Lecture 07:
The "Benchmark Model" and
"measurable" distances

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February 28, 2018

1 The Benchmark Model for the real Universe

- Up to this point, we've only considered "simplistic" universes which are either empty, or which just consist of a single component (e.g., matter *or* radiation, etc.).
- However, we know that the real Universe contains (at least) three main components: radiation, matter and Dark Energy (I say "at least", since there may be other components that are too insignificant to currently measure).
- Thankfully, things are made easier by different components adding linearly in the Friedmann Equation, i.e.,:

$$\varepsilon_{\rm tot} = \varepsilon_{\rm R} + \varepsilon_{\rm M} + \varepsilon_{\rm D} \tag{1}$$

- From this, and by using the relationships derived in previous lectures:

$$\varepsilon_0, c = \frac{3H_0^2 c^2}{8\pi G} \tag{2}$$

$$\Omega_{i,0} = \frac{\varepsilon_i, 0}{\varepsilon_c, 0} \tag{3}$$

$$H_0^2(1-\Omega_0) = \frac{-\kappa c^2}{R_0^2} \tag{4}$$

$$\varepsilon(a) = \varepsilon_0 a^{-3(1+\omega)} \tag{5}$$

$$\tag{6}$$

we get:

$$\left(\frac{H}{H_0}\right)^2 = \Omega \tag{7}$$