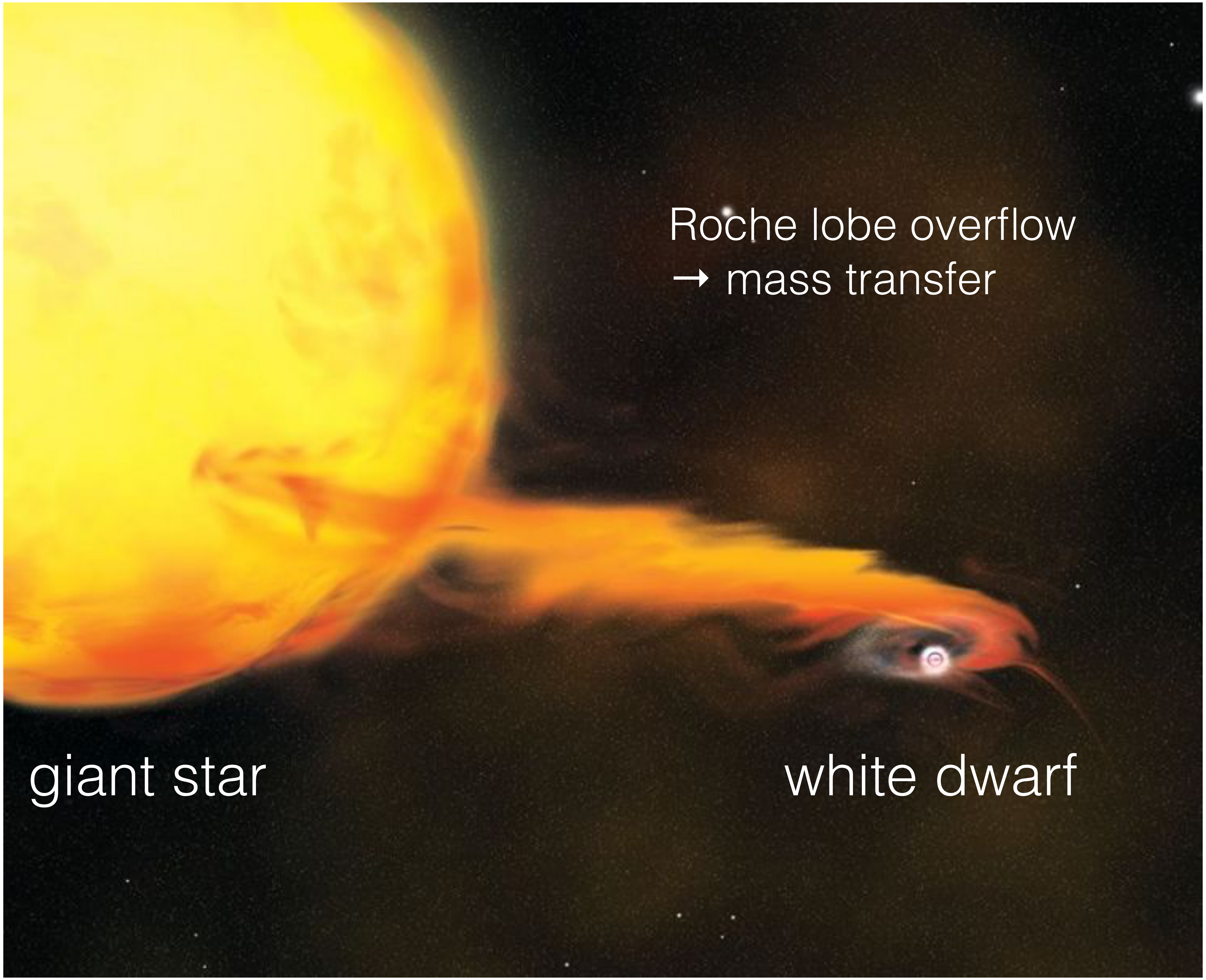
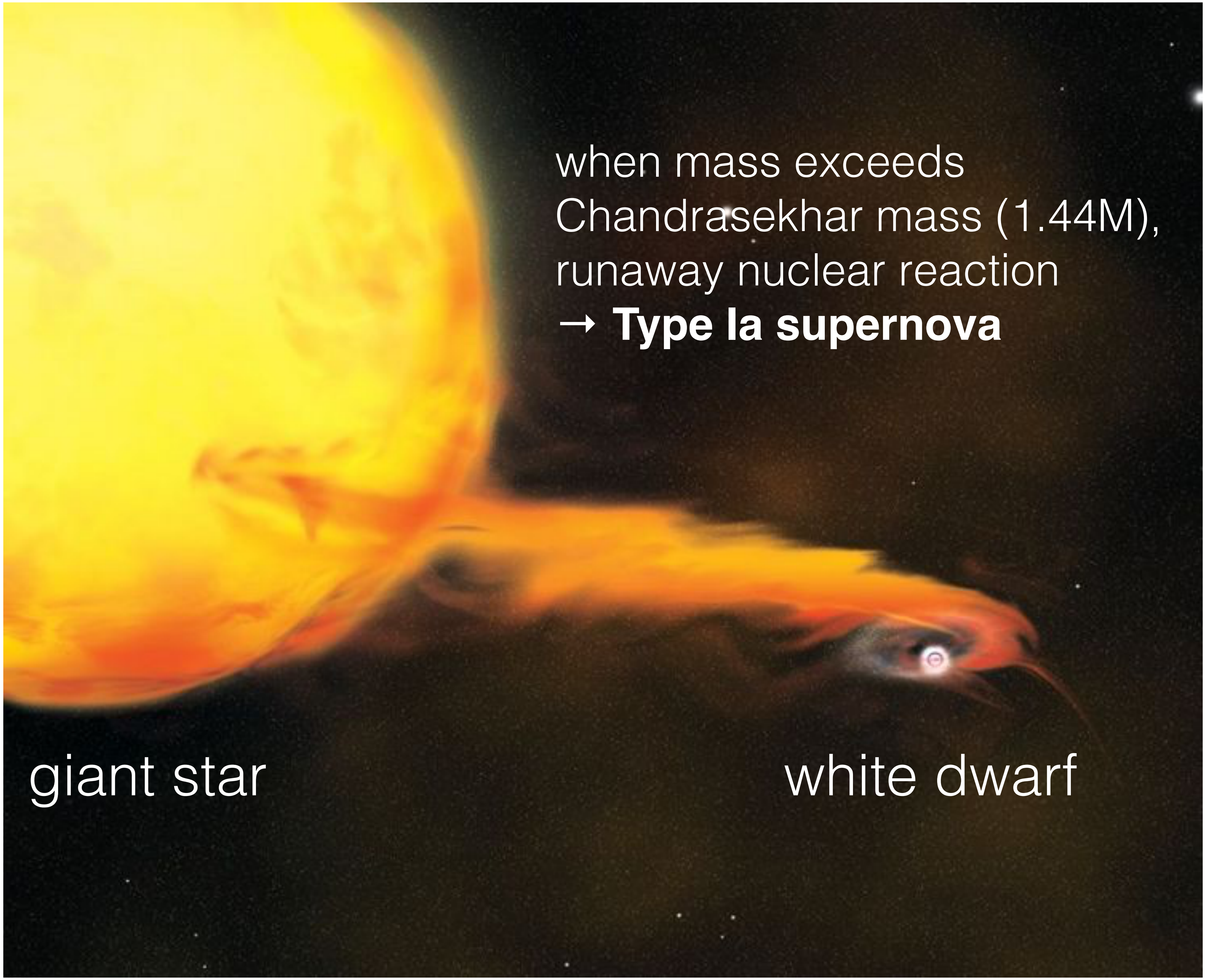
LAB 1
Hubble's Law

W3986: Astrostatistics

Quick bit of physics... Type Ia supernova



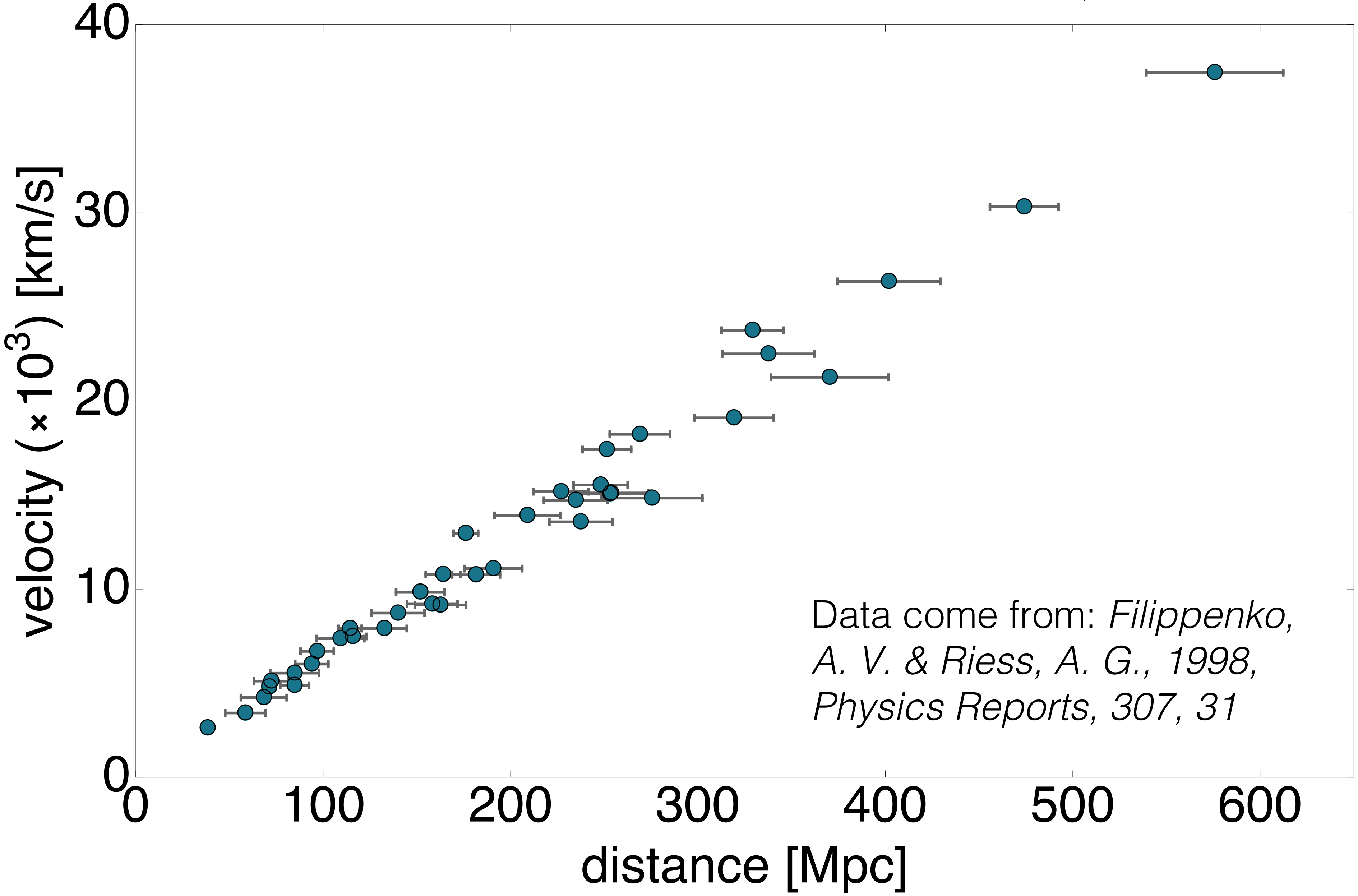
Quick bit of physics... Type Ia supernova



Hubble diagrams

- It is thought that all Type Ia supernova have the approximately same intrinsic luminosity
- That means the apparent brightness directly gives us the distance to that object (a “standard candle”)
- The redshift of the spectral lines gives us the velocity
- Plotting velocity vs distance of distant objects is called a Hubble diagram, after Edwin Hubble who did this in 1929

The gradient of the best-fitting straight line is known as Hubble's constant, H_0

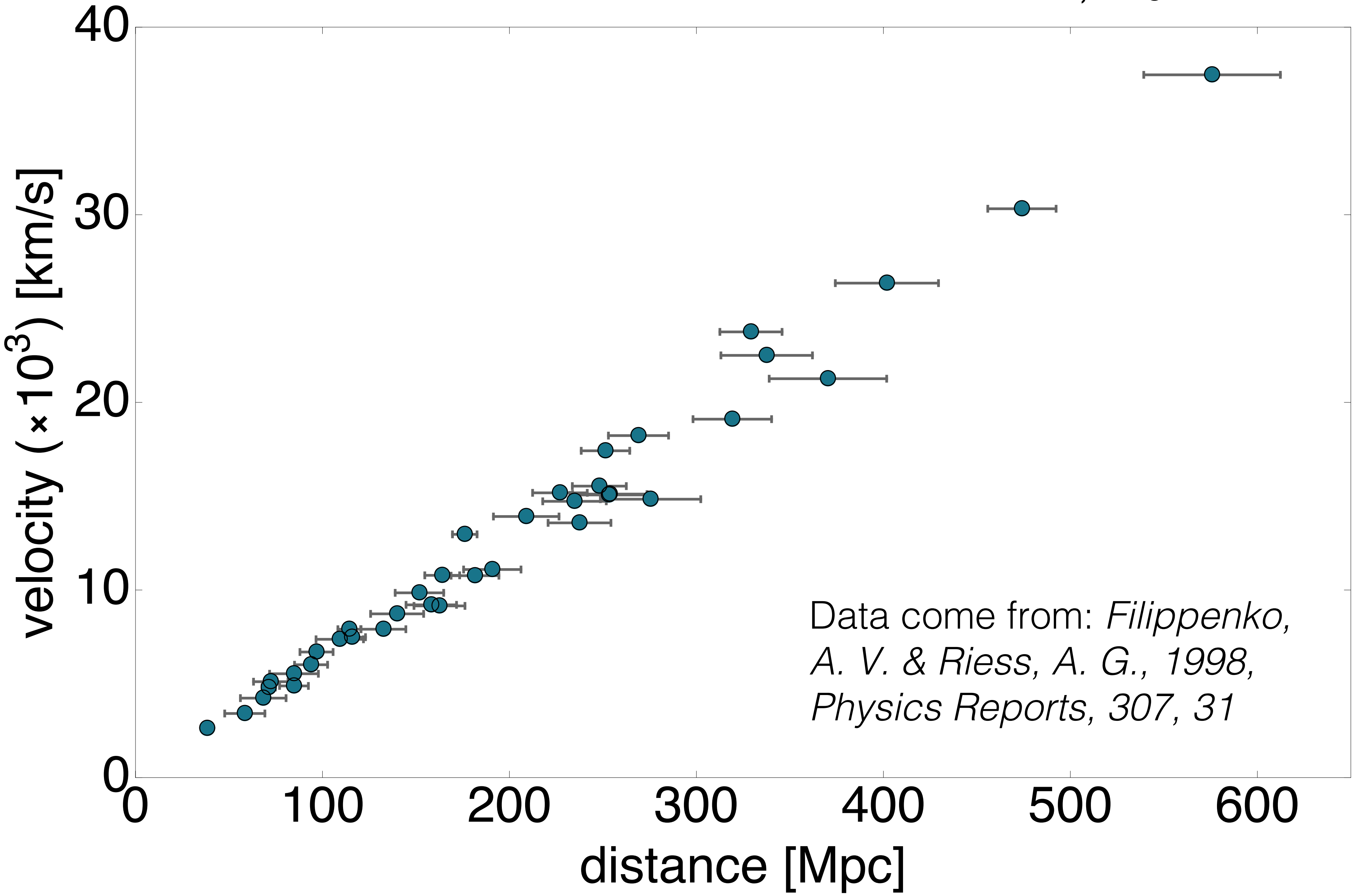


Since H_0 = velocity/distance = units of time^{-1}

inverse time = a rate => the expansion rate of the Universe

1/rate = age of the universe = $1/H_0$

The gradient of the best-fitting straight line is known as Hubble's constant, H_0



(= 1/the gradient)

age of the universe = $1/H_0$

YOUR TASK: *Use this data set to calculate the age of the Universe*

YOUR TASK: *Use this data set to calculate the age of the Universe*

1] Import data and re-arrange such that errors on are the y-axis

np.loadtxt
np.genfromtxt
astropy.ascii.read

check out CODING/ examples

2] Make a clear plot of the data, think about presentation

3] Do an unweighted fit of the data using numpy's polyfit   np.polyfit

(3b] make a histogram of residuals/error bar- is it Gaussian?)

4] Write your own code for solving the unweighted normal equation and check that you get the same answer   SEM2

5] Use polyfit again, use weighting and also output the covariance matrix   SEM3

6] Diagonal of the covariance matrix gives you the errors, so you should now able to express age of the universe with an error   SEM3

7*] Try censoring some of the data and see how your derived uncertainty increases (anything from single example to plots of *factor by which error increases* vs *fraction of data censored*)

8*] Try perturbing each data point by random.normal(0,error_i) and make a histogram of how best-fitting gradient changes over 1000 trials   "bootstrap"

9] Write up your summary slide   see example summary slide

you don't need to do a "*", but grade is capped at A without