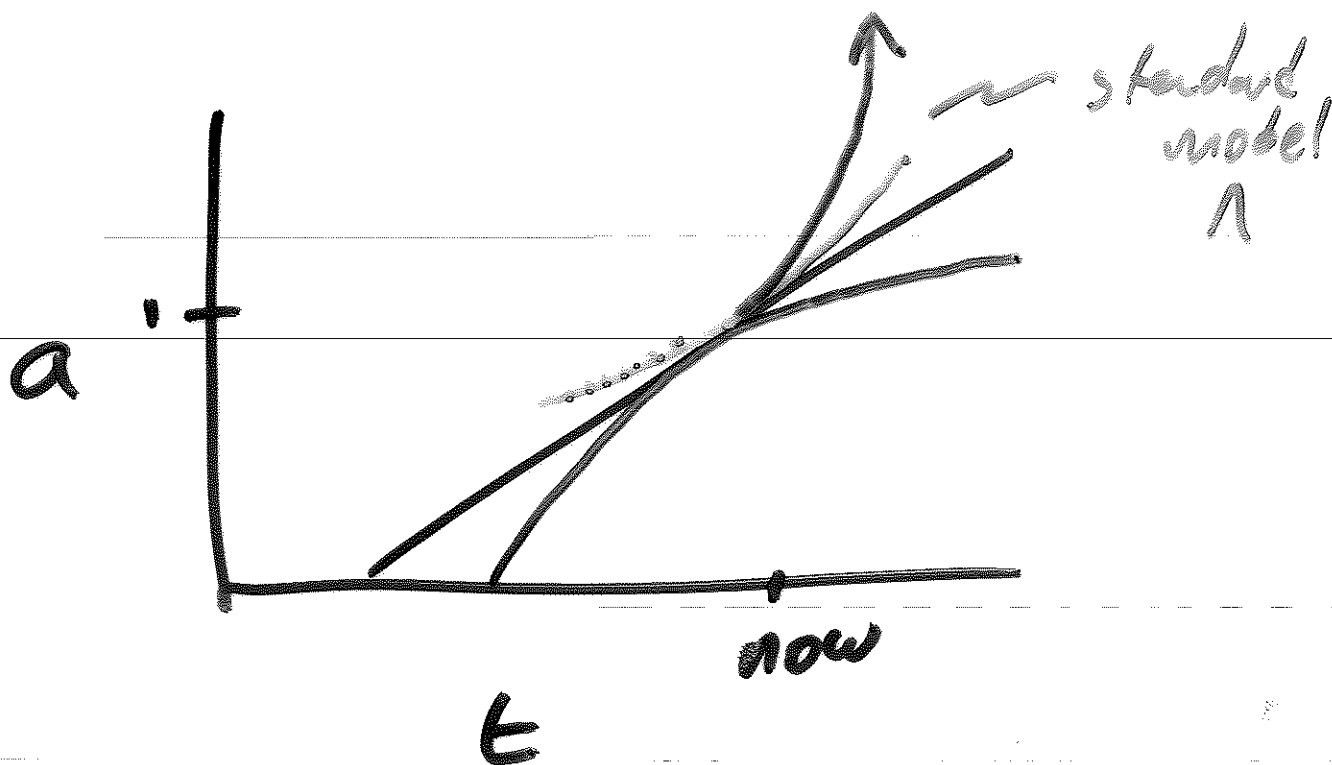


PAPER DRAFTS/OUTLINES
accepted thru Thurs. MORNING

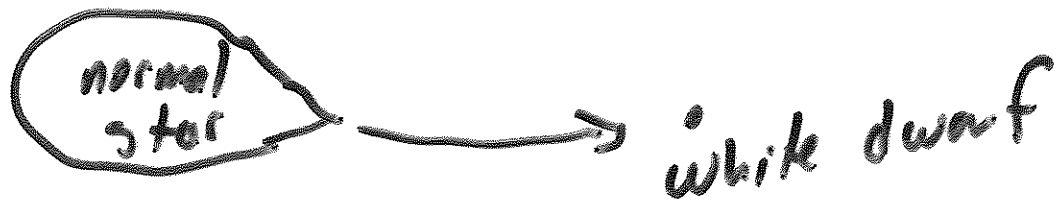
next week: NO SECTIONS
(no s'bucks hrs either)

following week: DOUBLE SECTIONS
(I'll explain...)

special welcome to pre-fresh
(and come hear about
black holes at 7pm!)



Type Ia Supernovae



white dwarf: C, O, N, Ne...

accreted material
around white dwarf

→ nuclear fusion

⇒ occasional thermonuclear
explosions of accreted
material

⇒ NOVA ⇒ ${}^{\text{C,O}}_{\text{N}}$

white dwarf gets more massive

"Chandrasekhar limit"

1.4 M_{\odot}

⇒ COLLAPSE

C (other elements)

fuse \Rightarrow energy
 \rightarrow Fe and
leave the rest

ALL AT ONCE

"STANDARD BOMB"

~~all~~ always have same
amount of material/
all explodes at once

\rightarrow always the same brightness

early 1990s:

1) HST measured Cepheids
in galaxies that had
Type Ia SN

\rightarrow calibration

know abs. mag

2) ground based telescopes discovered
compared MANY Type Ia

measure: all photons in some
 λ region at
some time

vary by 15-20%.

can correct for this
measure - color
decay rate

\Rightarrow good standard candle

* theoretical basis for
"standard candles"

* empirical basis: after some
corrections, the nearby
ones line up well
 $< 5\%$

1998: two groups doing same
things, different
approaches \rightarrow
same result

FABLE: Discovery of Dark Energy
MORAL: Replicating important
results \rightarrow greater
acceptance



\Rightarrow "Einstein's Cosmological
Constant" Λ

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Energy density of Λ is
constant as Universe expands

for matter
 ρ_{now}

• when a was $\frac{1}{2}$ its
present amount

$\frac{1}{8}$ the volume $(\frac{1}{2})^3 = \frac{1}{8}$

Same amount of matter

$$\rho_{\text{then}} = \frac{M}{V} \rightarrow \text{doesn't change}$$

\hookrightarrow does change

$$= 8 \rho_{\text{now}}$$

Dark Energy Dens. is CONSTANT

$\Lambda \Rightarrow$ univ. D.E. has
constant density

or maybe not?

Suppose D.E. density
INCREASES as Universe
gets bigger

\rightarrow then m^3 of volume has
increasing D.E.
 \rightarrow pushes universe faster
 \rightarrow size increases faster

\Rightarrow EXPONENTIAL
~~EXPANSION~~
EXPANSION

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\Rightarrow "Big Rip"