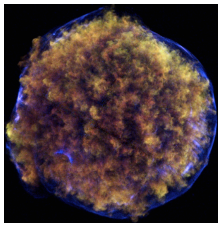


Type Ia Supernovae and the Expansion of the Universe

The constant brightness of Type Ia supernovae means that they can be used as standard candles to determine distance. By observing these supernovae in galaxies, we can measure the expansion rate of the universe as a function of distance, further out in the universe than ever before.

- **STEP 1: Plot the data in the table on Page 2 on the graph on Page 3**
- **STEP 2: Use this plot to answer the following questions:**

1. Are the furthest-away galaxies above or below the dashed line representing Hubble's law and a constant expansion rate for the universe?

2. Does this mean that they are moving away from us faster or slower than Hubble's Law would predict?

3. What could cause this to happen? Can we explain it with any forces we have discussed in class?

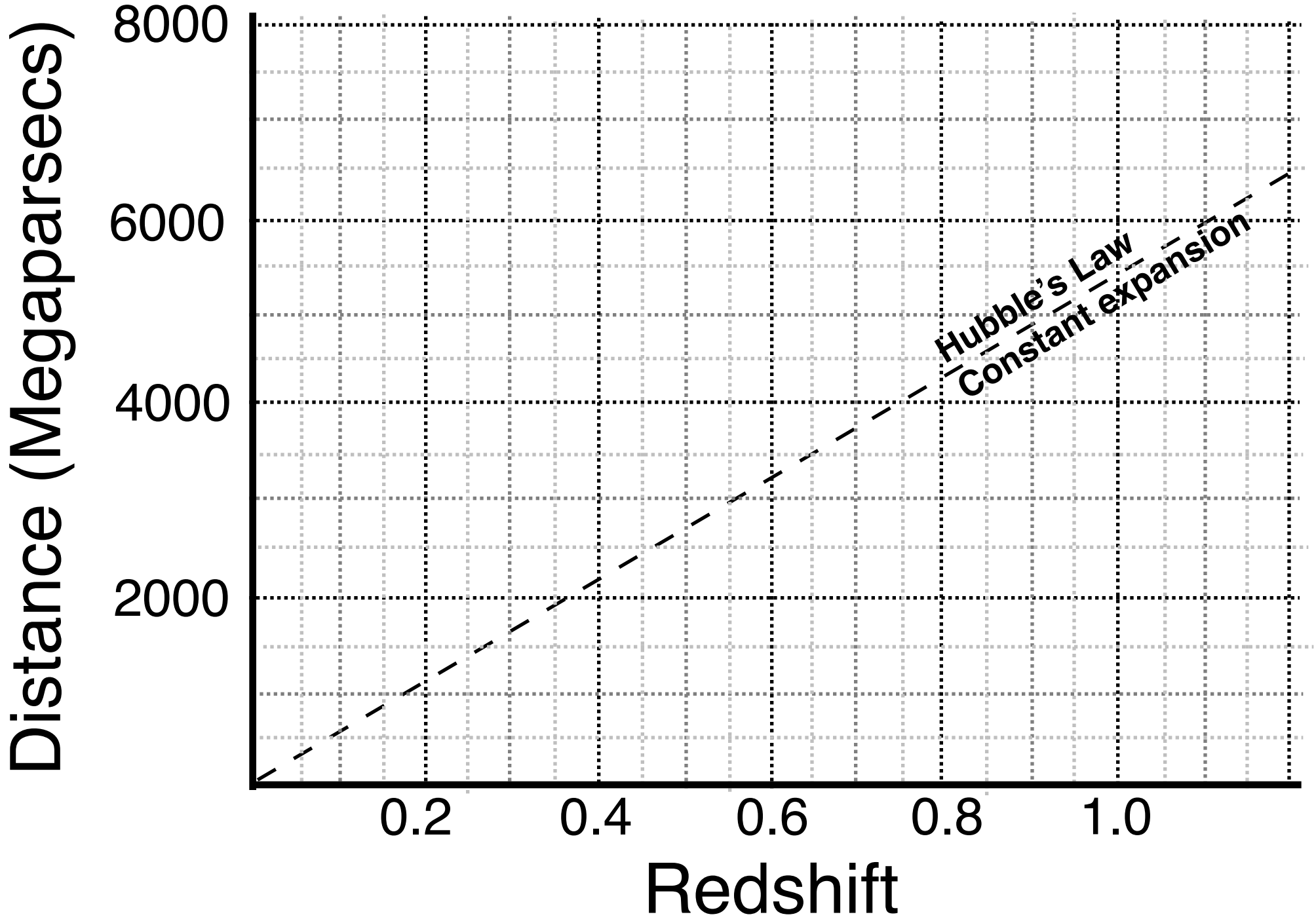
Supernova Data

Supernova Name	Redshift	Distance (Megaparsecs)
1996C	0.03	150
1990af	0.05	220
1992bs	0.08	390
1992aq	0.1	460
1996ab	0.12	660
1996J	0.3	1600
1996K	0.38	2800
1996U	0.43	2900
1995K	0.48	3100
1997cj	0.5	3500
1996I	0.57	3700
1996H	0.62	4000
1997ck	0.97	7200

1 **Megaparsec** = 1 million parsecs

1 **parsec** = 3.3 lightyears

Redshift is a type of Doppler Shift: it is a change in the color of the light we detect from an object moving away from us


Distance (Megaparsecs)
8000
6000
4000
2000
0.2
0.4
0.6
0.8
1.0
Redshift
Hubble's Law
Constant expansion