Thurs: PS #9 due
papers due
last lecture

next week: supersection

final: LAST PART OF COURSE ONLY
(there will be a review session —
and forum, and office hrs,
and other meetings if desired)

SUPERNOVAE

know that Universe is accelerating

$\Omega_\Lambda > \Omega_m$

know by how much bigger
Ω_Λ is than Ω_m

(assuming D.E. is cosmo. constant)

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Cosmic Microwave Background

recall: looking back
denser & hotter

$z = 3000$

$T \sim 10^4$

↳ H ionize

before that Universe was opaque

in any direction you should see hot ionized H
↳ surface of star

$\lambda_{obs} = \lambda_0 + \Delta\lambda = \lambda_0(1+z)$

$\Delta\lambda/\lambda_0$

$= \lambda_0 \times 3 \times 10^3$

$5 \times 10^{-7}\,m \times 3 \times 10^3 = 15 \times 10^{-4}$

$\sim 1\,mm$

microwaves

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TRUE: is a cosmic microwave background

in any direction

1960s ⇒ evidence for BB against SS

Very smooth
same everywhere
MUST be some irregularities
(Universe now irregular ⇐ contains objects)

COBE
⇐ Cosmic Background Explorer
⇒ satellite early 1990s

⇒ variations 10^{-5} to 1
(now 10^{30})

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another satellite

WMAP

↓ Wilkinson Microwave Anisotropy Probe

2003: much more precise map of CMB

→ size of inequalities

---

from sizes ⇒ cosmological information

⇒ find out

$\Omega_{tot} = \Omega_\Lambda + \Omega_m$

$= 1 \quad (\pm 0.1)$

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GROWTH OF STRUCTURE

at $z = 3000$ 10^{-5} perturbations

at $z = 0$ 10^{30} + perturbations

slight overdensity

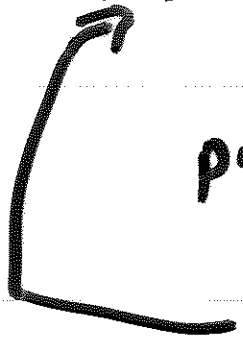
↳ more gravity

↓

pulls in nearby material

↓

denser



⇒ "Large Scale Structure"

distribution of galaxy & galaxy cluster

⇒ galaxy survey

position in sky

measure z

⇒ 3D map of sky

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Simulation growth of structure

Start with CMB

apply gravity

determine what simulation looks like "now"

does it look same as observations

assume D.E.

how much Dark Matter

some set properties

which input parameters → observations

compare simulations to redshift survey

Dark Matter

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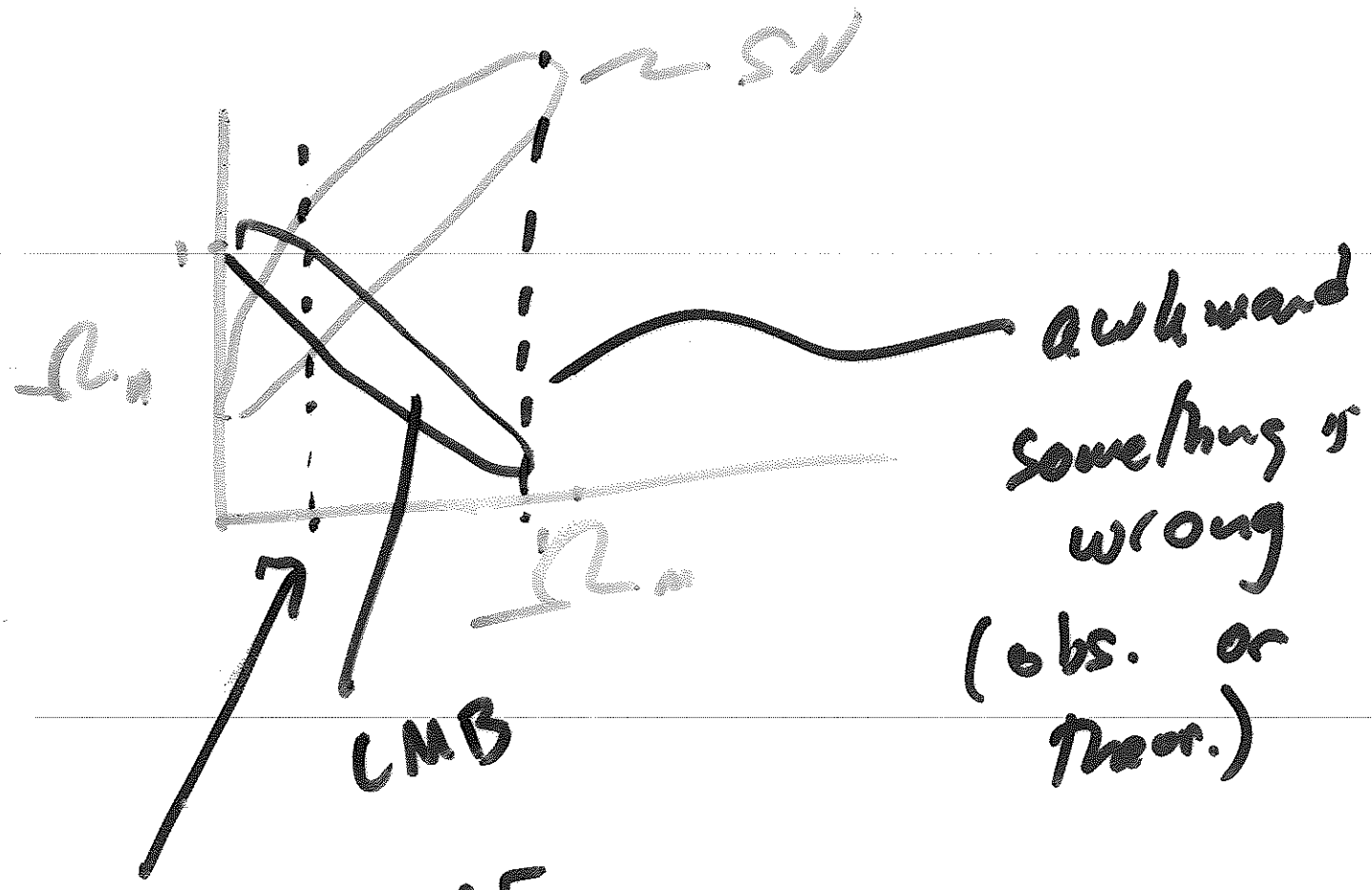

TEST of Cosmology

one measurement of 2 variable
$(\Omega_\Lambda, \Omega_m)$

two measurements of 2 variables
measure values for Ω_Λ, Ω_m

three measurement of 2 variables
TEST OF THEORY

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