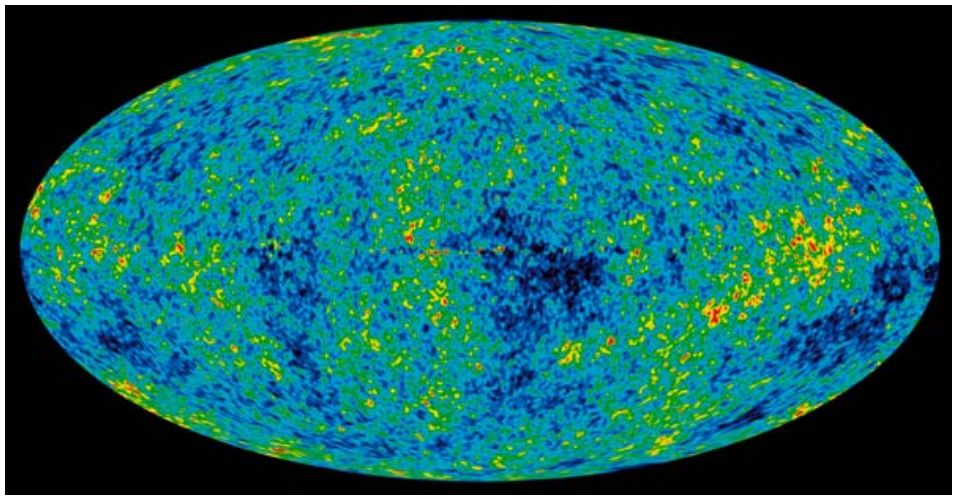
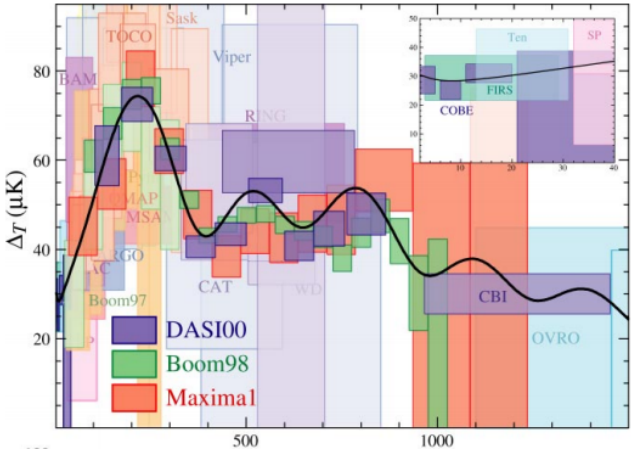


“Cosmic Microwave Background Anisotropies” Hu & Dodelson 2002

Allison Youngblood

ASTR 6000

January 26, 2012



CMB Formation

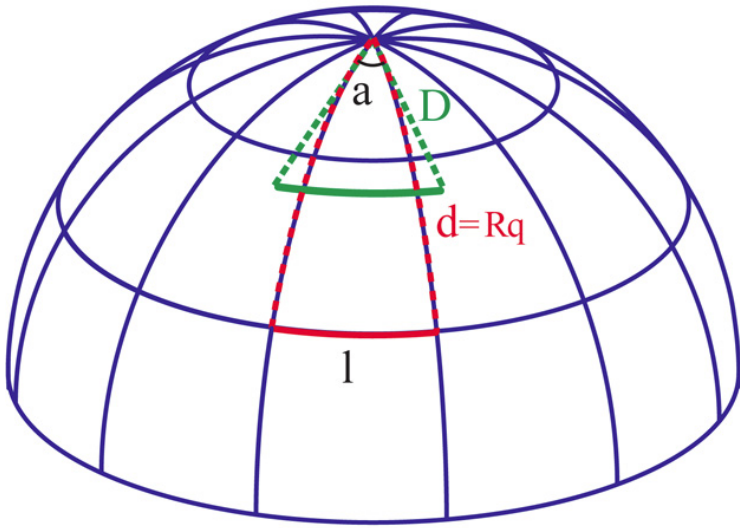
- Describe the universe before recombination. How does this relate to what we see today in the CMB?
- Why is the matter distribution in the universe clumpy, but the photon distribution smooth?
- Would we expect them to be the same or different?
- What is the proposed mechanism for the primordial small perturbations?

The Perturbations

- How do they work? What are the restoring forces? What do the oscillations represent?
- What's the difference between small-scale and large-scale anisotropies?
- What happens to the perturbations when the universe becomes neutral?
- How do fluctuations in a scalar field during inflation become temperature fluctuations?

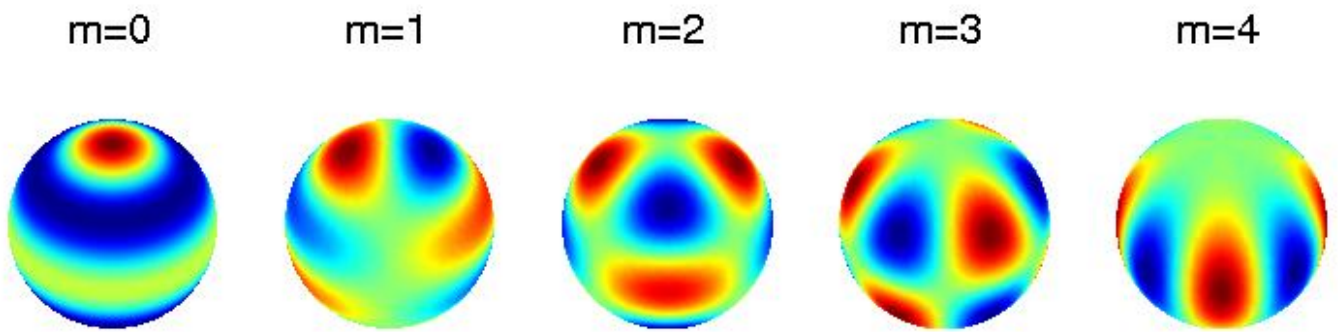
Open, Flat, or Closed?

- How do we know the universe is flat from the CMB power spectrum?
- How do the peak locations provide a means to measure the physical age of the universe?



Analysis of CMB

- Why can we use a linear response theory to predict the anisotropies of the CMB?
- Why do we use spherical harmonics predict and analyze the anisotropies?

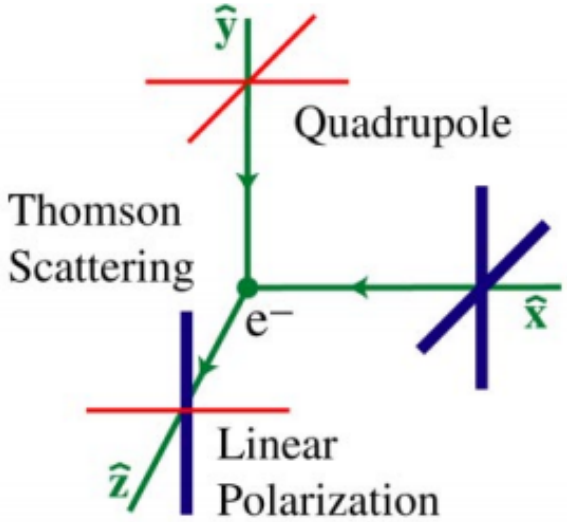


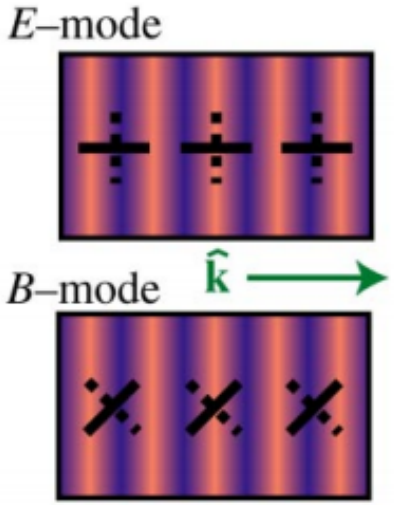
Errors/Uncertainties

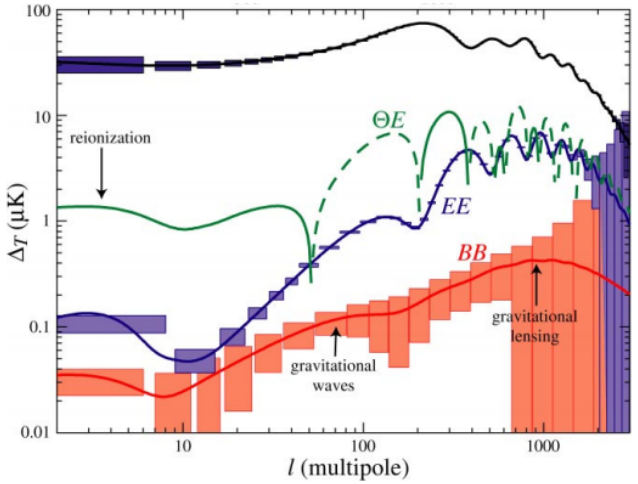
- Do we expect greater uncertainties at low or high multipoles?
- What are other sources of uncertainty?
- What is the cosmic variance?

CMB Polarization

- What would this tell us?
- What's the cause of this polarization?

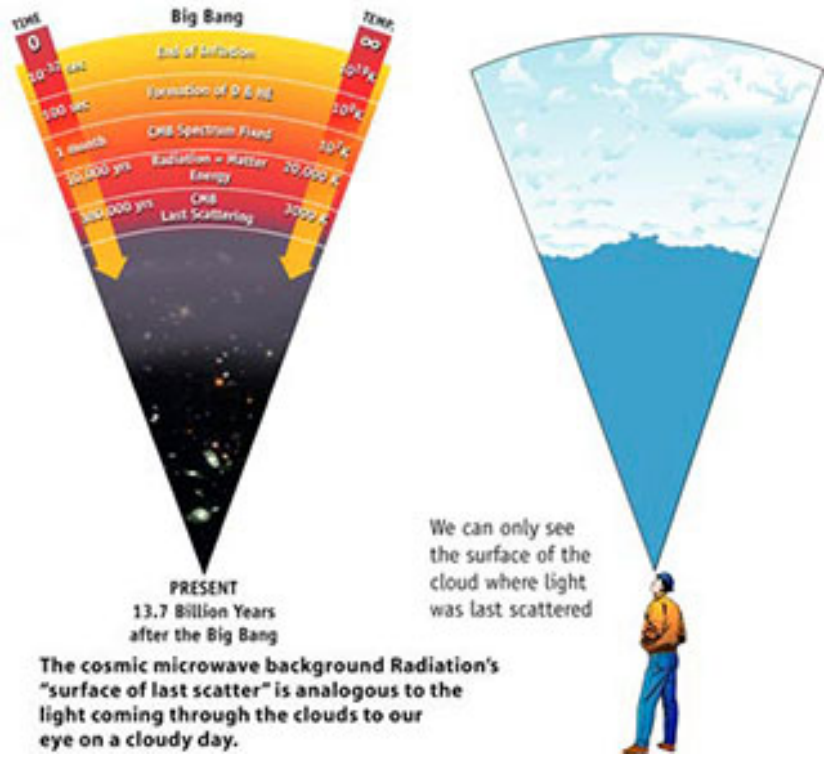




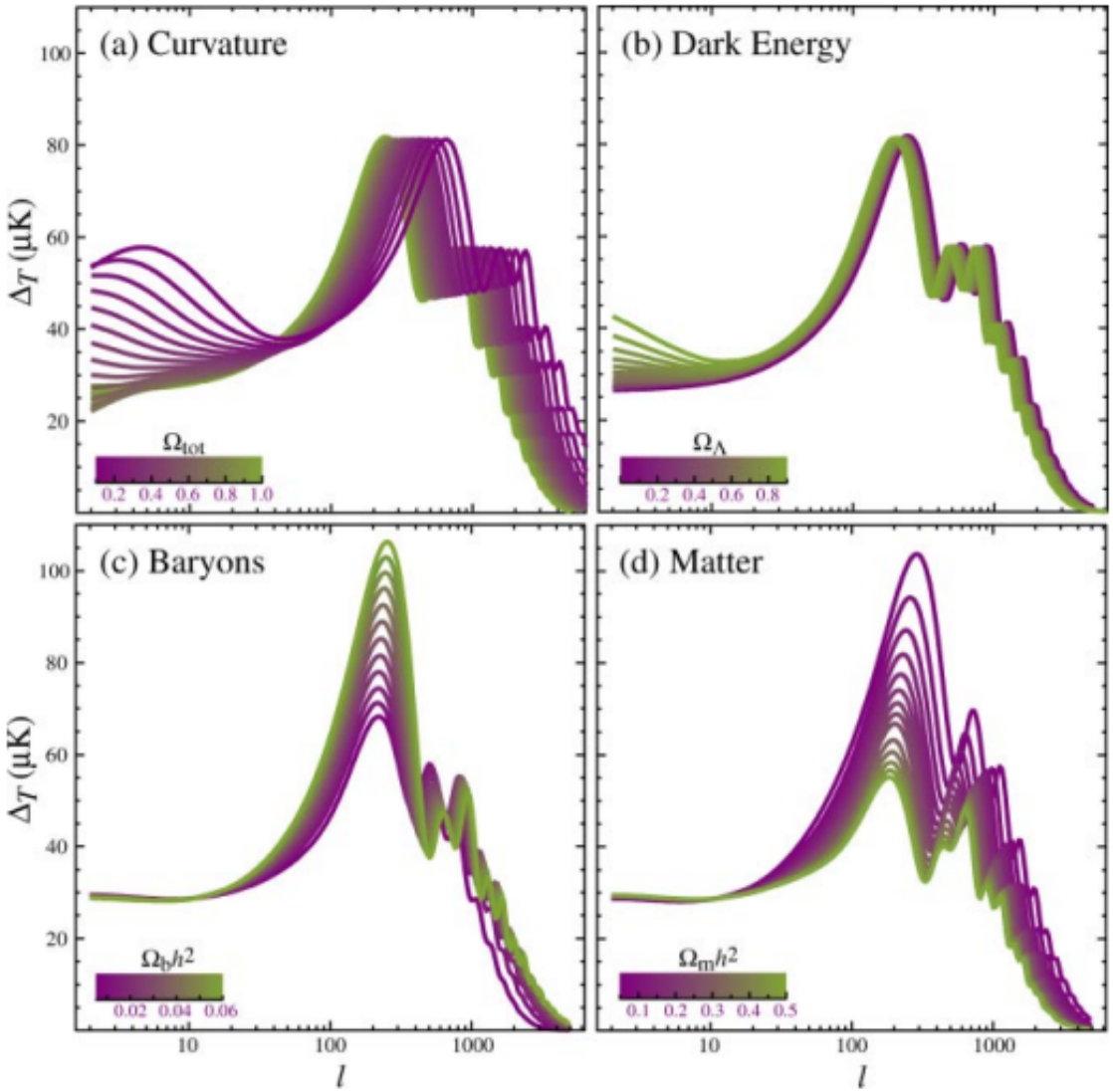


Damping

- What causes the damping of the acoustic oscillations?



The cosmic microwave background Radiation's "surface of last scatter" is analogous to the light coming through the clouds to our eye on a cloudy day.


(a) Curvature
(b) Dark Energy
(c) Baryons
(d) Matter
Δ_T (μK)
l
Ω_{tot}
0.2 0.4 0.6 0.8 1.0
Ω_Λ
0.2 0.4 0.6 0.8
$\Omega_b h^2$
0.02 0.04 0.06
$\Omega_m h^2$
0.1 0.2 0.3 0.4 0.5
20 40 60 80 100
10 100 1000