

Big Rip

Universe is expanding
(from Hubble Law)

distance out to $z < 0.2$

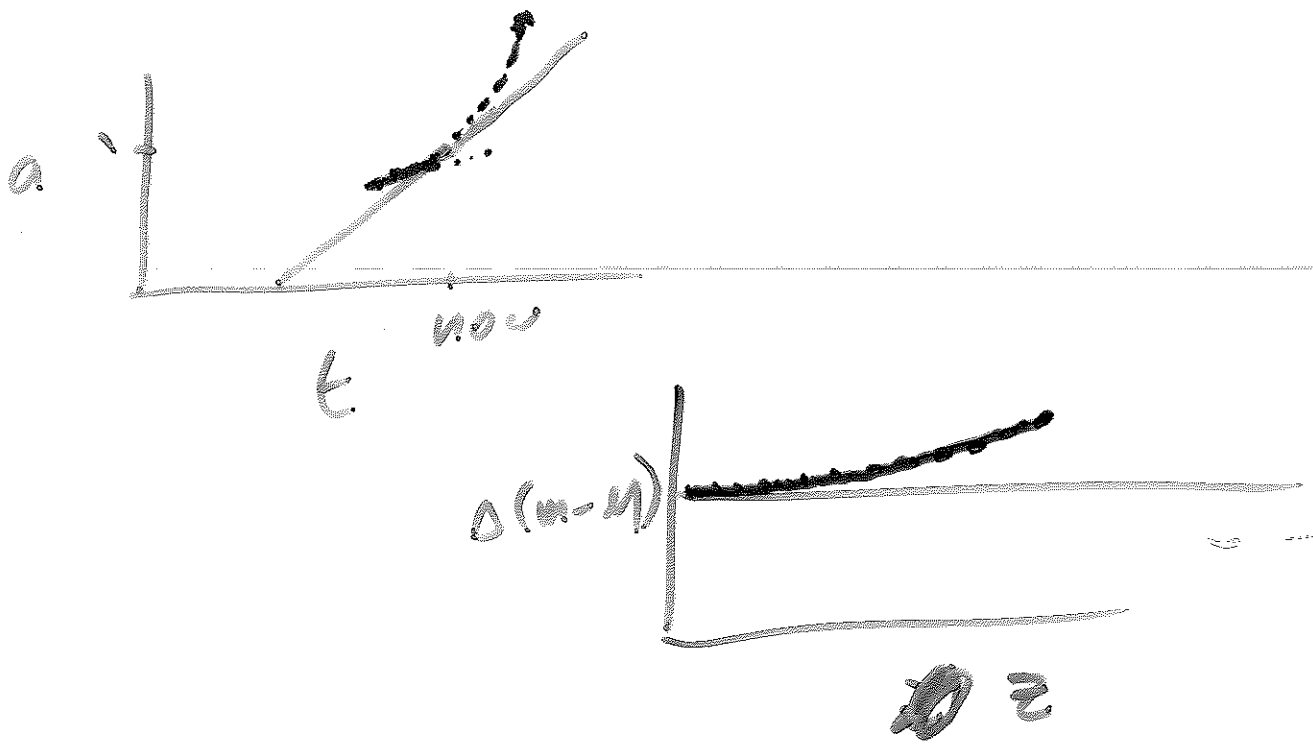
acceleration vs. deceleration

↓ ↓
Dark Energy vs. matter
(Dark Matter)

SNe $z > 0.3$ (out to ~~to~~ about $z=1$)

IN PAST: universe was expanding
more slowly than now

∴ universe is accelerating
∴ Dark Energy > matter



Dark Energy vs. Dark Matter
 at current $DE > DM$
 this change with time

matter density in past
 same amount of matter
 Universe was smaller
 $\rho = \frac{m}{V} \Rightarrow$ bigger in past

Λ is constant!

density is constant
in the past D.E. density
was SAME as now

if ρ_{matter} gets bigger in
past

and ρ_{DE} does not

then at some point in past

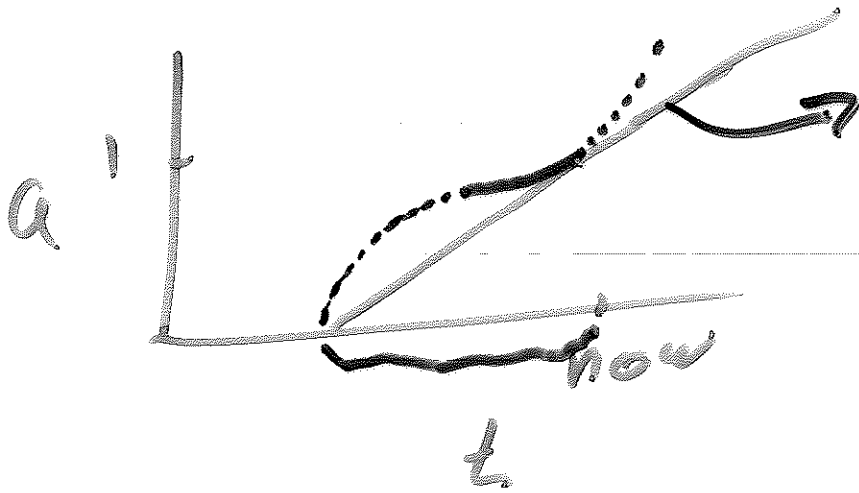
$$DE = DM$$

before that DM wins

→ Universe decelerates

from start until some moment
Universe decelerates

after some moment
accelerates

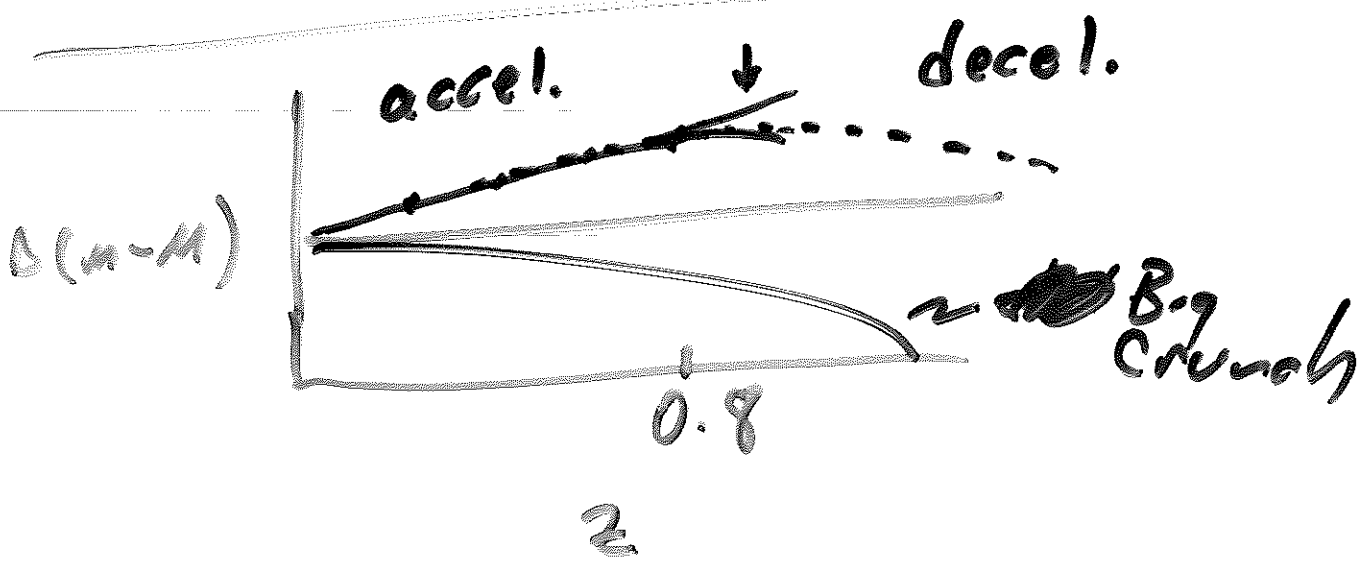


$\Omega_m = .25$
 $\Omega_\Lambda = .75$
 (at present)

and
 $H_0 = 70$

$\curvearrowright \Rightarrow$ decel!
 $\curvearrowleft \Rightarrow$ accel!

\Downarrow
 age of
 universe
 13.4 billion
 yrs



hard to see SN $z > 1$

- 1) faint
- 2) on top of galaxies
↳ look smaller
- 3) light is redshift
most radiation is
in infrared

DO THIS FROM SPACE

- 2) much better images
- 3) IR background is MUCH
fainter
and no atmospheric
absorptions

recently: Using HST to
find high- z supernovae

Small field of view \Rightarrow don't
find many SN

See Kinematic SN Ia residual Hubble Diagram, Fig. 6 in Riess et al. *Astrophysical Journal*. 2004. pp 607, 665

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a reason to worry...

gravitational lensing
makes things look brighter

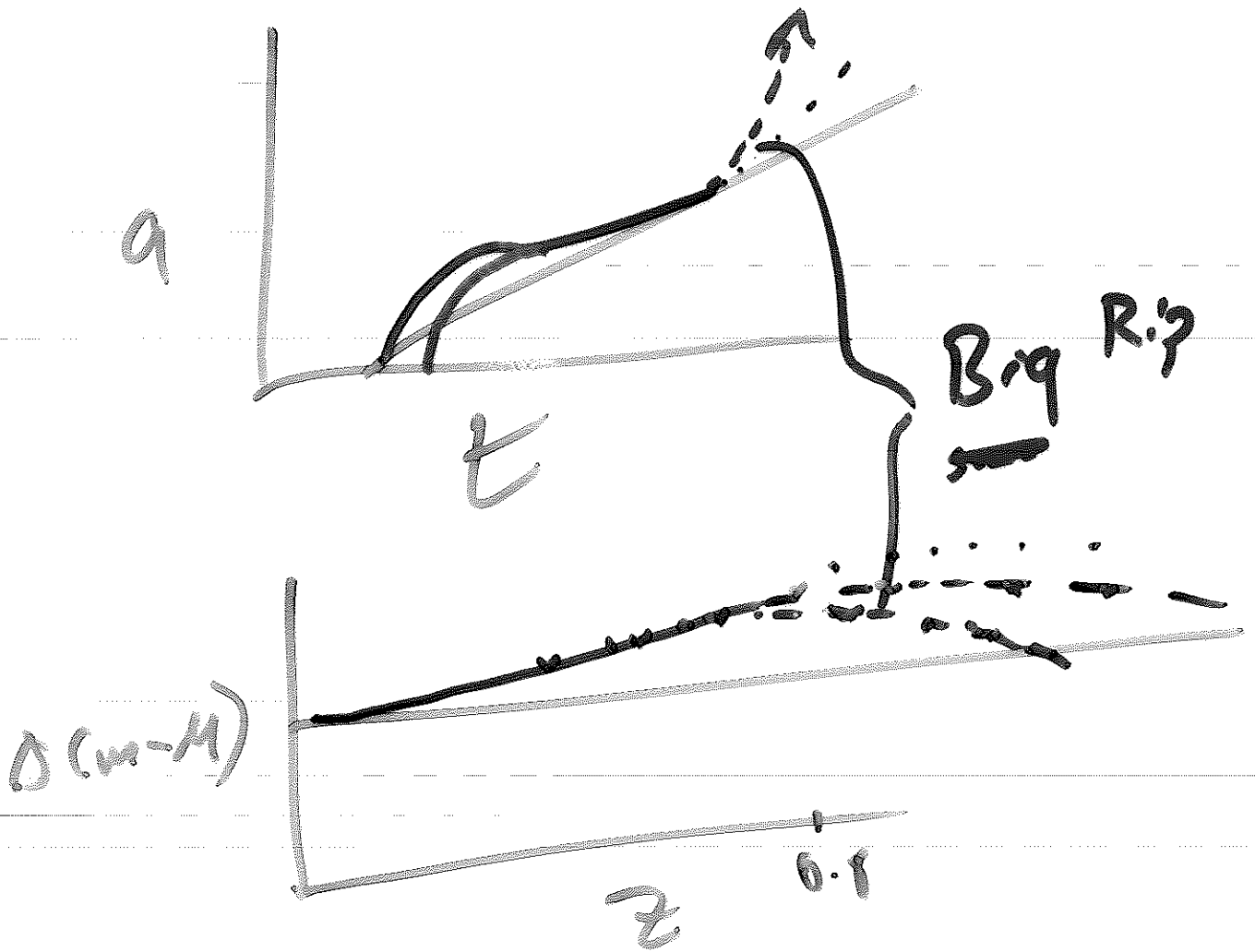
- 1) more distant objects
more likely to be lensed
- 2) at faint limit you see
~~abnormally~~ abnormally bright
things preferentially

Suppose Dark Energy isn't
constant

D.E. density increases w/
time \rightarrow "Big Rip"

D.E. density was LESS in
past

need to balance between dec!
acc!



Big Rip: same expansion now
 same accel now
 more accel. (future)
 more decel (in past)

space mission:

JDEM

joint dark energy
mission



NASA D.O.E.

SNAP ~~SM~~ supernova & acceleration
probe

(example)

space telescope:

WIDE FIELD OF VIEW
optimized for IR

find many supernovae $z > 1$

Large Synoptic Survey Telescope LSST

survey of sky every 3
days

⇒ find every low and
intermediate z
SNe

10^4 / yr (ish)

huge statistics to $z=0.5$
also study details of subpopulations
of SNe

30 Tbytes of data / night
