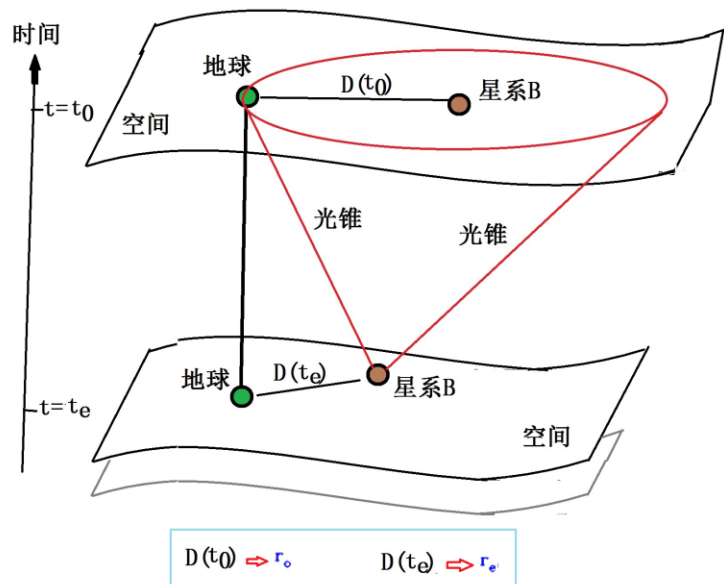
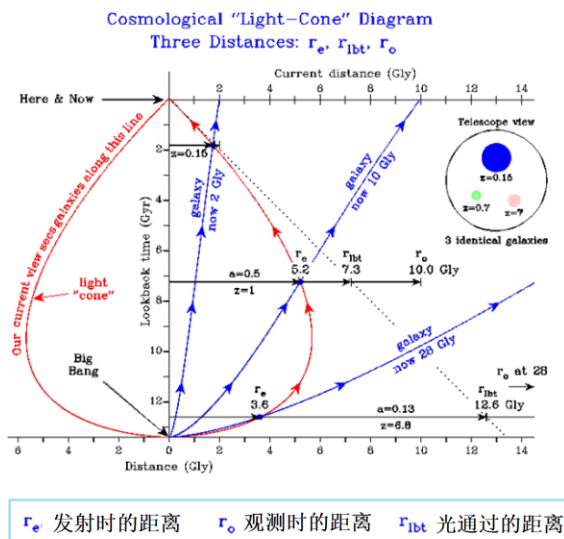


可观测宇宙的大小，计算过程如下：



弗里德曼度规 $c^2 dt^2 - R(t)^2 \frac{dr^2}{1 - kr^2} = 0$ $dt = dz \frac{dt}{dz}$

$\Rightarrow 0$

$1 + z = \frac{R_0}{R(t)}$ $H(t) = \frac{R'(t)}{R(t)} \Rightarrow dt = -\frac{dz}{(1+z)H(z)}$

$D(t_0) = \int_0^{t_0} dr = \int_0^{t_0} \frac{cdt}{R(t)} = \int_0^{t_0} \frac{c dz}{R_0 H(z)}$

138亿年

$= \frac{c}{H_0} \int_0^{z_{\infty}} \frac{dz}{(\Omega_m(1+z)^3 + \Omega_\Lambda)^{1/2}} = 1.35 \times 10^4 \text{Mpc} = 440 \text{ 亿光年}$

$H(t)$	哈勃参数
z	红移
$R(t)$	标度因子
$\Omega_m = 0.3$	尘埃物质密度 (明物质+暗物质)
$\Omega_\Lambda = 0.7$	暗能量密度 (宇宙常数项)
$H_0 = 71 \text{ km/s/Mpc}$	$1 \text{ pc} = 3.26 \text{ 光年}$