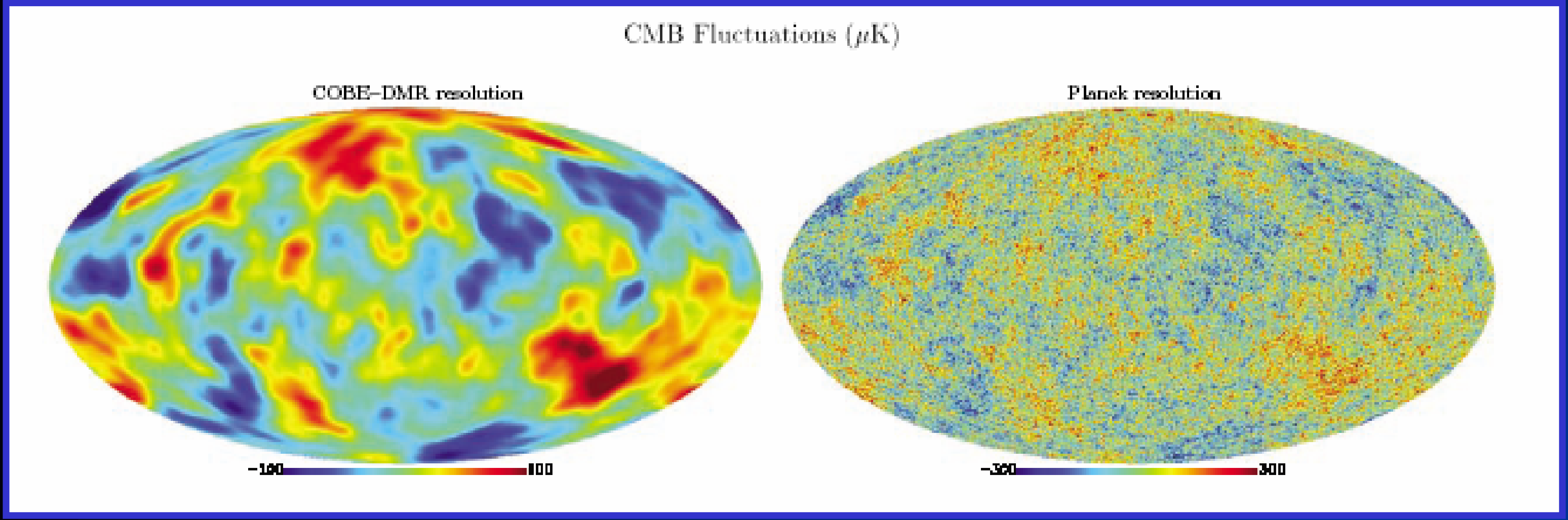
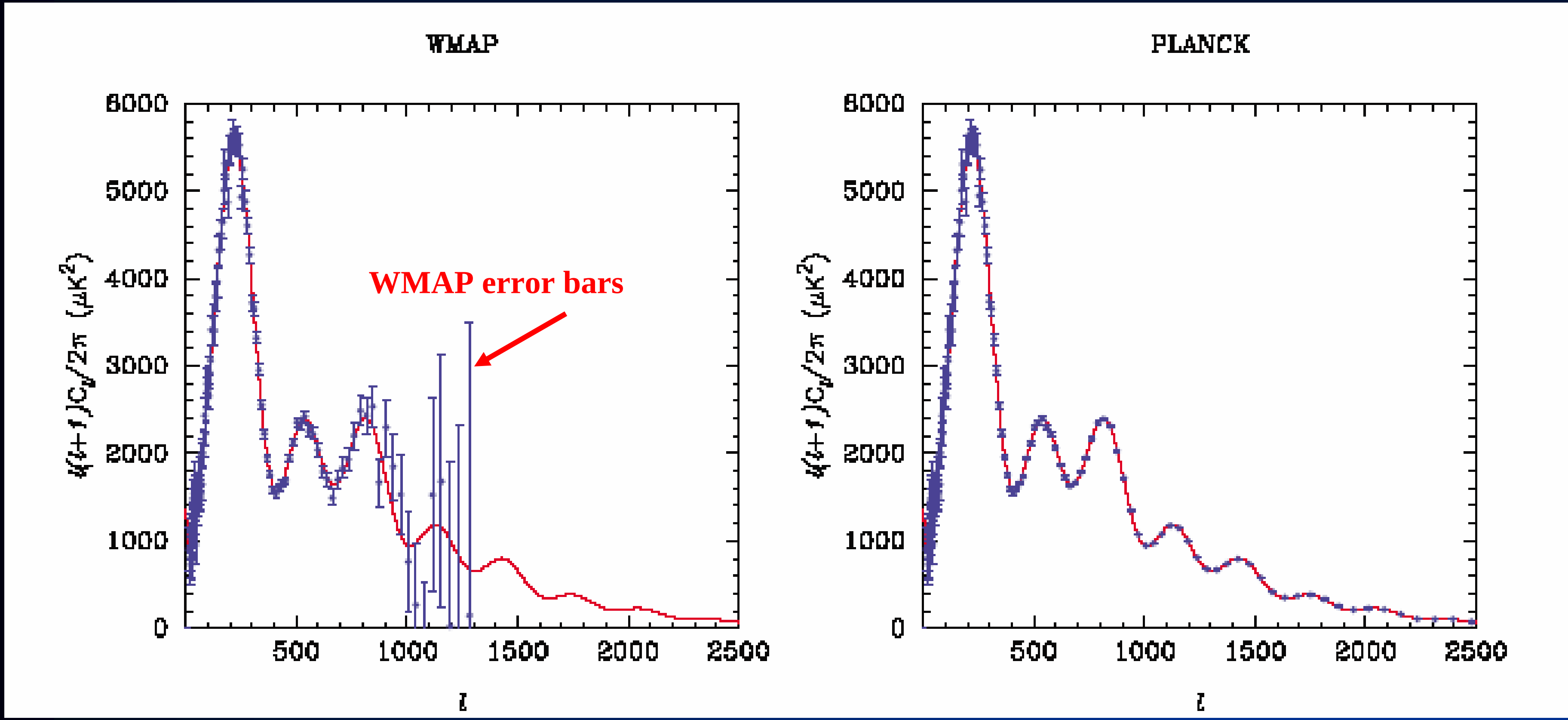
1. Summary of the Scientific Objectives of Planck:

- ***To map the small temperature variations in the Cosmic Microwave Background with a resolution of 5 arc minutes and sensitivity of 10^{-6} Kelvin***

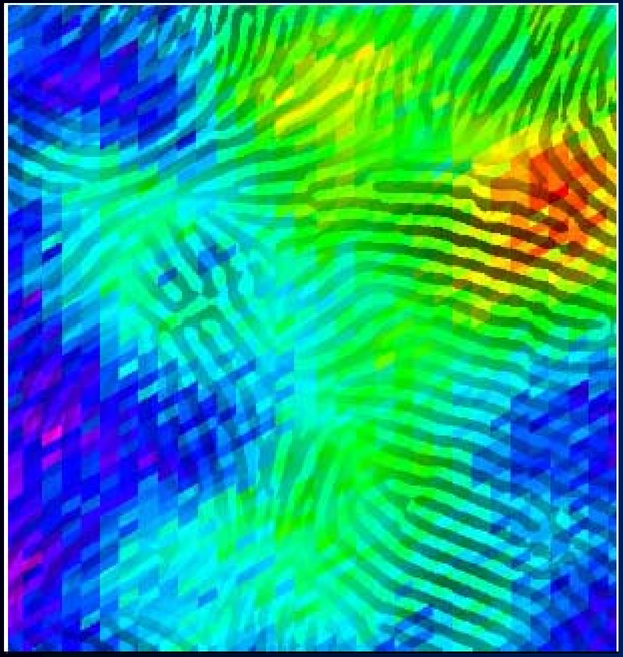


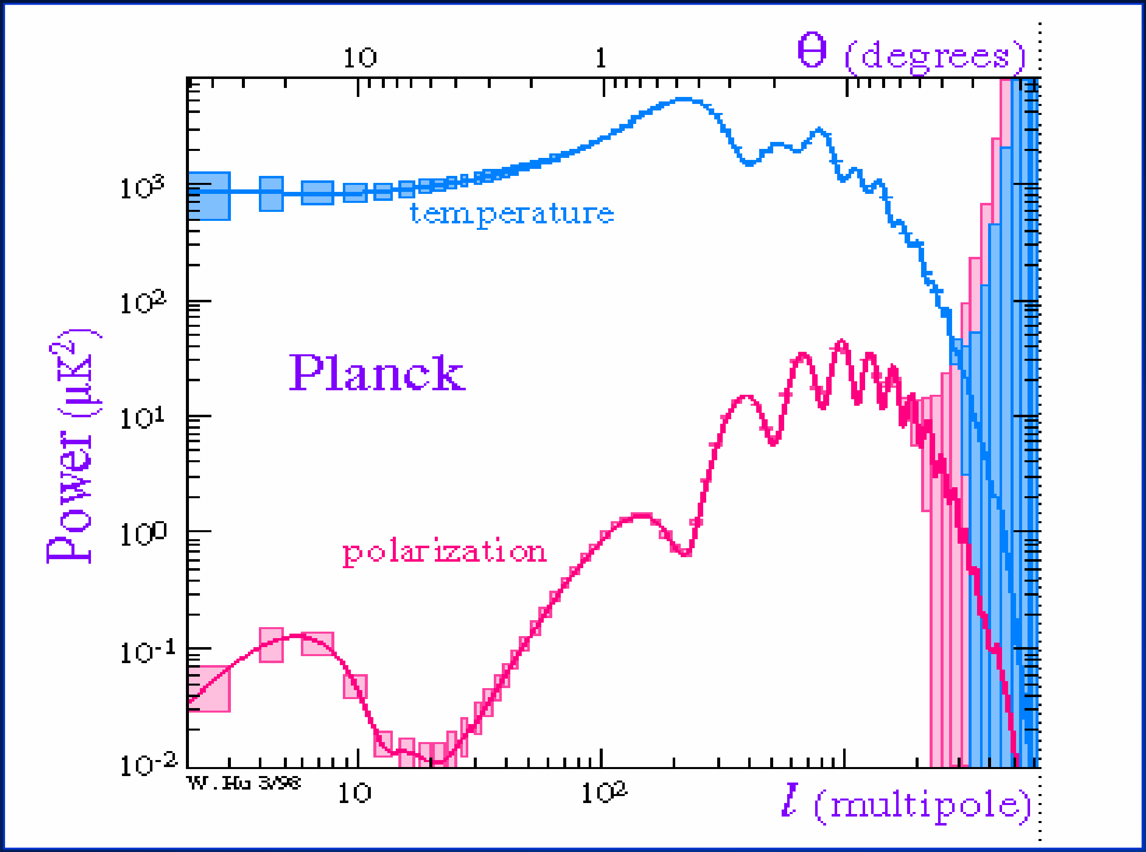
• *and constrain the power spectrum of the CMB at small scales*



Planck will do better than WMAP, the previous satellite to map the CMB, at the smallest scales, of a tenth of a degree or less.

• To map the polarization of the CMB and derive the polarization power spectrum of the CMB at high resolution ...

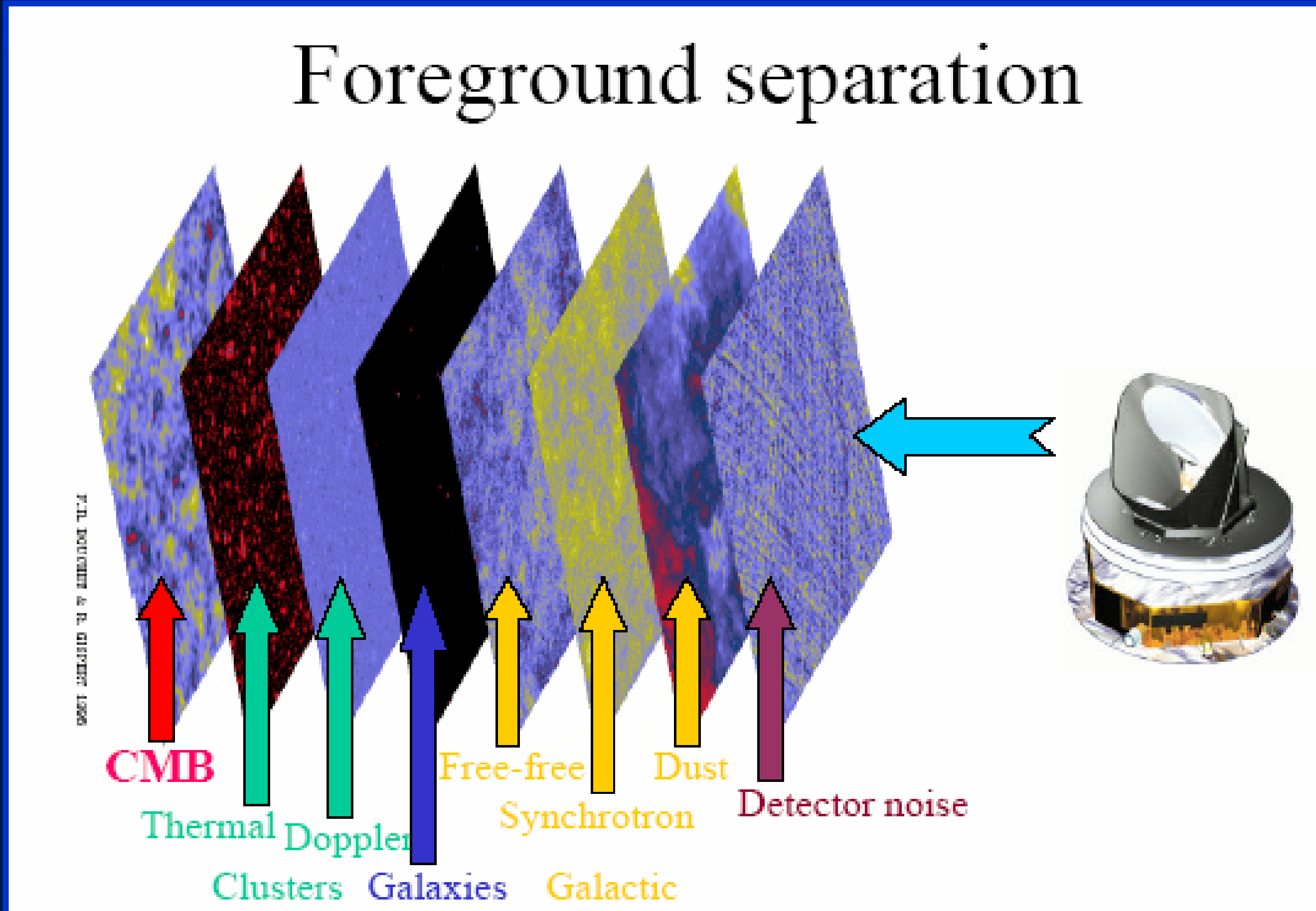




Because of scattering of the CMB photons off free particles in the early Universe, we expect the CMB should be polarized, just as sunlight scattering off dust in the atmosphere is polarized. The direction and strength of polarization of the CMB will help us figure out more about the distribution of matter in the very early Universe.

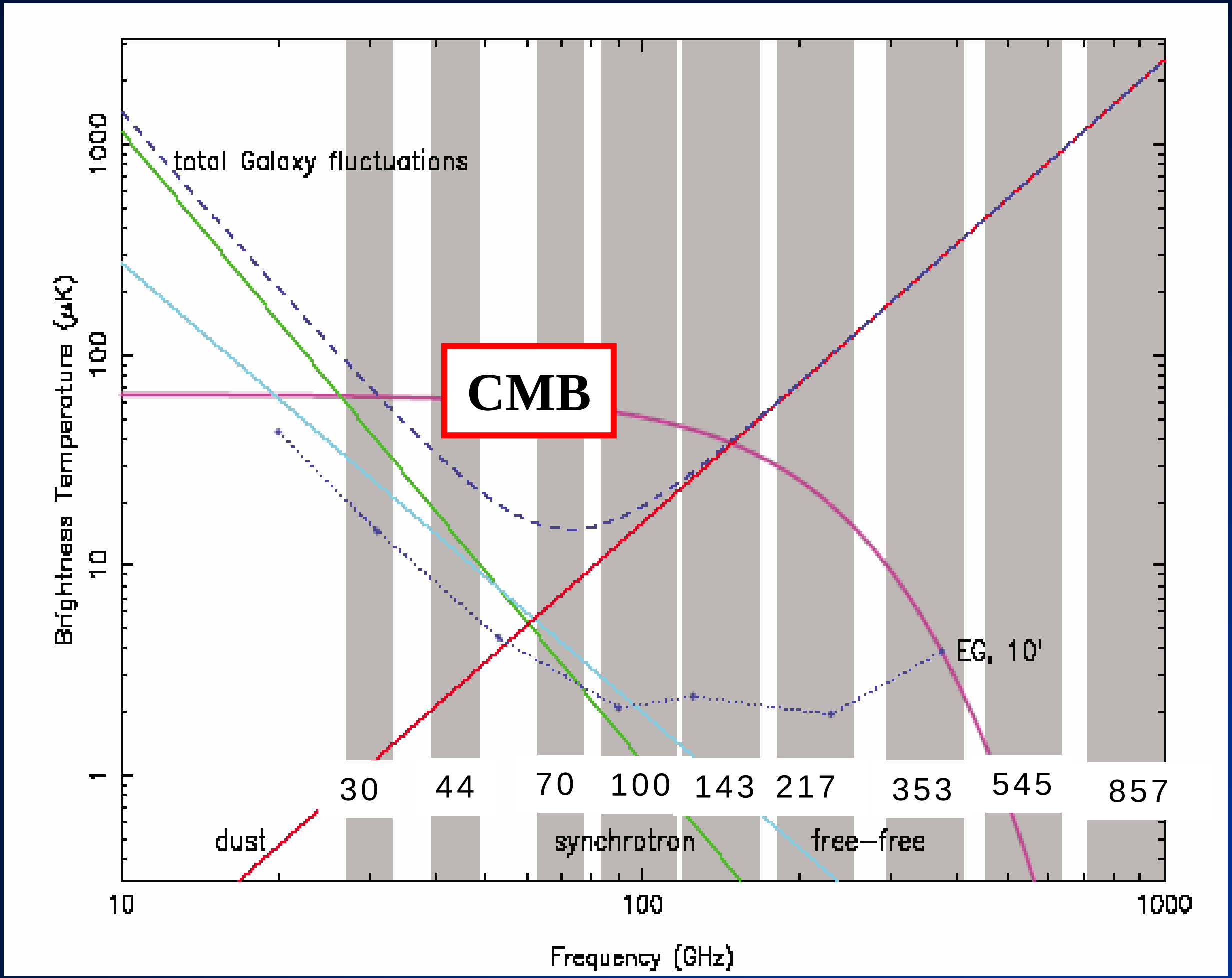
• To measure foreground sources accurately so as to separate the foreground signals from the CMB signal...

Between Planck detectors and the CMB there are several layers of “noise” that must be filtered out, including thermal and electronic noise from the instruments themselves, dust and ions in our galaxy, other galaxies and clusters, and hot gas between the galaxies, until we can finally sort out the very tiny signal from the CMB itself.



...by using the broadest frequency coverage of any experiment so far, ranging from 30 GHz (1 cm) to 857 GHz (0.35 mm).

This graph shows the signals that Planck will detect. The one that we want is the CMB; the others must be filtered out. The grey stripes are the frequency bands in which the Planck instruments will record the microwave signals from space. The frequencies shown in black are the center frequency of each band.



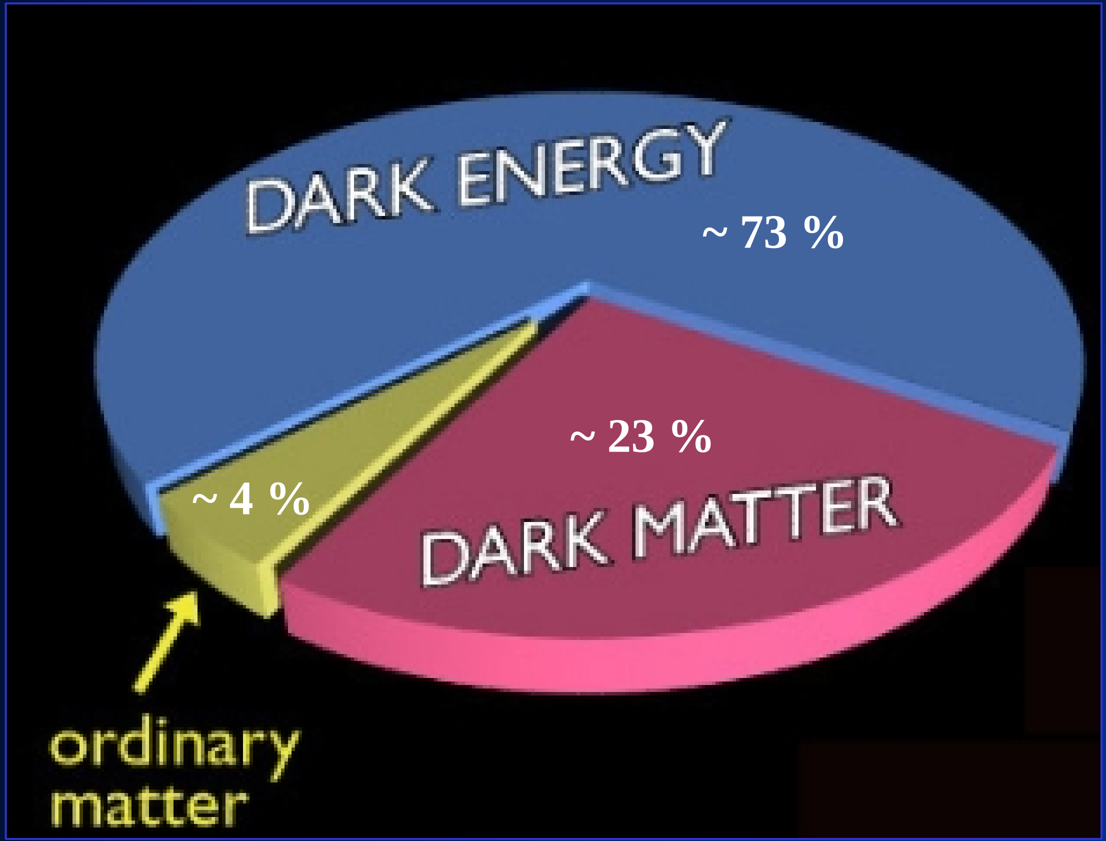
…which will permit better estimates of cosmological parameters:

As we will show, the Power Spectrum of the CMB is sensitive to these physical parameters. Other measurements, such as high red shift supernovae light curves, can give rough estimates of some of these parameters, such as cosmological constant, but only the Power Spectrum of the CMB is sensitive to all of these physical characteristics of the Universe.

Main Cosmological Parameters

- Ω_o Cosmological total density parameter
- H_o Hubble constant
- Ω_b Baryon density
- Ω_c Cold dark matter density
- Λ Cosmological constant
- n_s Spectral index of scalar perturbations
- Q Amplitude of fluctuation spectrum
- r Ratio of Gravitational wave to density perturbations
- τ_r Residual optical depth due to reionisation

• ***To understand the nature of the so-called "dark sector" which comprises ~ 96% of our universe...***



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- *To better understand inflation, and distinguish between theoretical models of fundamental physics, such as supersymmetry and string theory.*

We are at a very interesting crossroads in physics in the early years of the twenty-first century! We do not at this time have a way of reconciling our models of the Universe on the largest scales, as described by General Relativity, and our understanding of the smallest scales, as described by the Standard Model of Particles and Interactions. Can String Theory reconcile this hierarchy problem in physics? We don't yet know. Experimentally, we are looking to the Large Hadron Collider to provide evidence at the smallest scales, and to the CMB to provide evidence at the largest scales and most distant times, to help us find answers to the most basic questions of fundamental physics: What is the basic building block of matter? How many dimensions are there really? What is the cosmological constant, and what is the rest of the Universe made of?