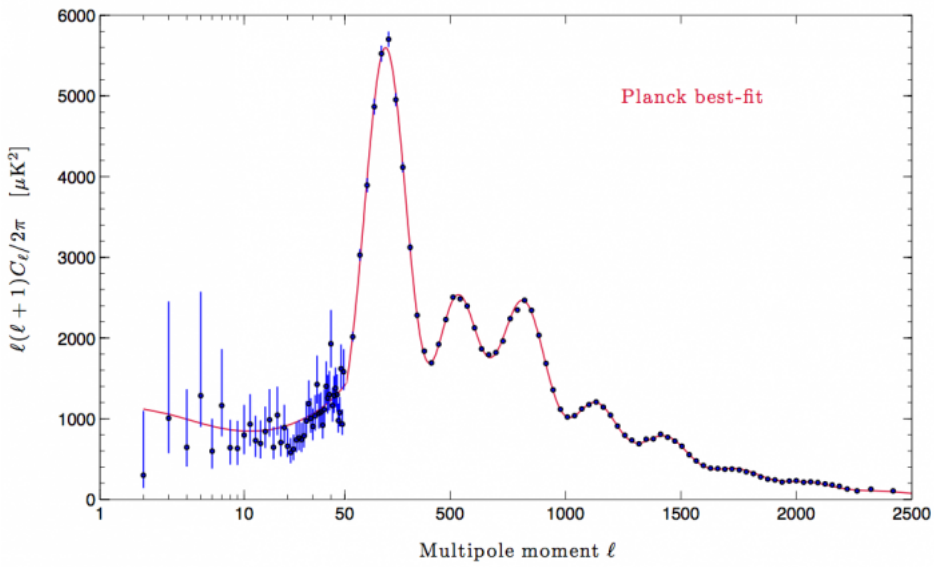
The CMB and Dark Matter

(1) The figure below shows the CMB power spectrum as obtained by the Planck satellite.



(a) The dots are the actual measurements, the solid line the fit. Notice that the points at the higher l have almost no error bars (they are actually smaller than the thickness of the solid line so don't show up) while the points at lower l have higher error bars. Discuss at your table possible reasons for the difference in the magnitude of the error bars.

(b) For the longer l modes, we saw in the lecture that the fluctuations were caused when baryonic matter "fell into" potential wells and set up acoustic waves. Suppose that the photon–baryon fluid is at maximum compression when photon decoupling takes place. Compared to photons not trapped in the well, will the photons in the well have higher, lower, or equal temperature to those not trapped. Do the same analysis for the case in which the photon–baryon fluid is at a minimum pressure.

(c) Use the results of (b) to qualitatively explain the oscillations in the CMB power spectrum

(d) Begin work on chapter 8 homework problems.

(2) Imagine a star undergoing in a circular orbit around the center of its host galaxy.

(a) In terms of the star's velocity,v, and radius from the center,R, give the star's acceleration.

(b) Use Newton's second and gravitational laws, to give the star's acceleration.

(c) Combine parts (a) and (b) and give the star's velocity as function of distance from the center, R (your expression will include other terms that are parameters as well).

(d) Plot the functional form of $v(R)$.

(3) At your table, discuss fully the evidence for dark matter. Which observation do you find most convincing and why?

Homework 03–Due Friday, Feb. 21

1. Problem 6.3
2. Problem 6.8
3. Problem 8.2
4. Problem 8.4