South Pole Telescope Measurements of the CMB Damping Tail

South Pole Telescope

- 10 meter telescope
- Located at the Geographic South Pole
- Detectors at 95, 150 and 220 GHz

Observations

- 5 fields from 2008 and 2009

- Measurements at 150 GHz

- Some overlap between fields

- Total effective area of 792.1 deg^2

Observations

- Multipole range $650 < l < 3000$

- 5' circular masks of point sources

- Fields don't include galactic plane

- Power from unmasked sources similar to anisotropy power at $l = 3000$
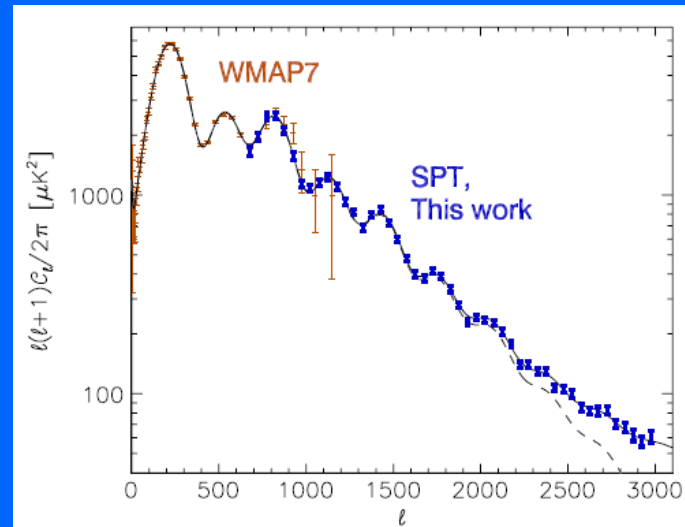
SZ Effect

- Negligible for main peaks discussed last week
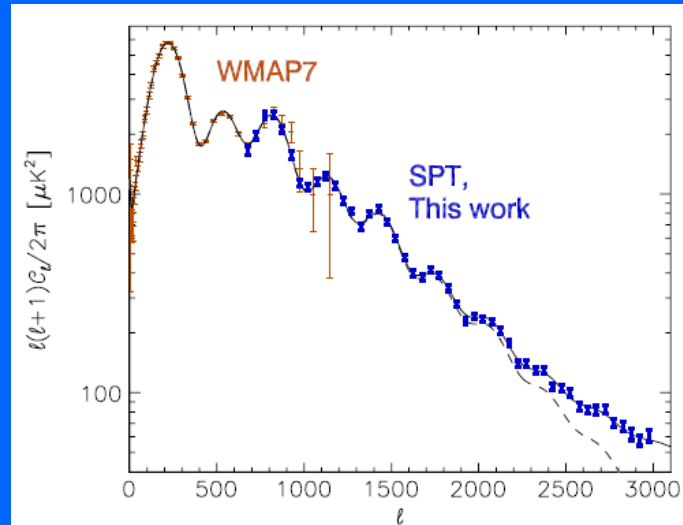- Important on angular scales of this paper?

SZ Effect

- Similar magnitude to primary anisotropy at l = 3000

- Strength of SZ effect taken as free parameter in their model
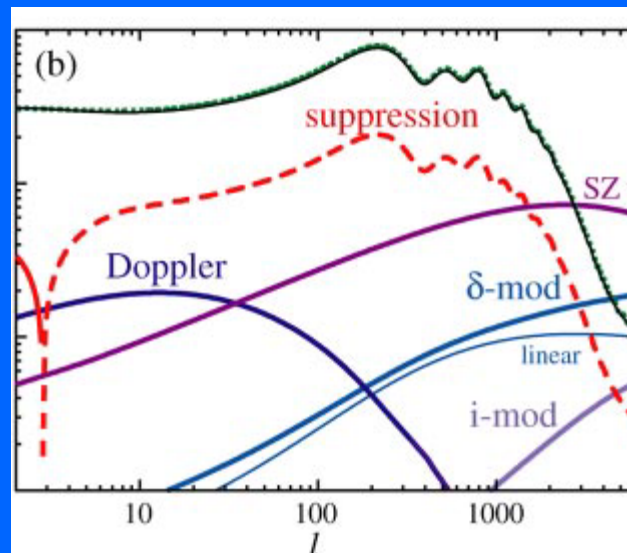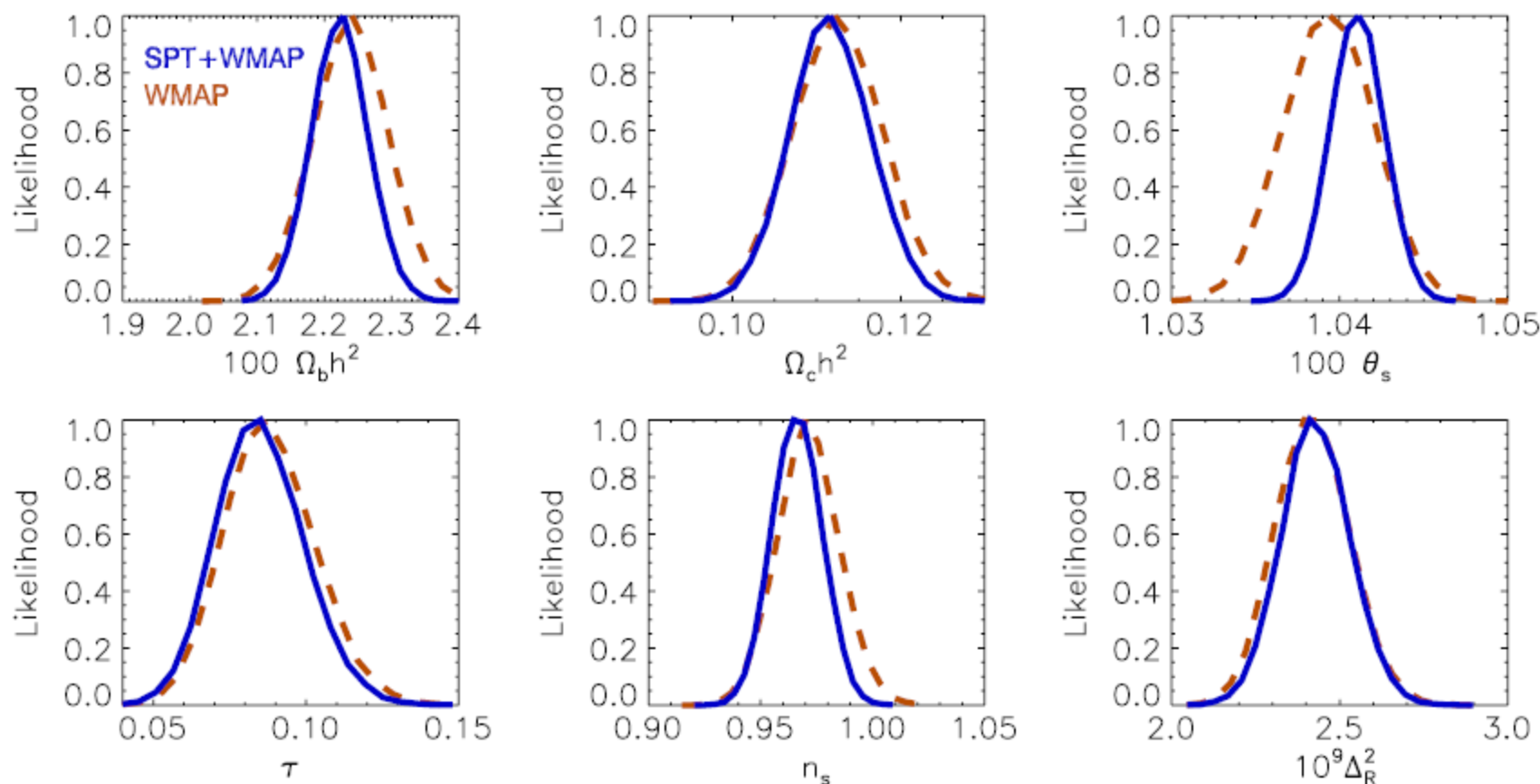
CMB Damping Tail

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- CMB photons scatter during recombination

- Random walk

- CMB damped on scales smaller than distance these photons travel

Cosmological Parameter Fits

Cosmological Parameter Fits

- Biggest improvement in θ_s (angular scale of sound horizon at last scattering)

- Next biggest in baryon density and n_s

- Why these parameters?

Spectral Index

- Scale dependence of perturbations during inflation

- $n_s = 1$ corresponds to scale invariance

- Find $n_s = 0.9663 \pm 0.0112$

- This is a 3.0σ preference for $n_s < 1$

- Distinguish between models of inflation

Gravitational Lensing

- 4.9σ preference for lensing over none
- Strength of lensing $A_L^{0.65} = 0.94 \pm 0.15$
- $A_L = 1$ corresponds to expected strength

Primordial Helium Abundance

- 7.7σ detection of presence of helium

- (Evidence that helium actually exists!)

- Find $Y_p = 0.296 \pm 0.030$

- Compared to 0.2478 from big bang nucleosynthesis models

Number of Relativistic Species

- Non-zero N_{eff} at 7.5σ (neutrinos exist!)
- Find N_{eff} = 3.85 ± 0.62
- Above standard value of 3.046

Degeneracy of Parameters

- Also find running of spectral index deviates from expected value

- However, find $dn_s/d(\ln k)$, Y_p, N_{eff} degenerate
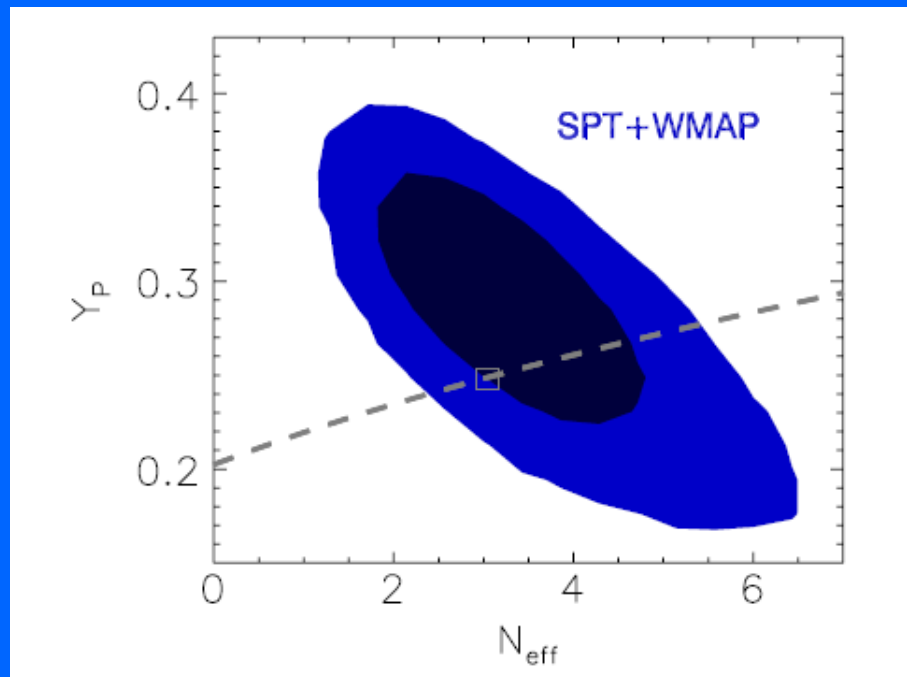
Degeneracy of Parameters

- Adding external data from cluster abundances bring all closer to expected values

- Can any conclusions be drawn about these parameters? What ones?