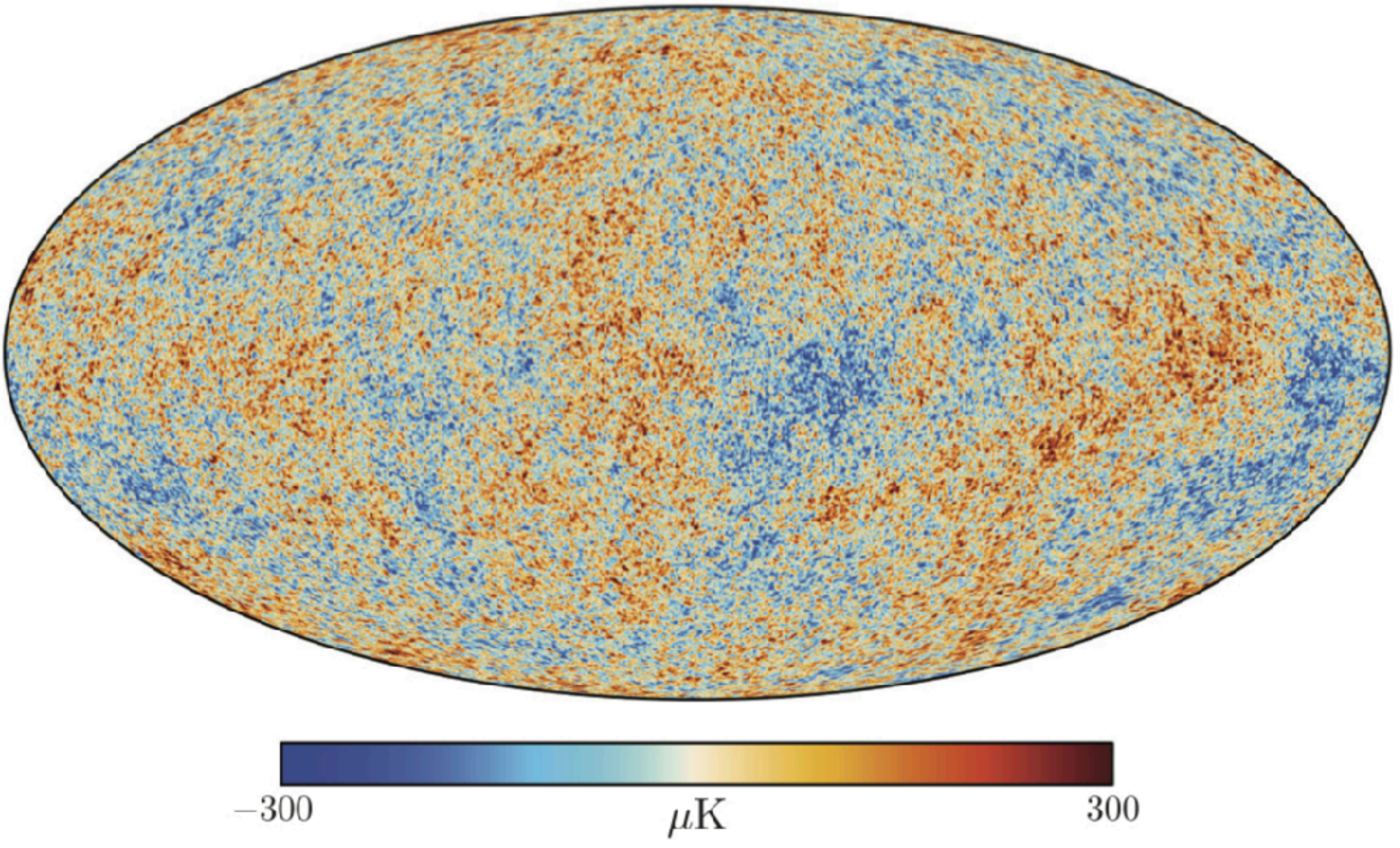
Cosmology and Particle Theory

Lecture 2

Jay Hubisz Sept. 12, 2022

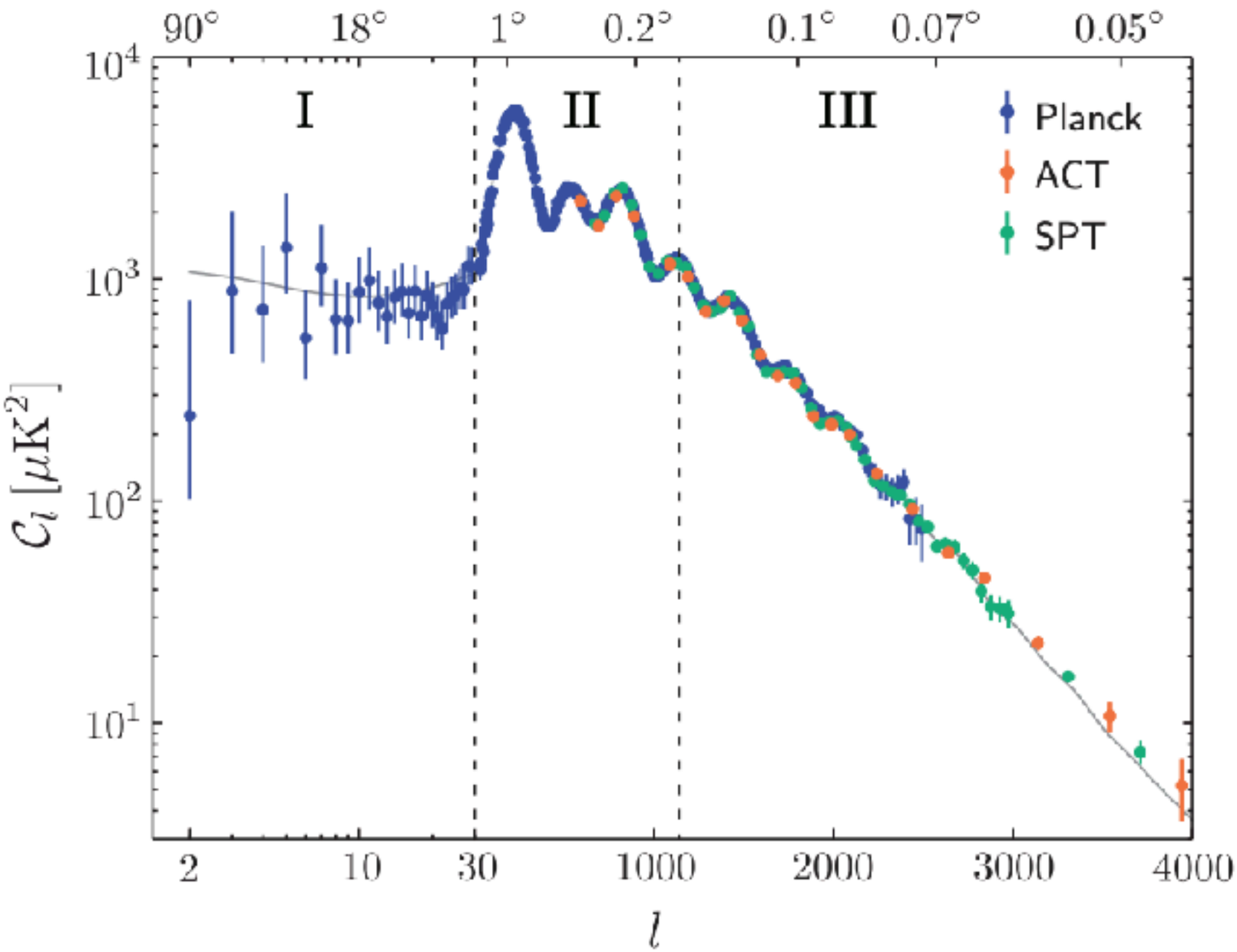
CMB Anisotropies

Planck data



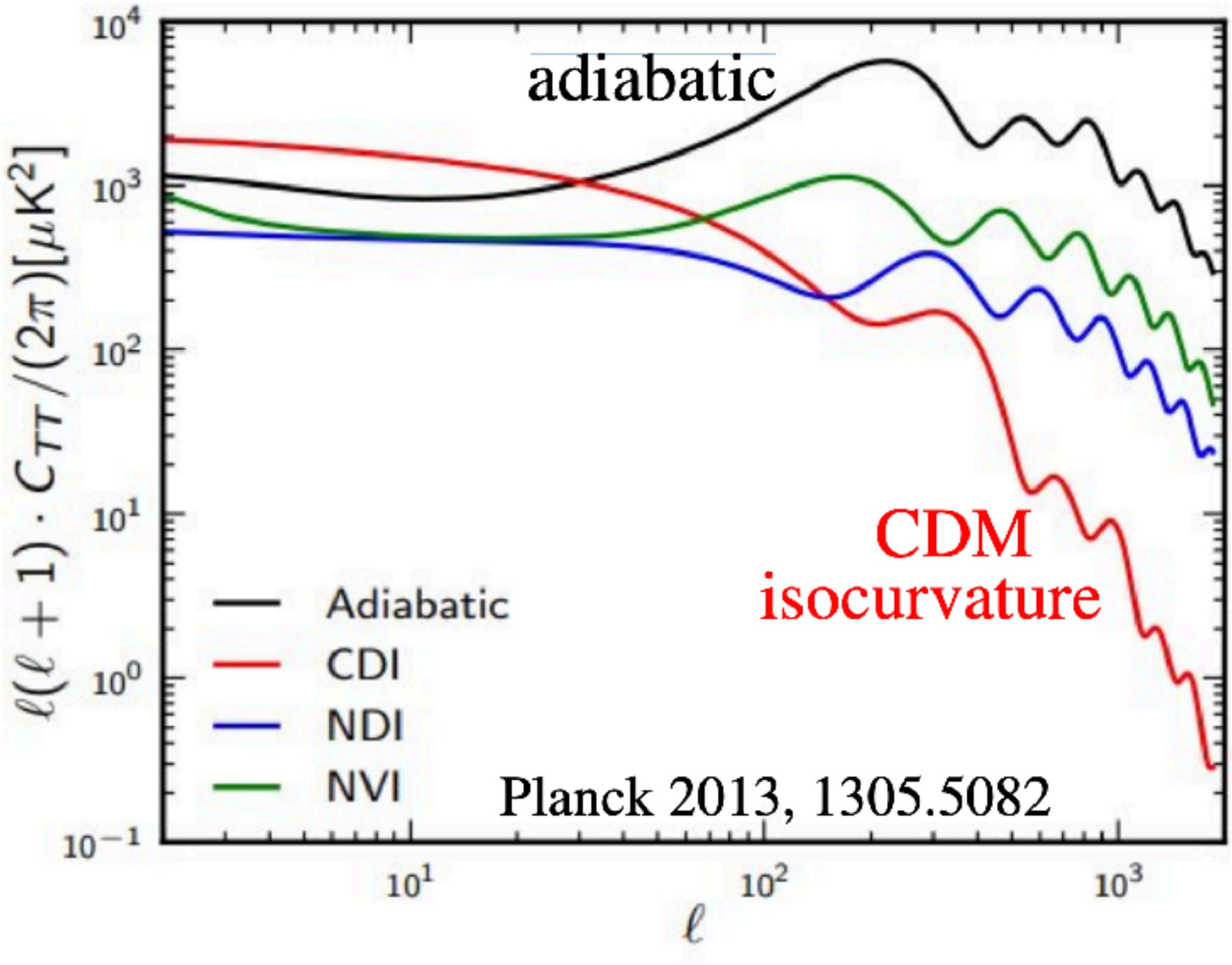
The CMB power spectrum

The data

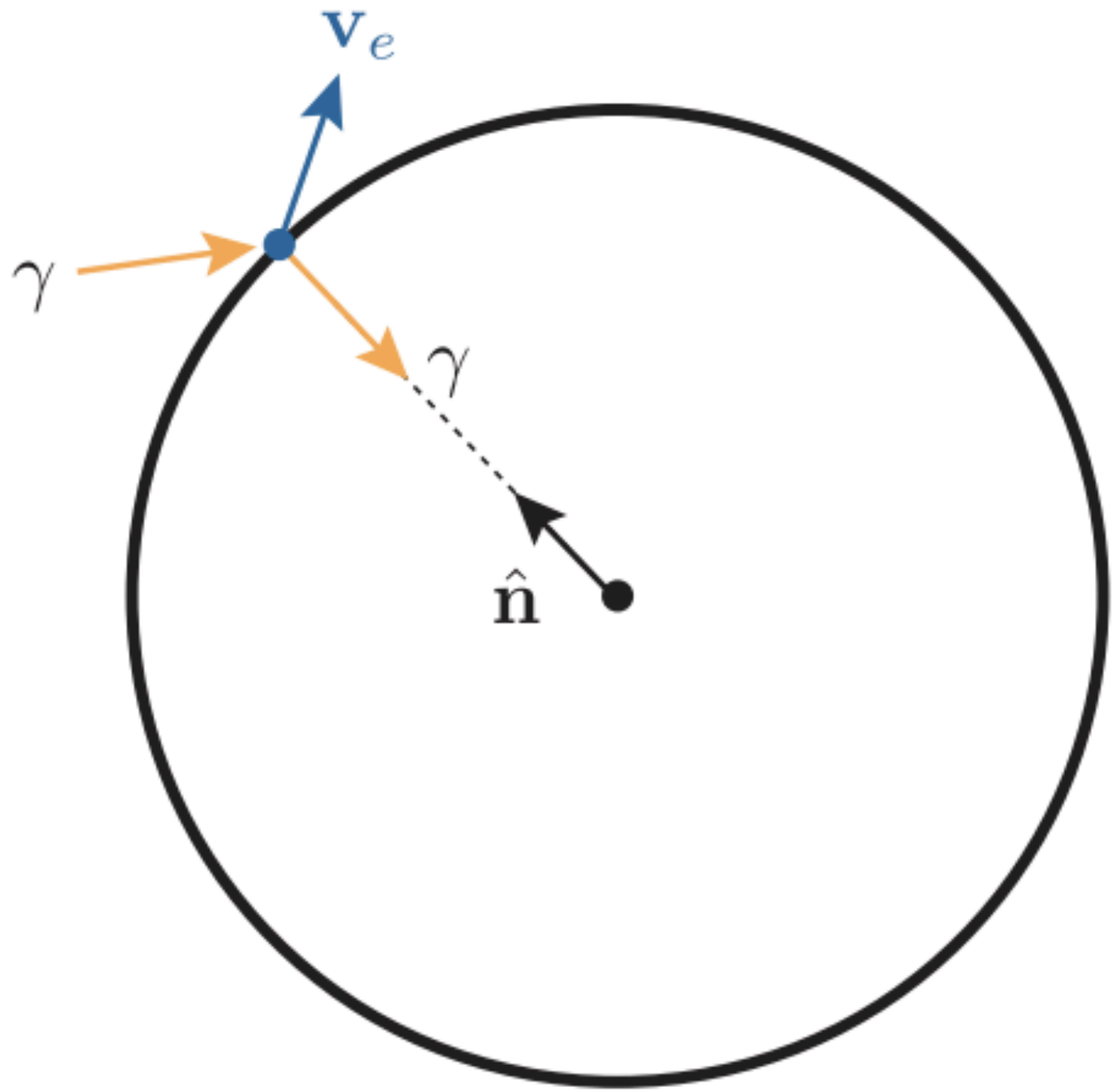


CMB affected by form of initial conditions

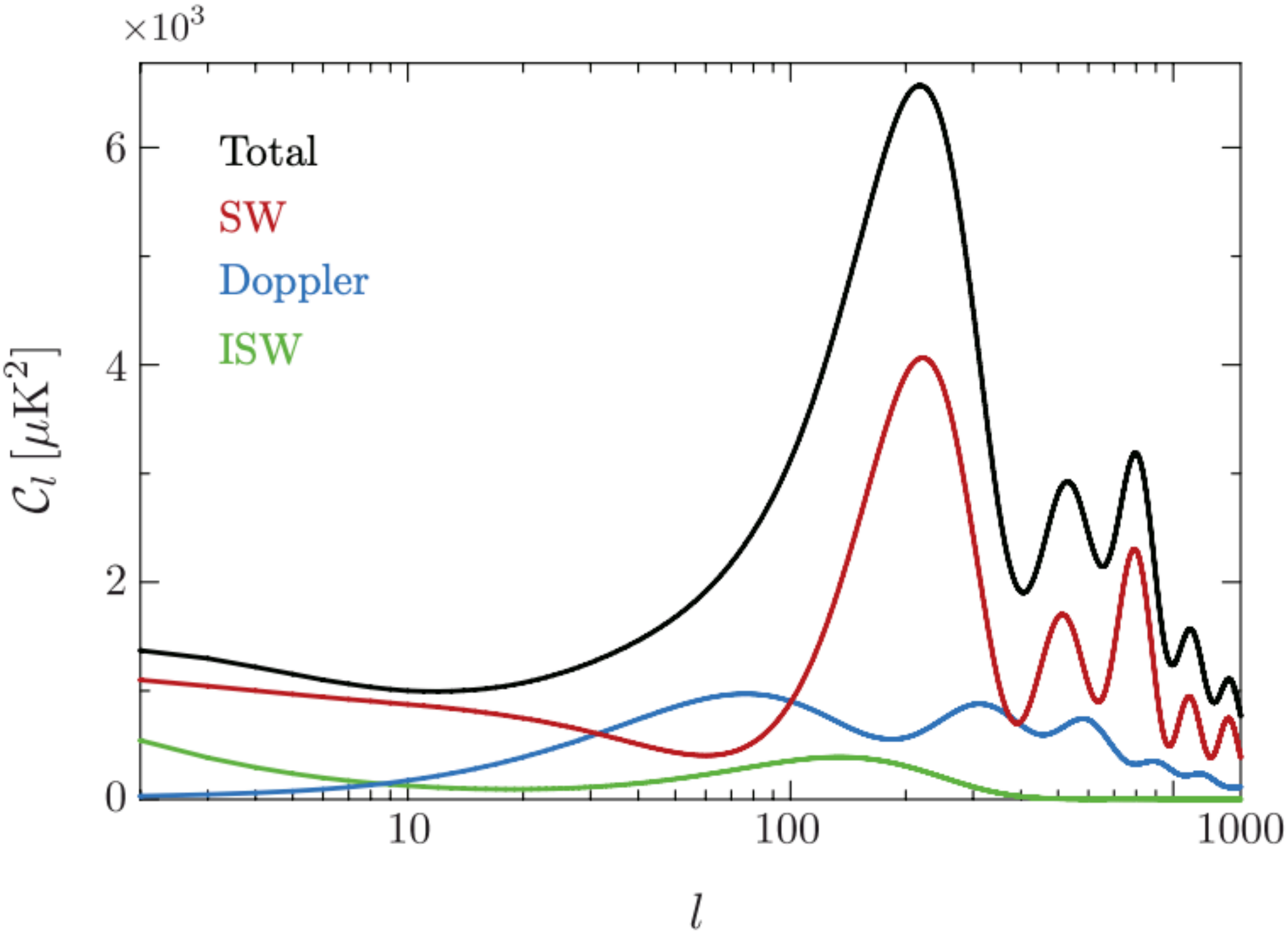
Adiabatic vs isothermal



The Doppler Anisotropy



Contributions to power spectrum



Oscillations and the Power Spectrum

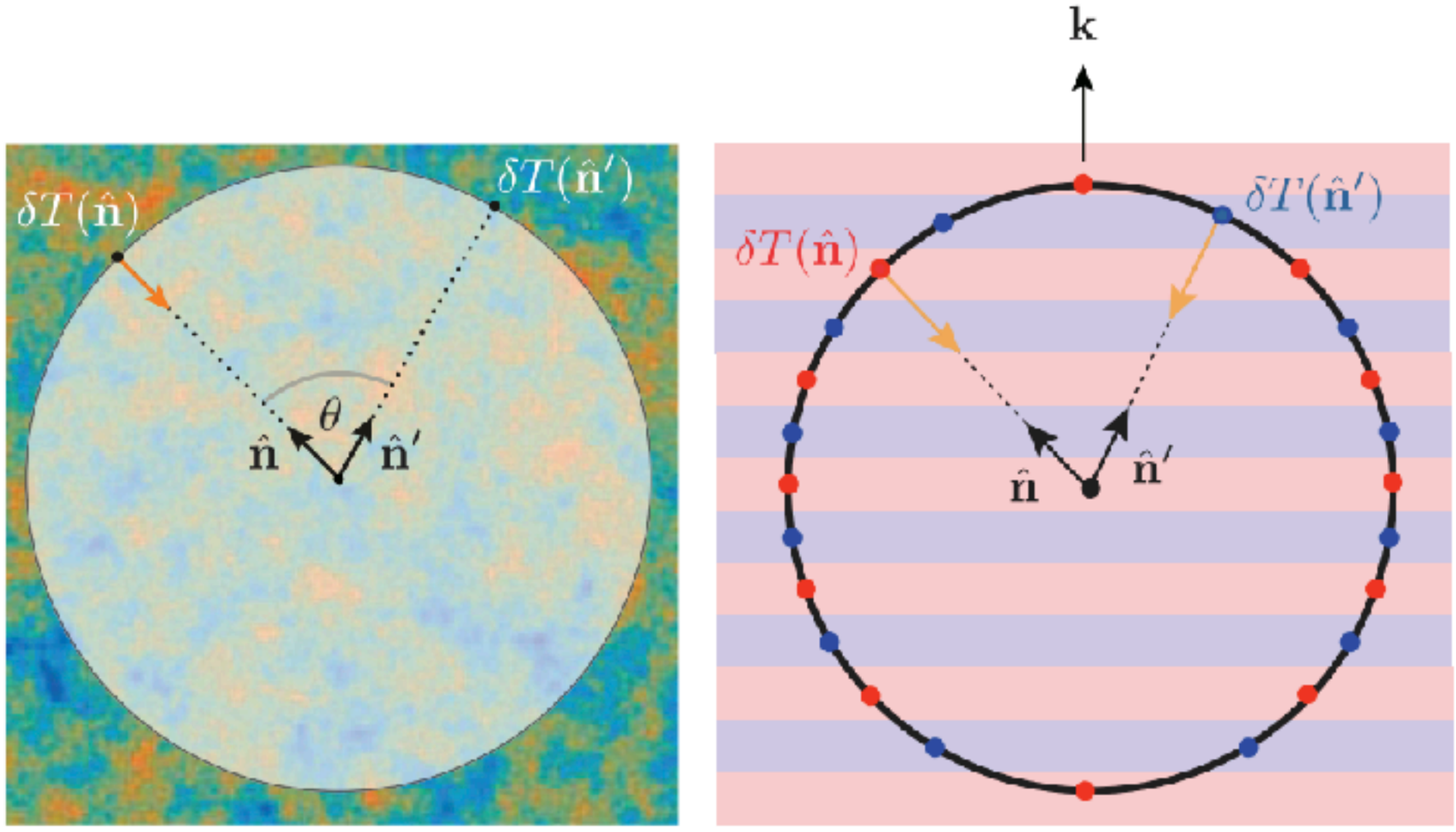
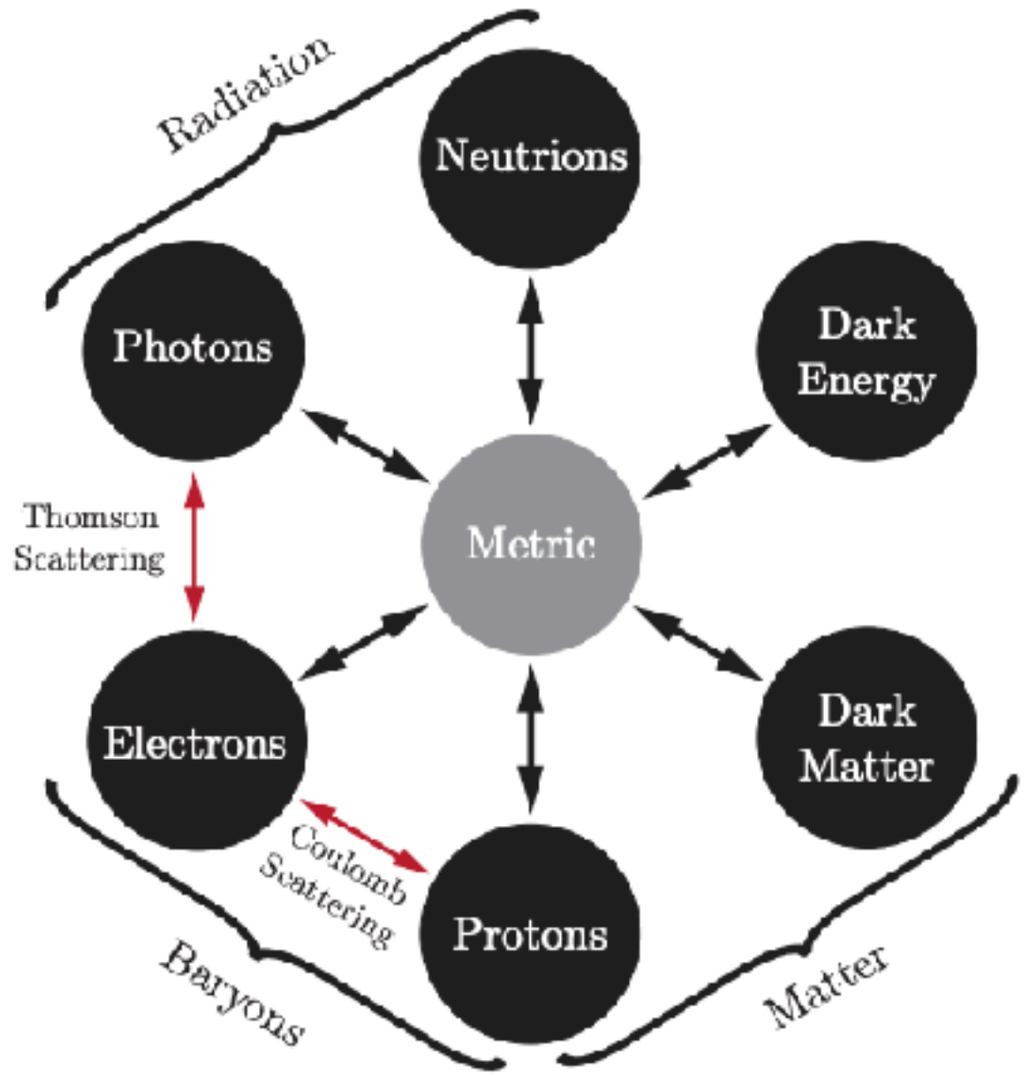


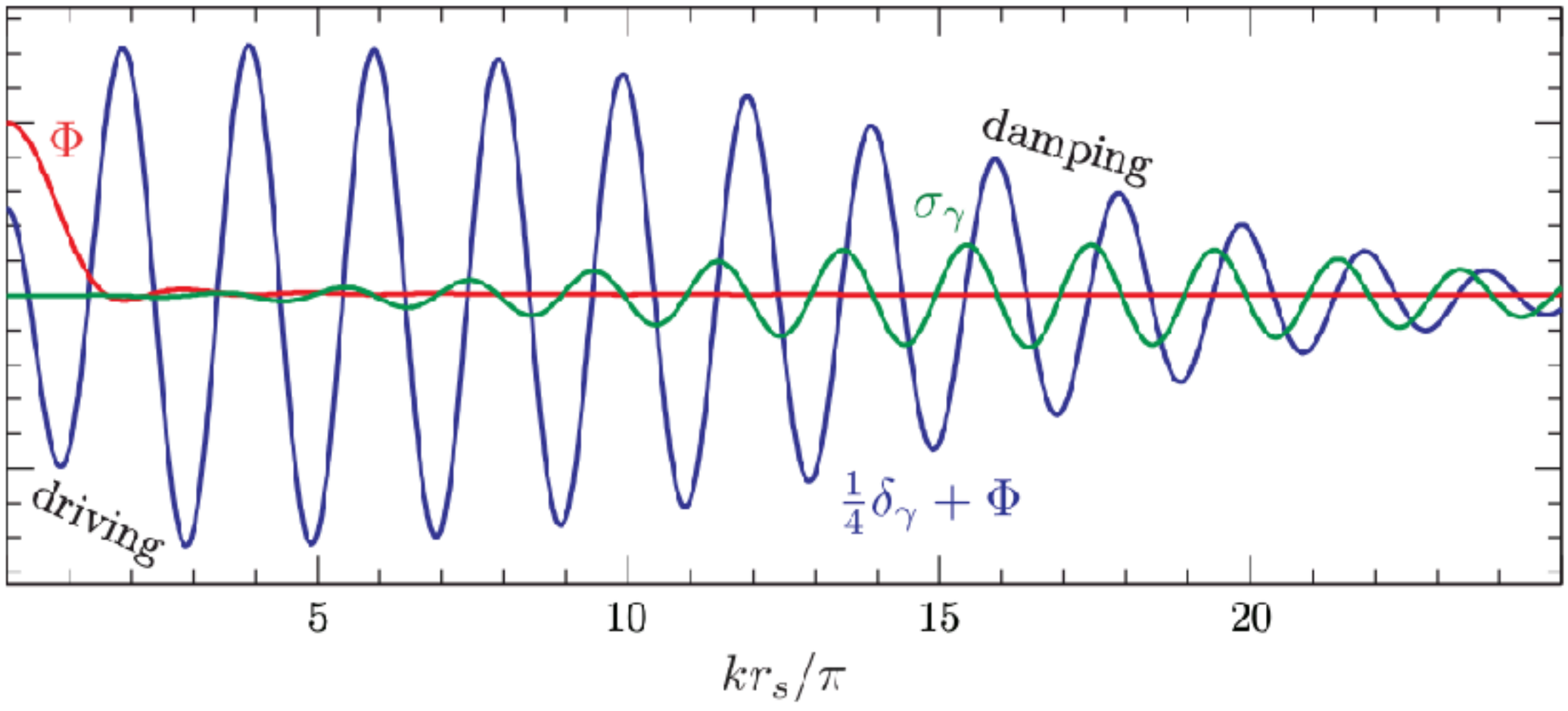
Figure 7. *Left*: Illustration of the two-point correlation function of the temperature anisotropy $\delta T(\hat{\mathbf{n}})$. *Right*: Illustration of the temperature anisotropy created by a single plane wave inhomogeneity are recombination.

Interactions in the early Universe



Radiation Driving

Enhancing oscillations



Features in the CMB

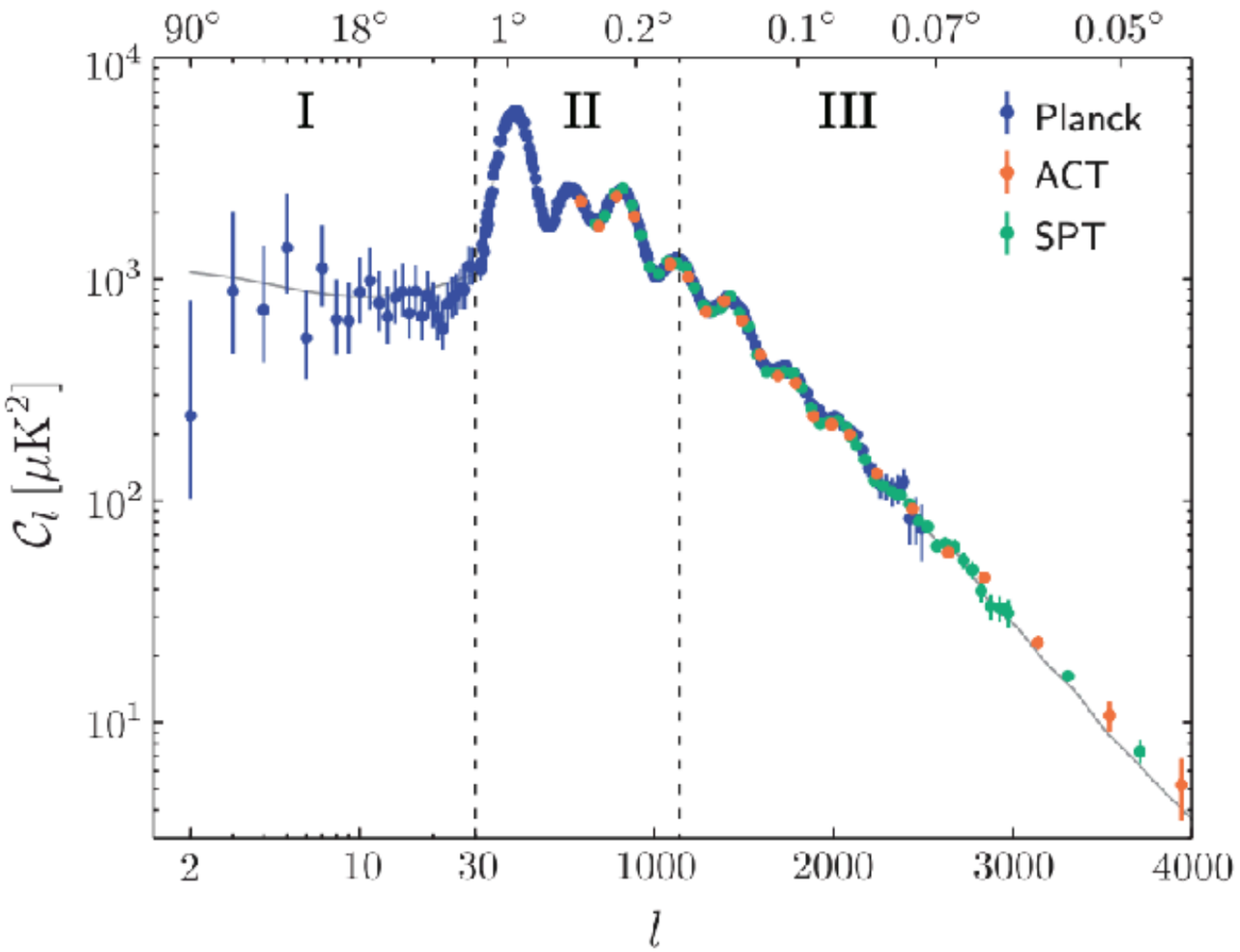


Figure 9. The angular variations of the CMB power spectrum are consequence of the dynamics of sound waves in the photon-baryon fluid. On large scales (region I), the fluctuations are frozen and we directly see the spectrum of the initial conditions. At intermediate scales (region II), we observe the oscillations of the fluid as captured at the moment of last-scattering. Finally, on small scales (region III), fluctuations are damped because their wavelengths are smaller than the mean free path of the photons.