PHYS 800
Special Topics in Cosmology

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The Distance-Redshift Relation
Things that go Boom in the night.
Type Ia Supernovae
Type Ia SN as “standard candles”

Their intrinsic luminosity is directly related to the time duration of the blast. (also known as the “light curve”)
The Distance-Redshift Relation

The graph illustrates the observed magnitude of distant Type Ia supernovae plotted against their redshift, indicating how the universe's structure changes with distance. The data points represent observations from two major projects: the High-Z Supernova Search and the Supernova Cosmology Project.

Two models are compared: the accelerating universe, which is consistent with current data, and the decelerating universe. The accelerating universe is represented by a best-fit line, while the decelerating universe is represented by another line.

For a universe with empty density ($\rho = 0$), the line would be different, and for a universe with critical density ($\rho_c$), another line is shown. The linear scale of the universe relative to today is indicated on the x-axis.
How fast do different universes expand?

All universes have same expansion rate at $z=3$. ($R=1/4$)

NB: here, $a$ = expansion factor = $R$. 

$H(z)/(1+z) = \dot{a}$

- $\Omega_m = 0.3$, $\Omega_\Lambda = 0.7$
- $\Omega_m = 0.3$, $\Omega_\Lambda = 0.0$
- $\Omega_m = 1.0$, $\Omega_\Lambda = 0.0$
- $\Omega_m = 5.0$, $\Omega_\Lambda = 0.0$
Measuring the expansion rate.

![Graph showing the expansion rate of the Universe as a function of redshift. Local data from Reiss+03, SDSS galaxies, BOSS galaxies, BOSS LyAF are plotted.](fig:expansion)