Introductory Astronomy

Week 8: Cosmology

Clip 5: A Brief History of Everything

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A Timeline: Early Years

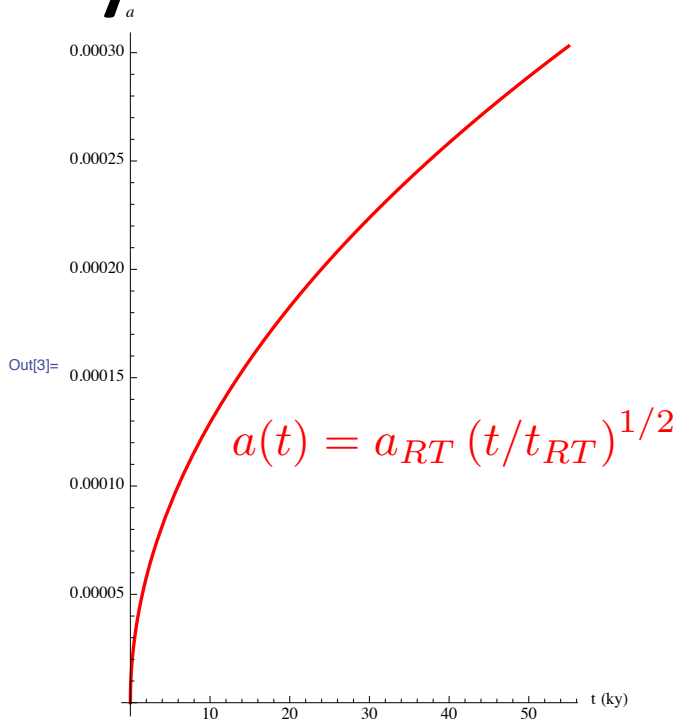
- Using Best Data

$$\Omega_{Db,0} = 0.044$$
$$\Omega_{D,0} = 0.256$$
$$\Omega_{R,0} = 4.765 \times 10^{-5}$$
$$\Omega_{\Lambda,0} = 0.74$$

  construct history of scale factor

- Early epoch: radiation dominated until

$z_{RT} \sim 3300 \quad t_{RT} \sim 55\,\mathrm{ky}$



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Now and Beyond

- Matter dominates until

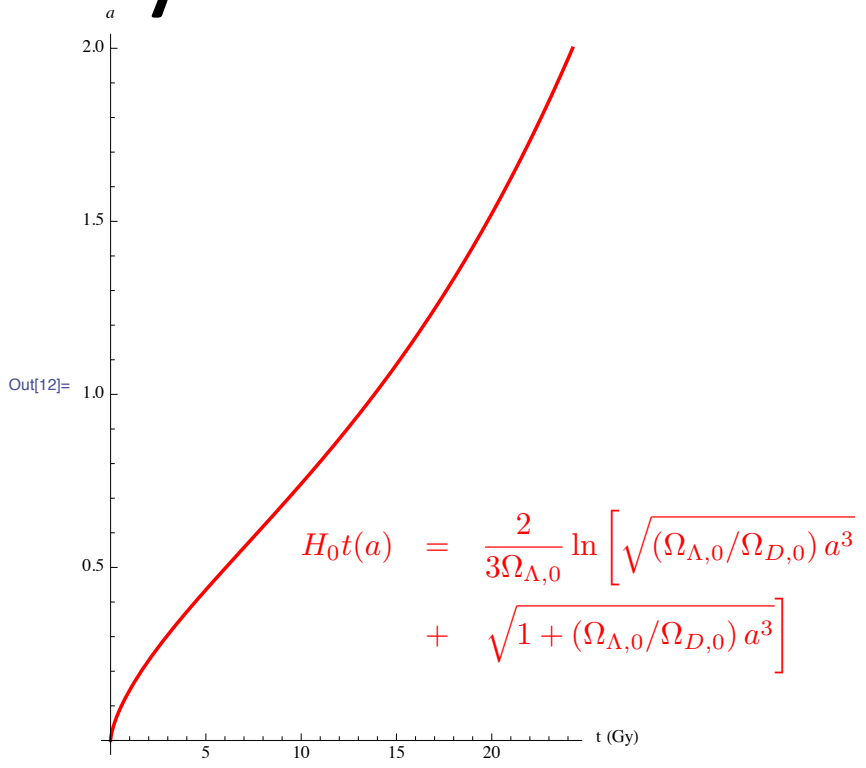
$$a_{MT} = (\Omega_{D,0}/\Omega_{\Lambda,0})^{1/3} = 0.706$$

$$z_{MT} \sim 0.4 \quad t_{MT} \sim 0.59 t_0 = 8.18\,\mathrm{Gy}$$

$$a(t) = a_{MT}\,(t/t_{MT})^{2/3}$$

- For large times Λ dominates and

$$a(t) \sim e^{\sqrt{\Lambda/3}ct}$$



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Particle Horizons

- How far can we see?
- By time t how much of the universe has a given observer seen?
- This size of observable universe – particle horizon
- Objects on particle horizon are seen at $t = 0$

- In radiation era

$$D_h(t) = 2ct$$

- In matter era

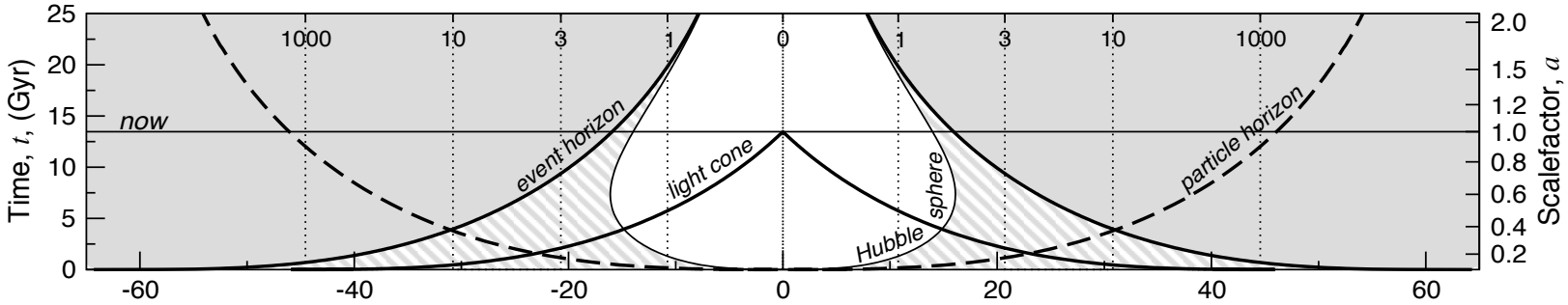
$$D_h(t) = 3ct$$

- Today $D_h(t_0) = 46\,\mathrm{Gly}$
- In exponential expansion

$$D_h(t) \to \sqrt{3/\Lambda}a(t) = 62a(t)\,\mathrm{Gly}$$

Event Horizons

- How far into today's universe will we ever see?
- Event horizon separates events from which light will reach us someday from those we will never see
- Exponential expansion means galaxies leave our visible region with time
- As object approaches event horizon its light infinitely redshifted



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Credits

- Cosmological Horizons: From T.H. Davis and C.H. Lineweaver, http://arxiv.org/pdf/astro-ph/0310808v2.pdf