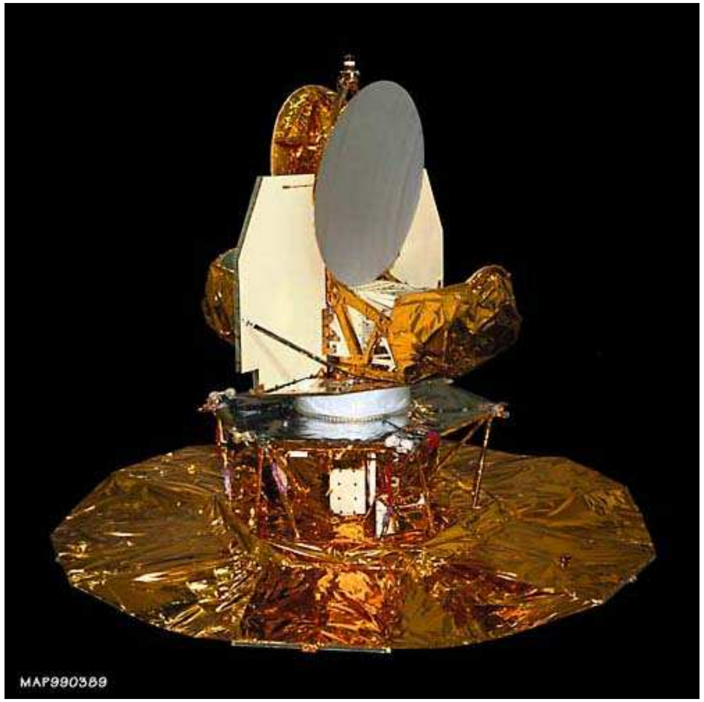
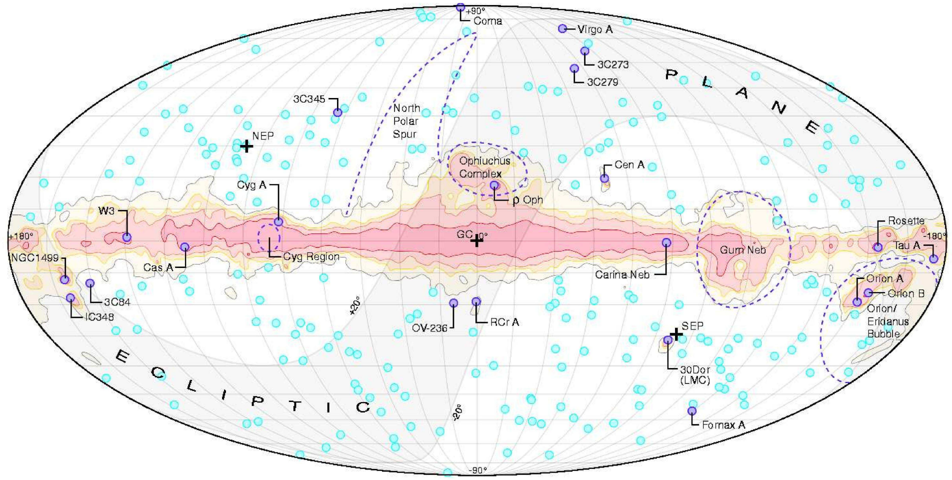


Wilkinson Microwave Anisotropy Probe (WMAP):

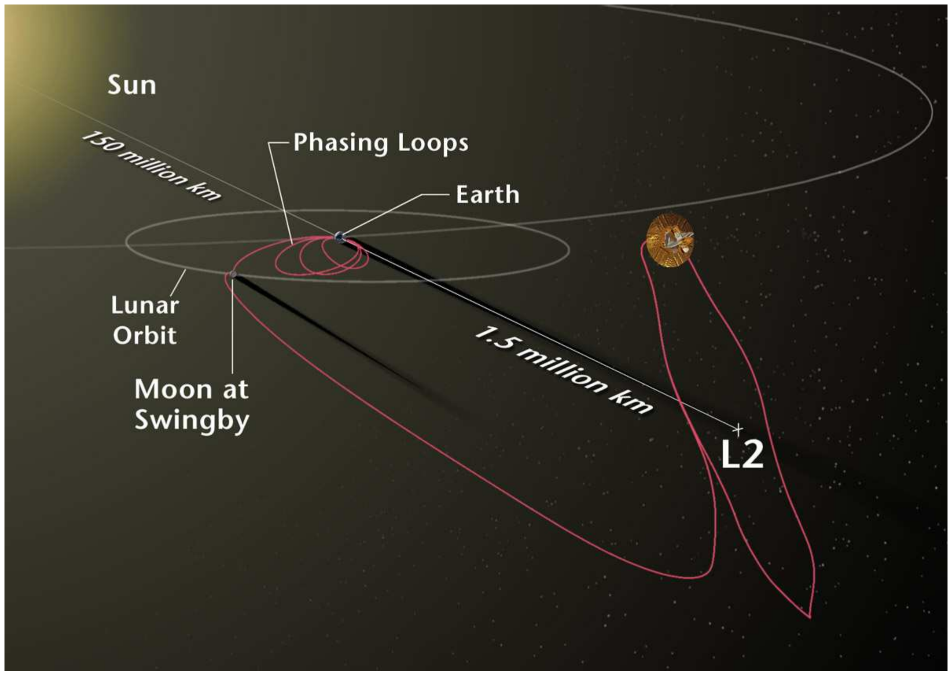
- Launched 2001 June 30, measurements began 2001 August 10
- Orbit around 2nd Lagrange Point of Sun-Earth System
- Highly precise radiometers of high spatial resolution (best: 0.21° FWHM in W-Band at 3.2 mm) in five wavebands

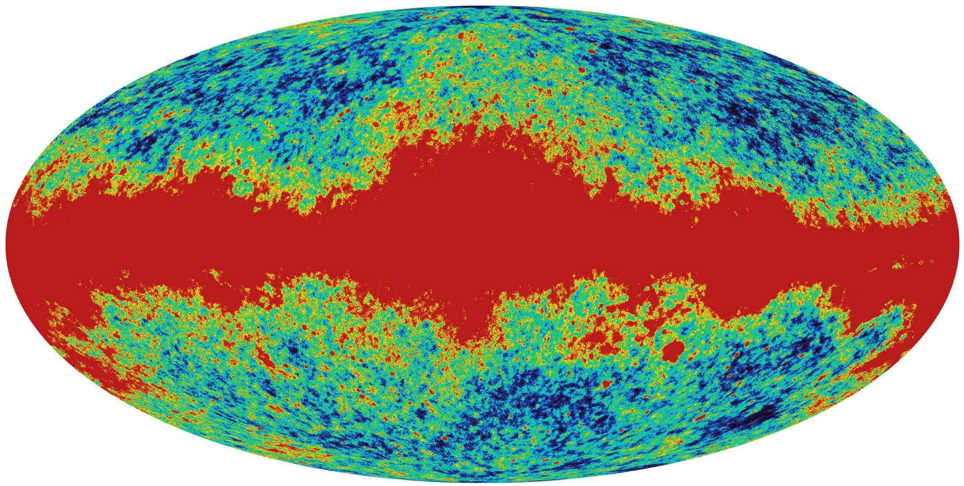
(see Bennett et al. 2003 for an overview).



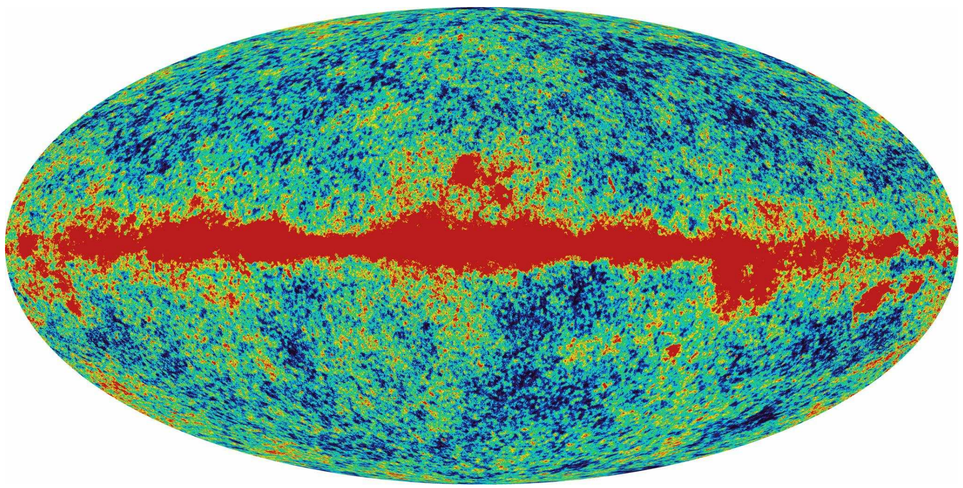
Foreground features of the microwave sky (Bennett et al., 2003).

Sunyaev Zeldovich effect is expected to be strongest in Coma cluster, temperatures of -0.34 ± 0.18 mK in W and -0.24 ± 0.18 mK in K-band; barely detectable with WMAP, does not contaminate maps.

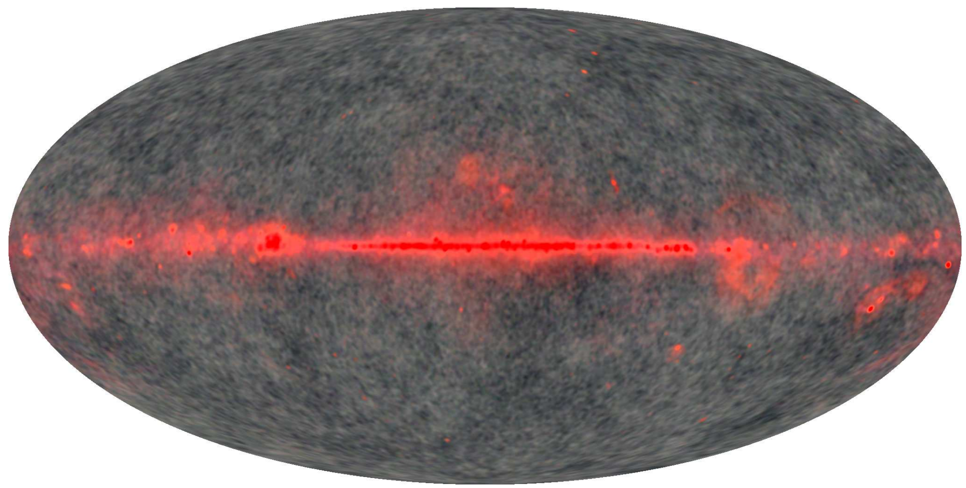




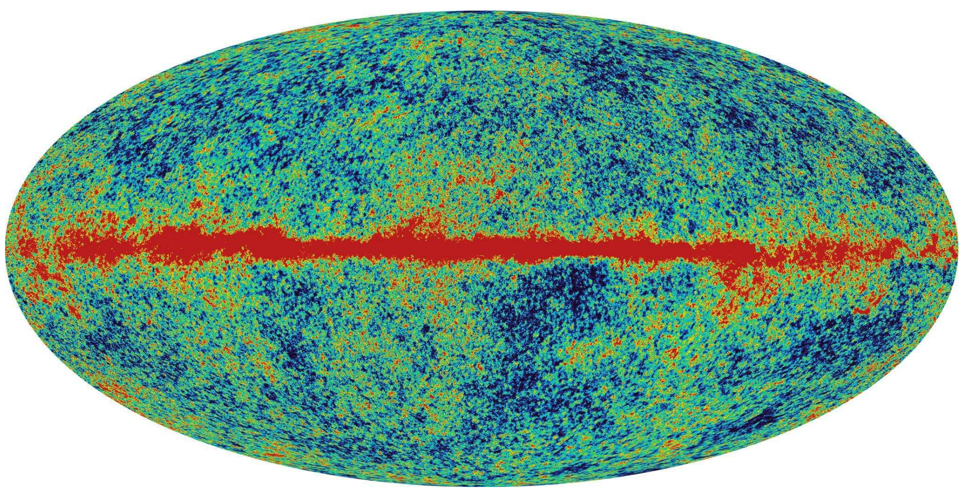
WMAP, K-Band, $\lambda = 13$ mm, $\nu = 22.8$ GHz, $\theta = 0.83°$ FWHM



WMAP, Q-Band, $\lambda = 7.3\,\text{mm}$, $\nu = 40.7\,\text{GHz}$, $\theta = 0.49^\circ$ FWHM

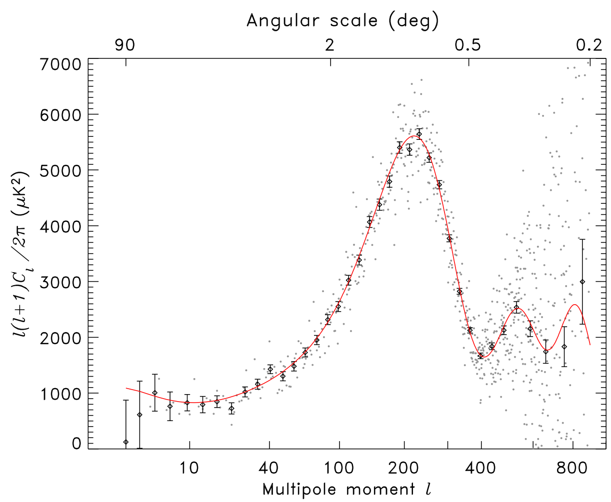


Different spectral signature enables identification of Galaxy foreground radiation



WMAP, W-Band, $\lambda = 3.2\,\text{mm}$, $\nu = 93.5\,\text{GHz}$, $\theta = 0.21^\circ$ FWHM

Power Spectrum



(WMAP, 1 year data; Spergel et al., 2003, Fig. 1)

Best fit parameters for WMAP data after 7 years of measurements (Jarosik et al., 2010):

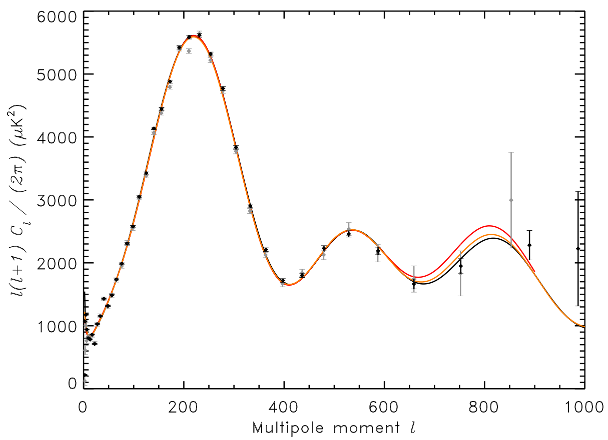
$h = 0.704(14)$
$\Omega_b = 0.0456(16)$
$\Omega_c = 0.227(14)$
$\Omega_\Lambda = 0.728(16)$
$\Omega_{tot} = 1.0023^{+0.0056}_{-0.0054}$
$\tau_{reion} = 0.089 \pm 0.030$
Age $= 13.75(11)$ Gyr

Ω_c: Ω in dark matter.

Power spectrum requires that Λ behaves like a cosmological constant.

$\Longrightarrow$ Very good agreement between data and theory!

Power Spectrum



(WMAP, 3 year data; Spergel et al., 2007, Fig. 2)

Best fit parameters for WMAP data after 7 years of measurements (Jarosik et al., 2010):

$$h = 0.704(14)$$
$$\Omega_b = 0.0456(16)$$
$$\Omega_c = 0.227(14)$$
$$\Omega_\Lambda = 0.728(16)$$
$$\Omega_{tot} = 1.0023^{+0.0056}_{-0.0054}$$
$$\tau_{reion} = 0.089 \pm 0.030$$
$$\text{Age} = 13.75(11)\ \text{Gyr}$$

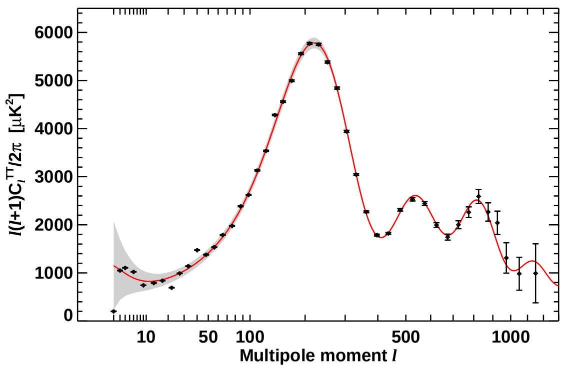
Ω_c: Ω in dark matter.

Power spectrum requires that Λ behaves like a cosmological constant.

$\Longrightarrow$ Very good agreement between data and theory!

13–93

Power Spectrum



(WMAP, 7 year data; Larson et al., 2010, Fig. 1)

Best fit parameters for WMAP data after 7 years of measurements (Jarosik et al., 2010):

$$h = 0.704(14)$$
$$\Omega_b = 0.0456(16)$$
$$\Omega_c = 0.227(14)$$
$$\Omega_\Lambda = 0.728(16)$$
$$\Omega_{tot} = 1.0023^{+0.0056}_{-0.0054}$$
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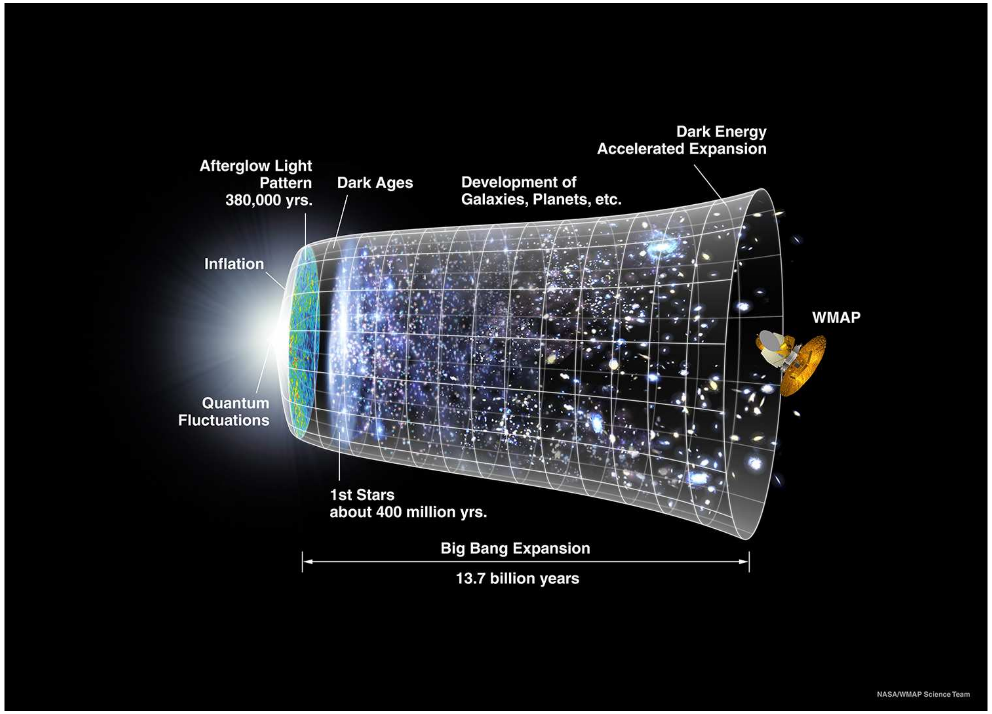

Bahcall, N. A., & Soneira, R. M., 1983, ApJ, 270, 20

Bennett, C. L., et al., 2003, ApJ, submitted

Cole, S., et al., 2005, MNRAS, 362, 505

de Lapparent, V., Geller, M. J., & Huchra, J. P., 1986, ApJ, 302, L1

Eisenstein, D. J., & Hu, W., 1999, ApJ, 511, 5

Hamilton, A. J. S., & Tegmark, M., 2002, MNRAS, 330, 506

Jaffe, A. H., et al., 2000, Phys. Rev. Lett., submitted (astro-ph/0007333)

Jarosik, N., et al., 2010, ApJ, in press (arXiv:1001.4744)

Larson, D., et al., 2010, ApJ, in press (arXiv:1001.4635)

Peacock, J. A., 1999, Cosmological Physics, (Cambridge: Cambridge Univ. Press)

Peebles, P. J. E., 1980, The Large-Scale Structure of the Universe, (Princeton, NJ: Princeton Univ. Press)

Spergel, D. N., et al., 2007, Astrophys. J., Suppl. Ser., 170, 377

Spergel, D. N., et al., 2003, ApJ, submitted

Springel, V., Frenk, C. S., & White, S. D. M., 2006, Nature, 440, 1137

Springel, V., et al., 2005, Nature, 435, 629

Strauss, M. A., 1999, in Structure Formation in the Universe, ed. A. Dekel, J. P. Ostriker, (Cambridge: Cambridge Univ. Press)

Strauss, M. A., & Willick, J. A., 1995, Phys. Rep., 261, 271

Tegmark, M., et al., 2004, ApJ, 606, 702

Tucker, D. L., et al., 1997, MNRAS, 285, L5

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