The Effect of Redshift on Observed Quantities

Definitions: $redshift = z = \frac{\Delta\lambda}{\lambda} = \frac{\lambda_{now} - \lambda_z}{\lambda_z}$ $\quad 1 + z = \frac{\lambda_{observed}}{\lambda_{emitted}}$

<u>Remember</u>: We always observe from a redshift of ZERO! Higher redshift means we are looking farther away and longer ago.

Scale Factor:

We observe **now**, when the scale factor of the universe is $\mathbf{R_{now}}$. An object we observe at redshift **z** emitted its light long ago when the universe had scale factor $\mathbf{R_z}$.

The relationship between these scale factors is $\frac{R_{now}}{R_z} = 1 + z$. The universe is larger now than it was at redshift z.

Wavelength:

The wavelength we observe now is related to the emitted wavelength by $\frac{\lambda_{now}}{\lambda_z} = 1 + z$. Wavelengths are stretched out by the expansion of the universe.

Temperature:

The temperature of the background radiation now as compared with its temperature at a redshift of z is $\frac{T_{now}}{T_z} = \frac{1}{1 + z}$. The universe is cooler now than it was at redshift z.

Therefore we can also see the following relationships:

$$\frac{R_{now}}{R_z} = \frac{\lambda_{now}}{\lambda_z} = \frac{T_z}{T_{now}}.$$