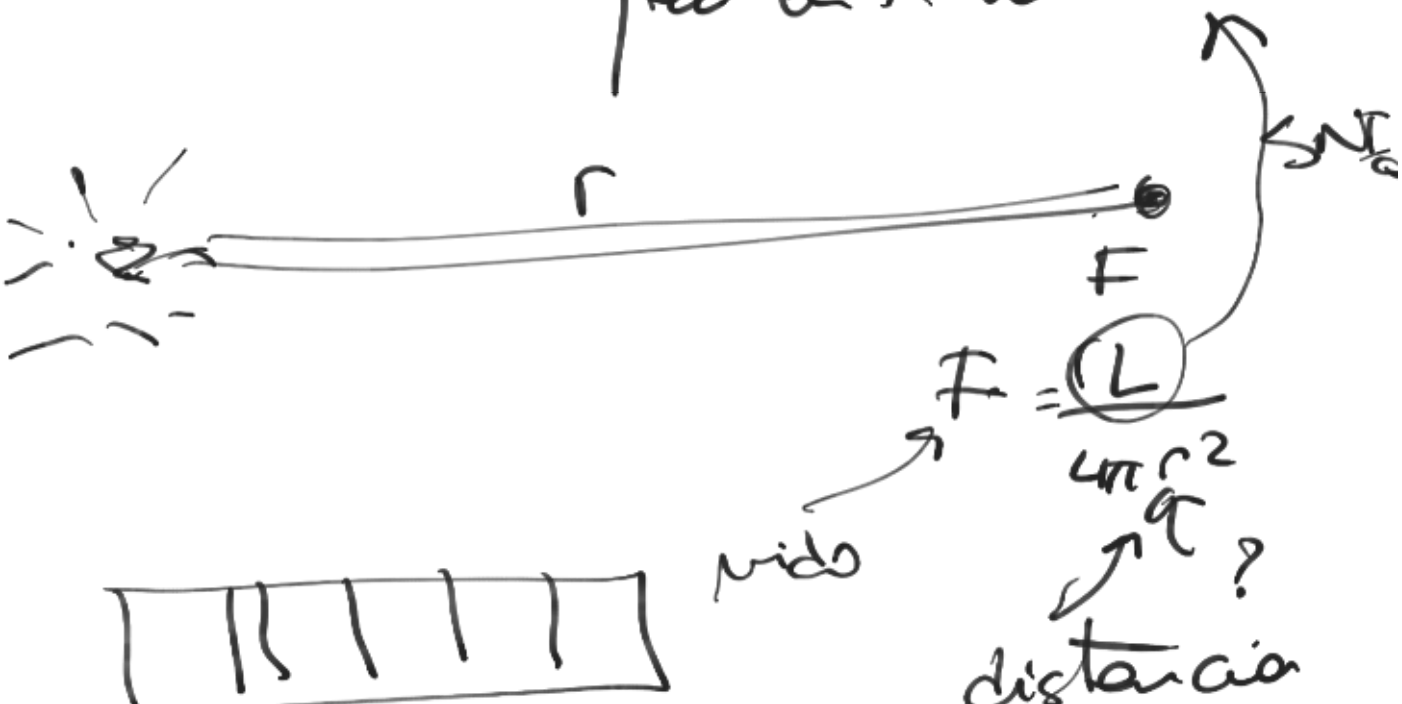
F.R.W → Universo en expansión.

$$8\pi G^{\mu\nu} + \Lambda = R^{\mu\nu}$$

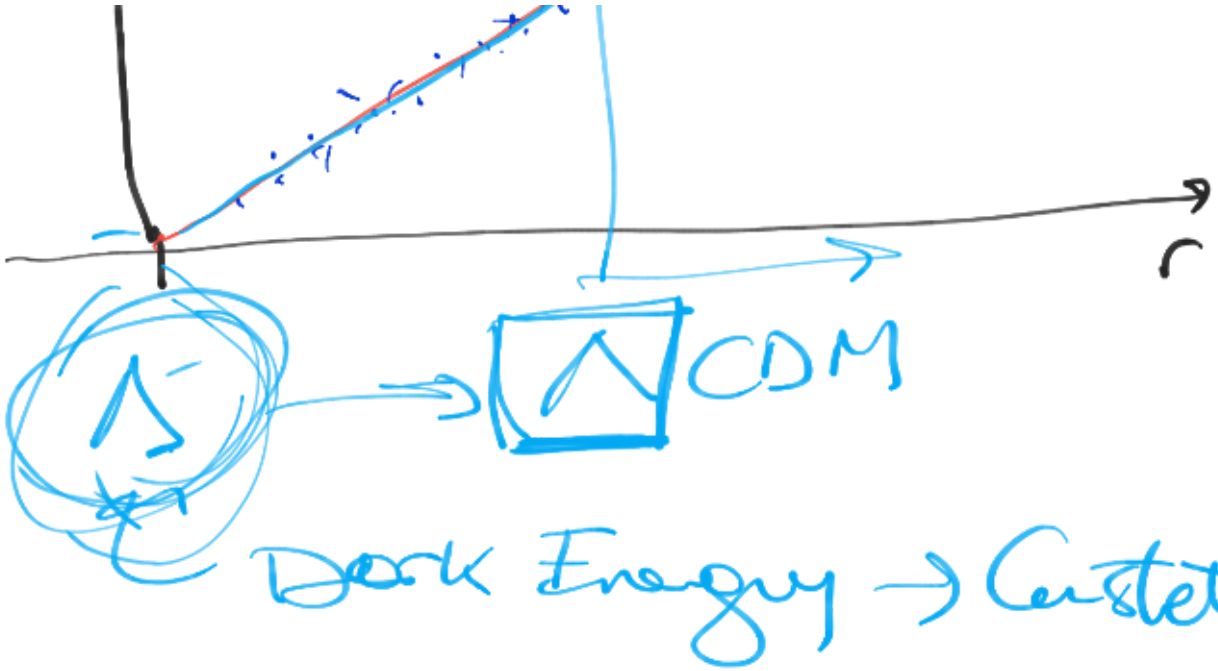
constante cosmológica

Hubble expansión

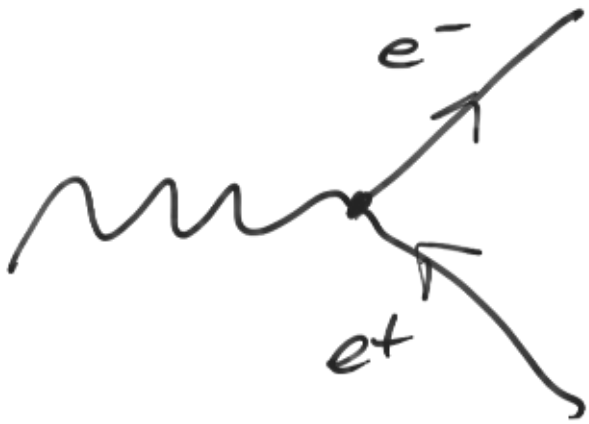
SNIa → se conoce muy bien la cant. de energía que libera la SNIa



z espectro



Dark Energy → Carsten



$E_\gamma \geq 2 m_e c^2$

$E_\gamma \geq 1{,}022\ \text{MeV}$

$\langle E_\gamma \rangle < 1{,}022\ \text{MeV}$

$\phi(E) \propto e^{-E/kT}$ Faktor Boltzmann

Plasma.

Núcleos simples (H, D, ^3He, ^3H, ^7Be, ^7Li, ...)

positrons, electrons, fotons.

→ Compton, efecte fotoelèctric

Opacidad de pares, rad. de fondo

$\langle E \rangle \sim eV \rightarrow$ Absorción

↓

Neutro.

El Universo se hace transparente

$\langle E \rangle \sim eV \sim T \simeq 4000K$

$378000 \leftrightarrow z = 1100$

$T \simeq 3{,}6\,K$

$T \simeq 2{,}7K$