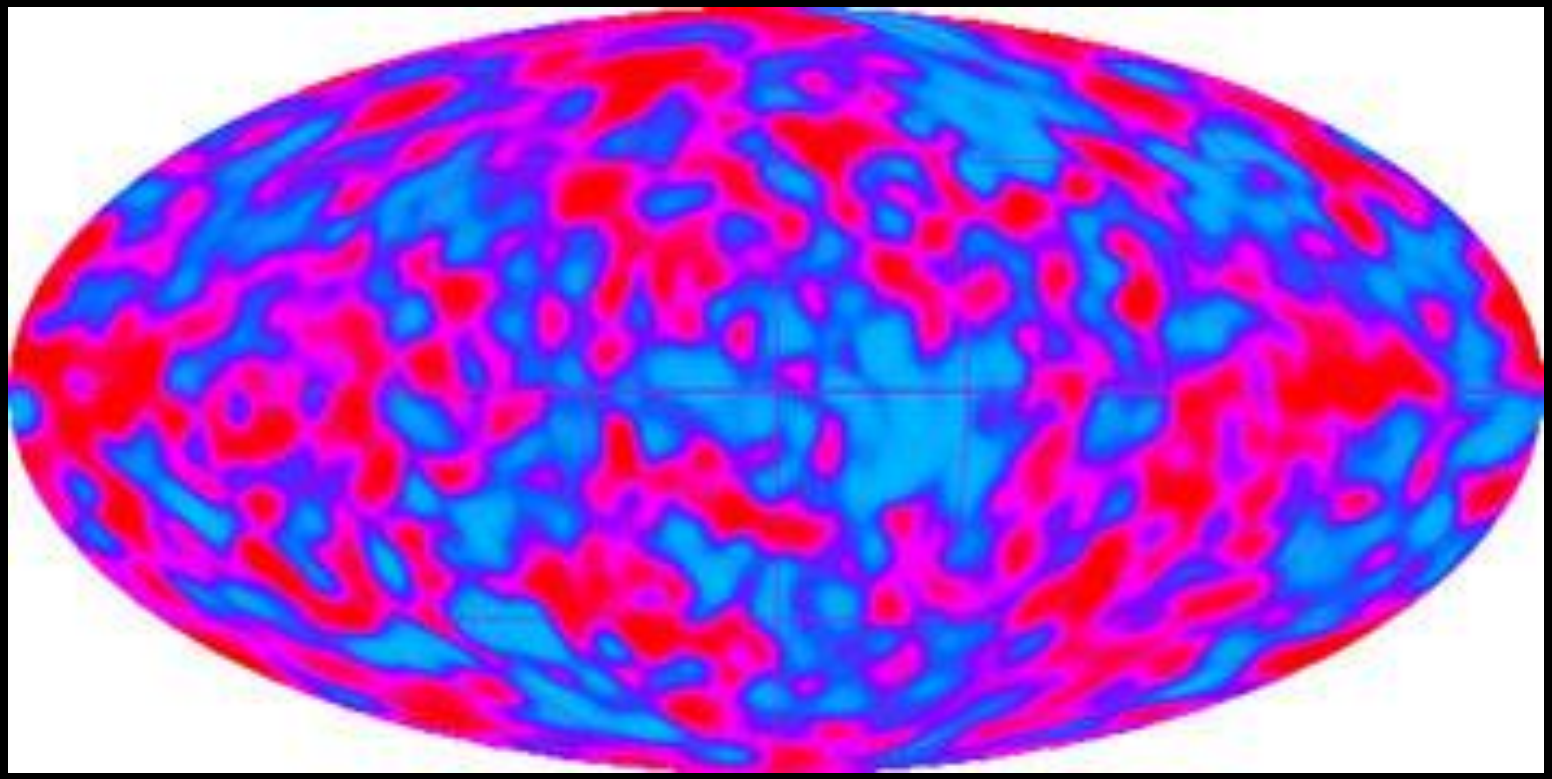
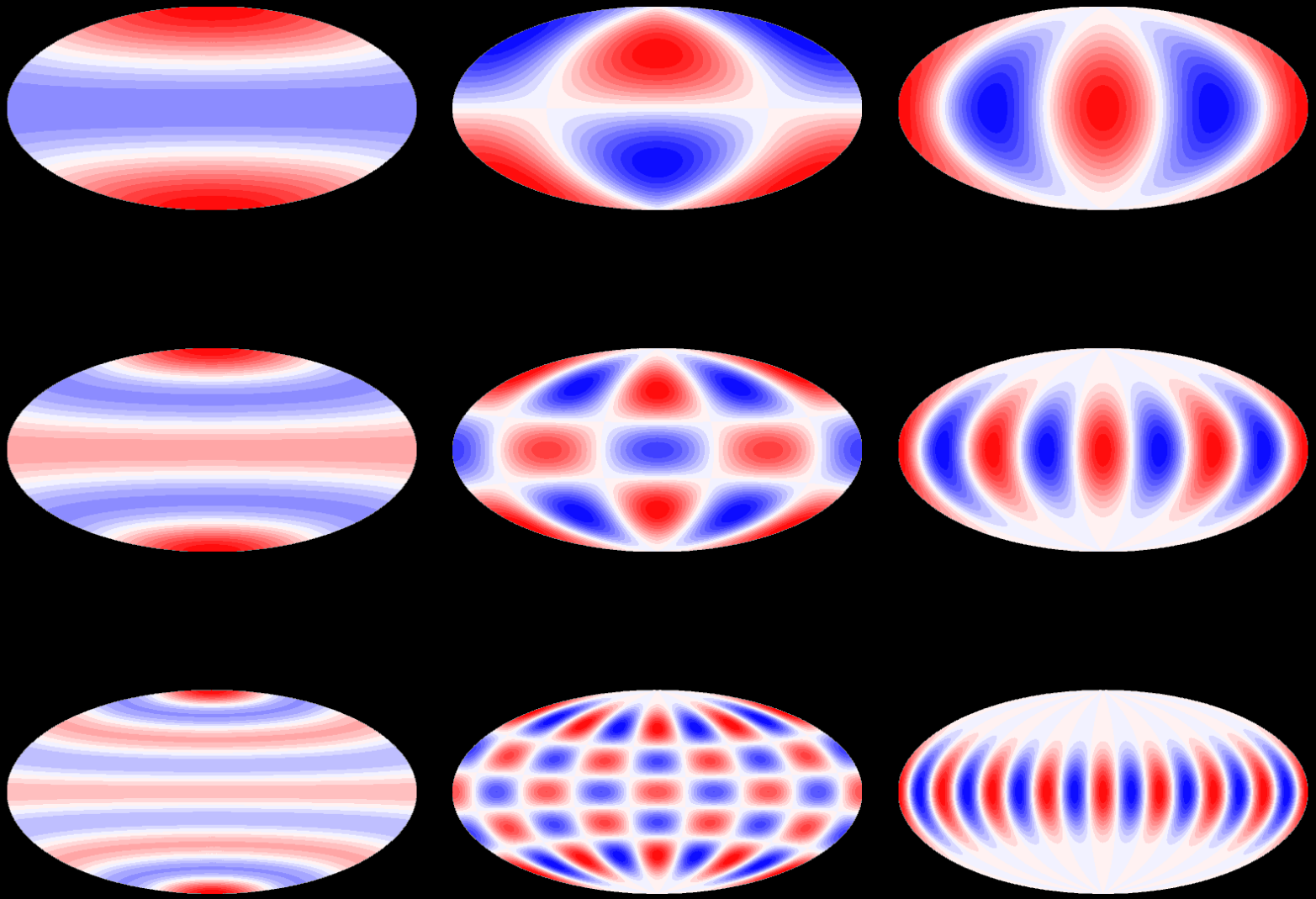
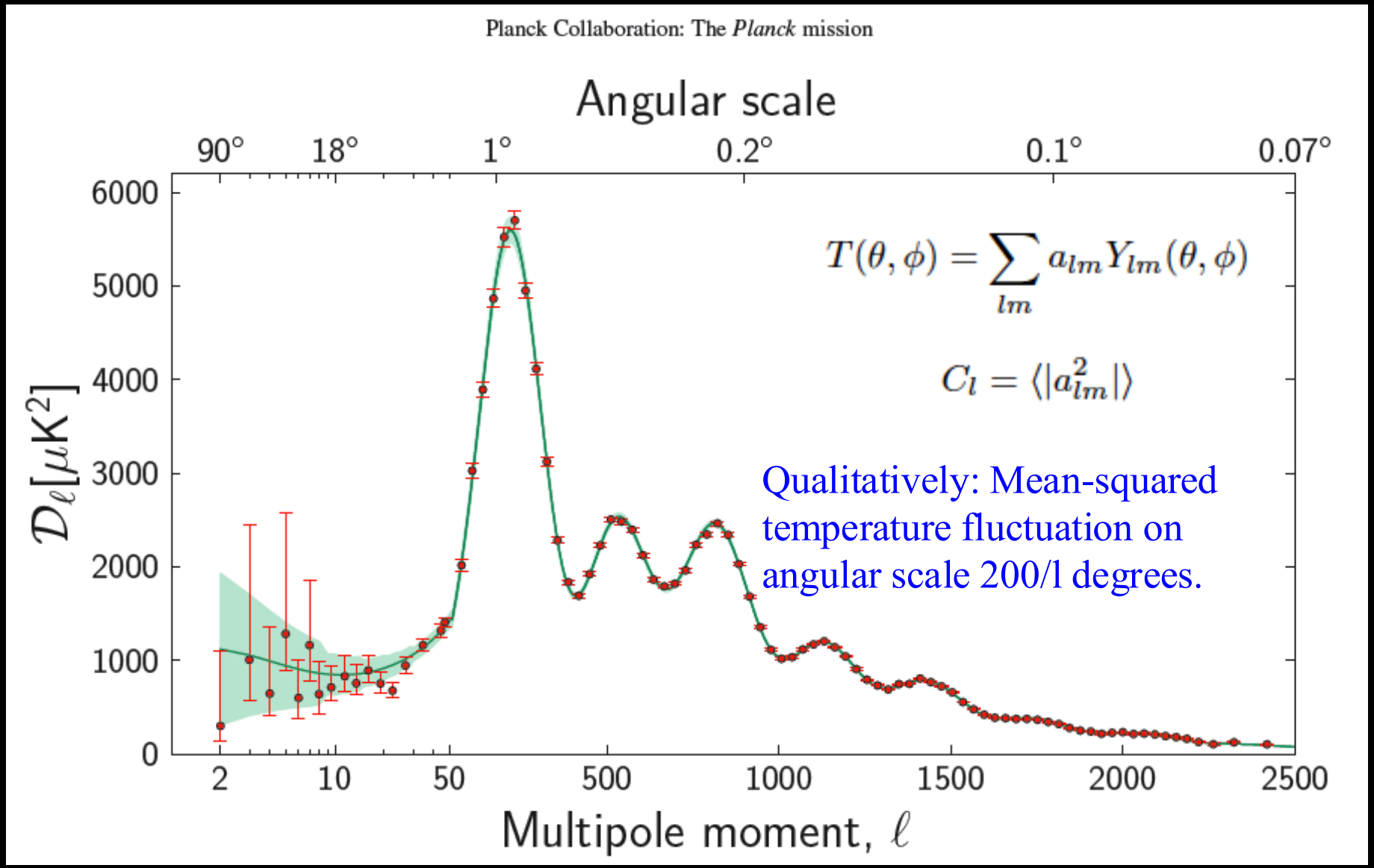
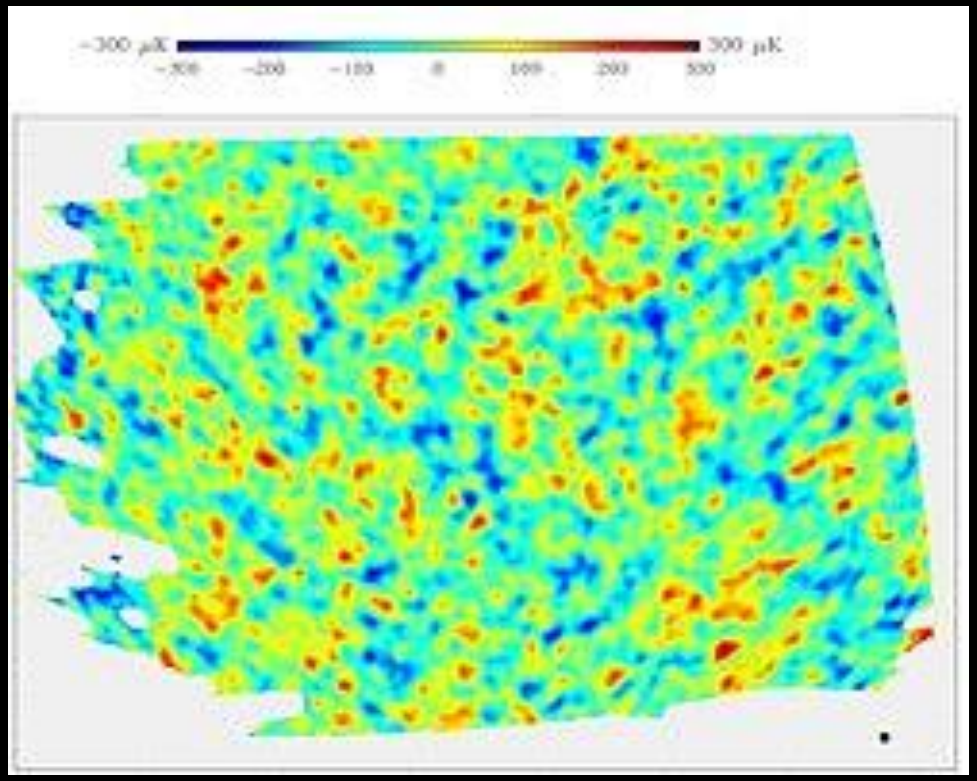


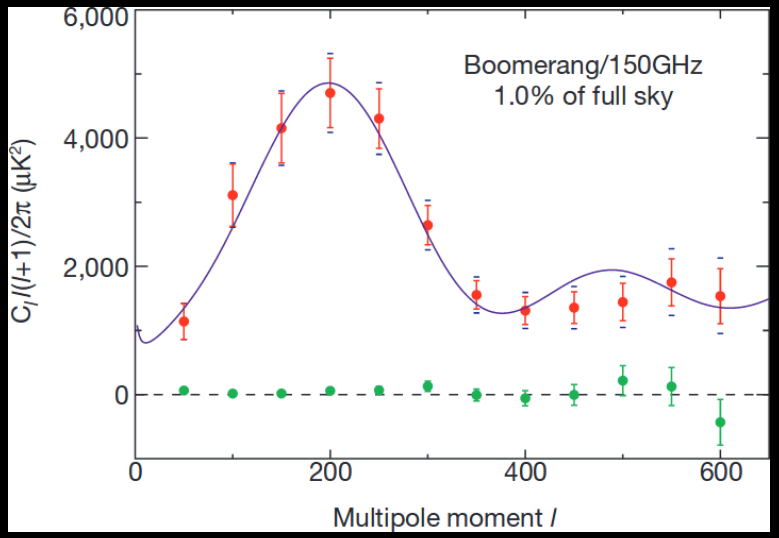
Cosmic Background Explorer (COBE), 1992++




Planck Collaboration: The *Planck* mission
Angular scale
90°
18°
1°
0.2°
0.1°
0.07°
6000
5000
4000
3000
2000
1000
0
$\mathcal{D}_\ell [\mu K^2]$
$T(\theta,\phi) = \sum_{lm} a_{lm} Y_{lm}(\theta,\phi)$
$C_l = \langle |a_{lm}^2| \rangle$
Qualitatively: Mean-squared temperature fluctuation on angular scale 200/l degrees.
2
10
50
500
1000
1500
2000
2500
Multipole moment, ℓ



Boomerang Balloon CMB Map, 2000



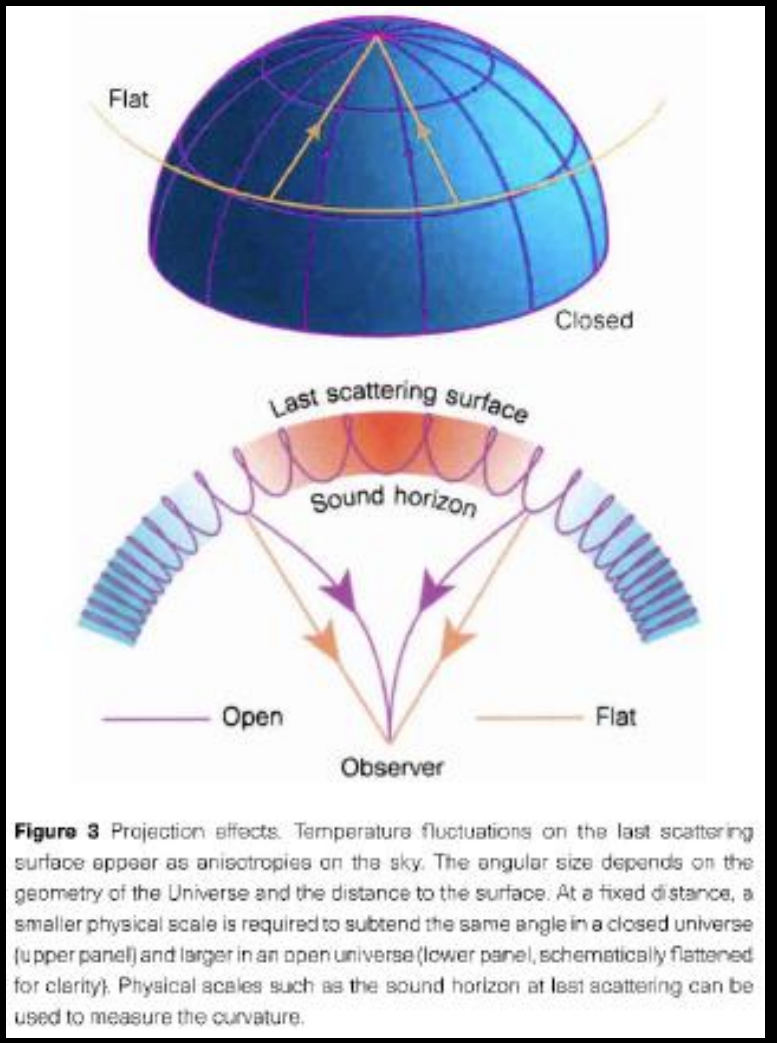
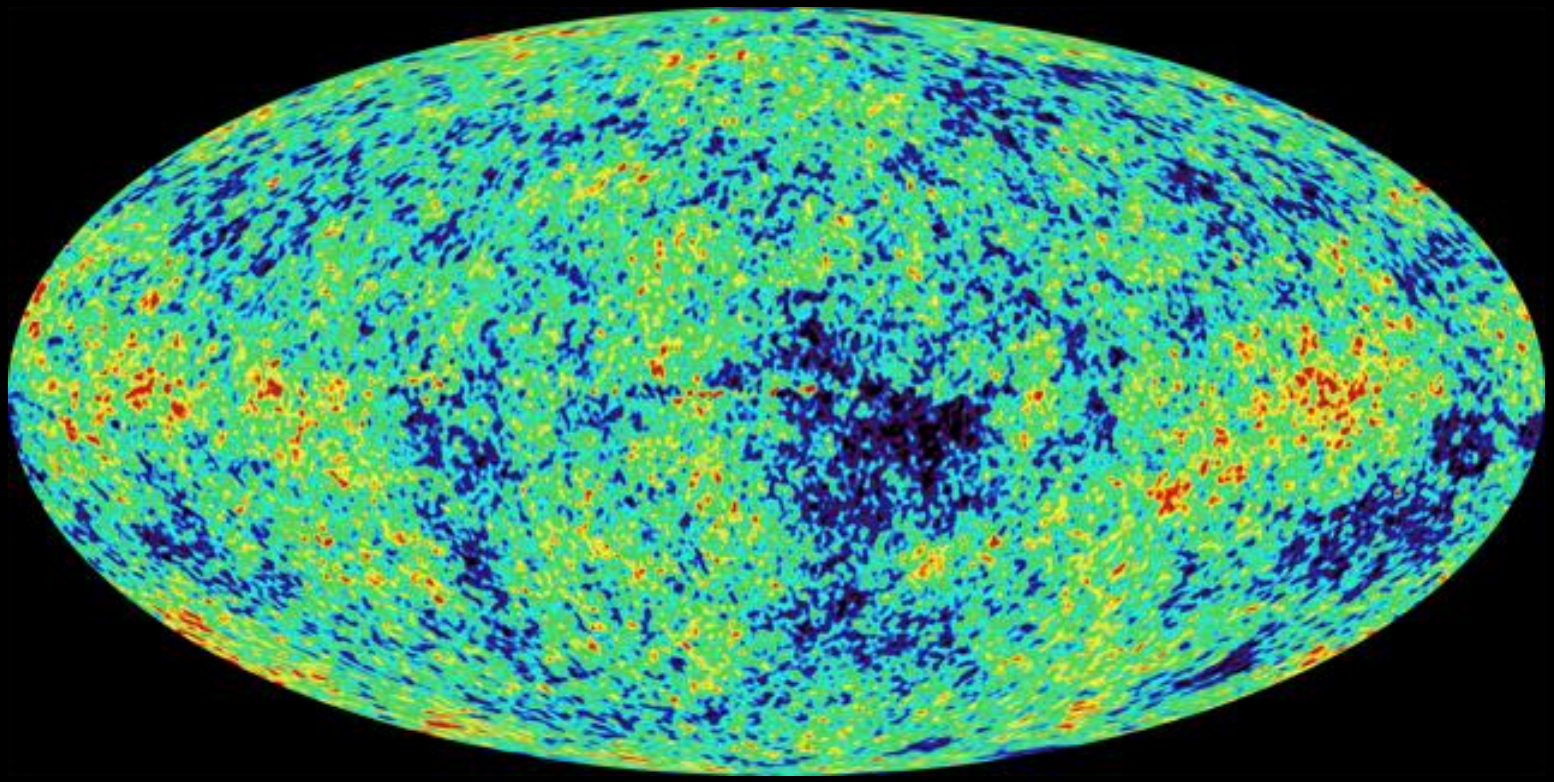
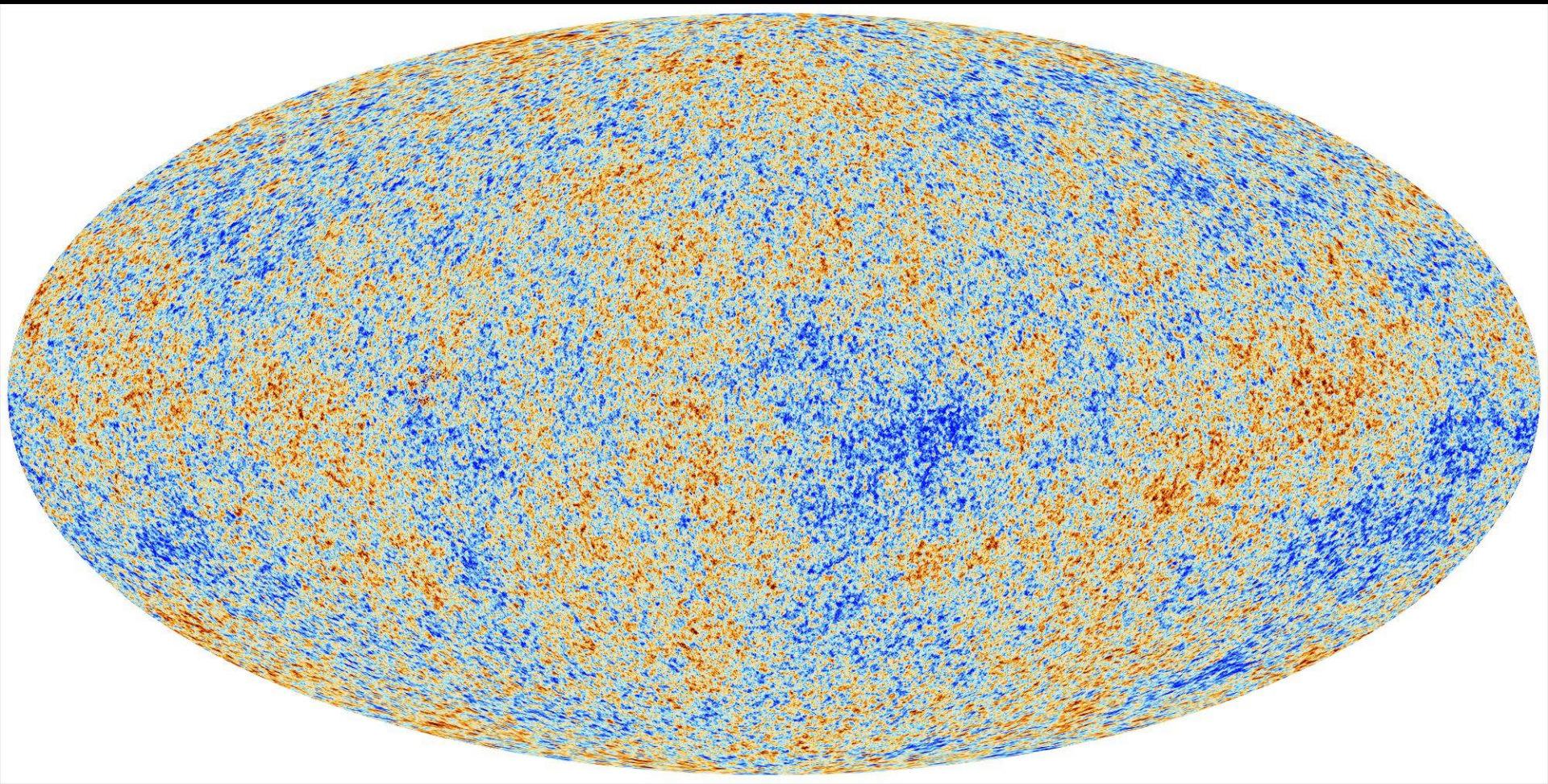


Figure 3 Projection effects. Temperature fluctuations on the last scattering surface appear as anisotropies on the sky. The angular size depends on the geometry of the Universe and the distance to the surface. At a fixed distance, a smaller physical scale is required to subtend the same angle in a closed universe (upper panel) and larger in an open universe (lower panel, schematically flattened for clarity). Physical scales such as the sound horizon at last scattering can be used to measure the curvature.

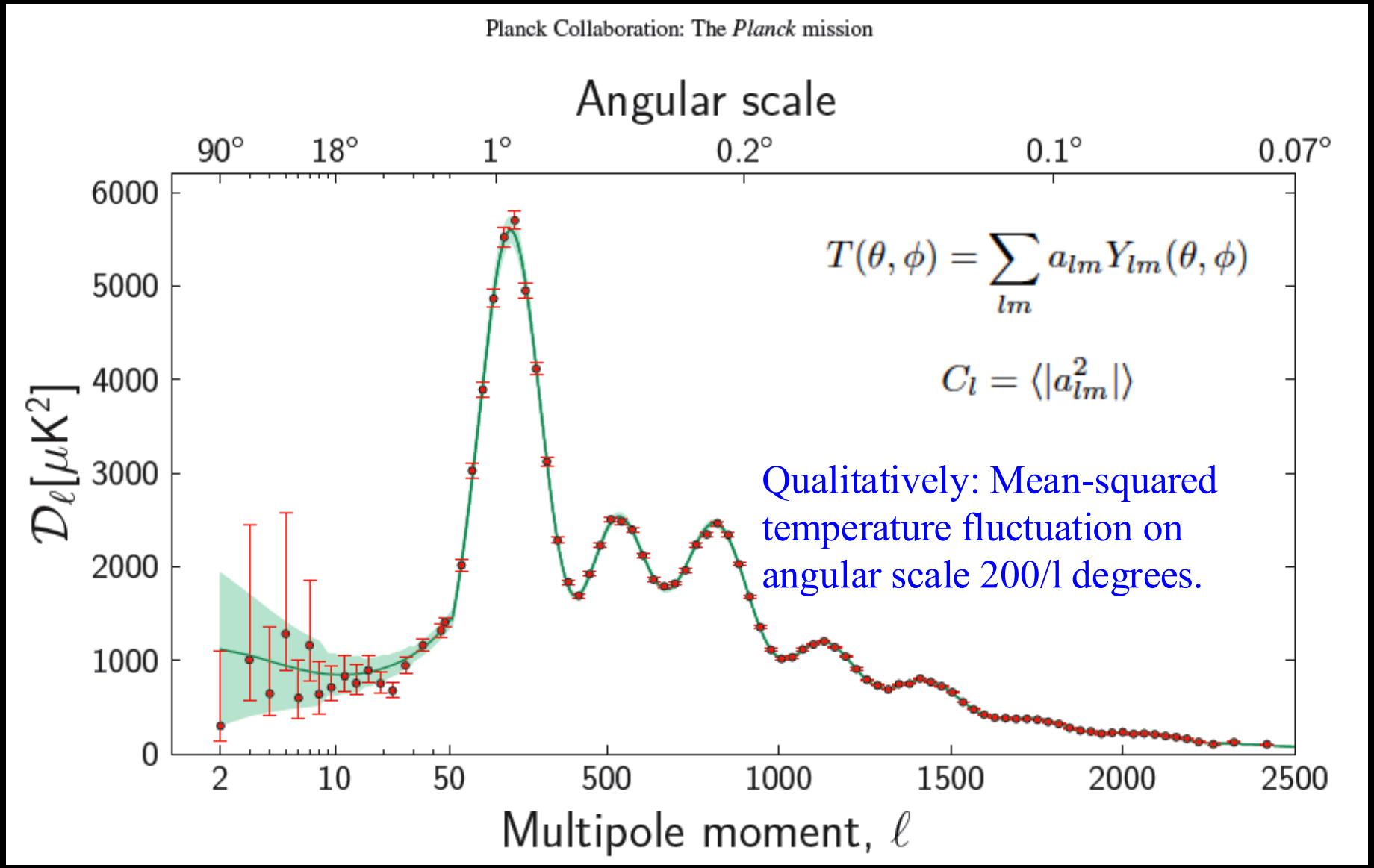
Hu, Sugiyama, & Silk 1997



Wilkinson Microwave Anisotropy Probe (WMAP), 2001-2010
First results 2003, ”Final” results ~2009.



Planck CMB mission, 2009-2013 ["Final" results ~ 2018]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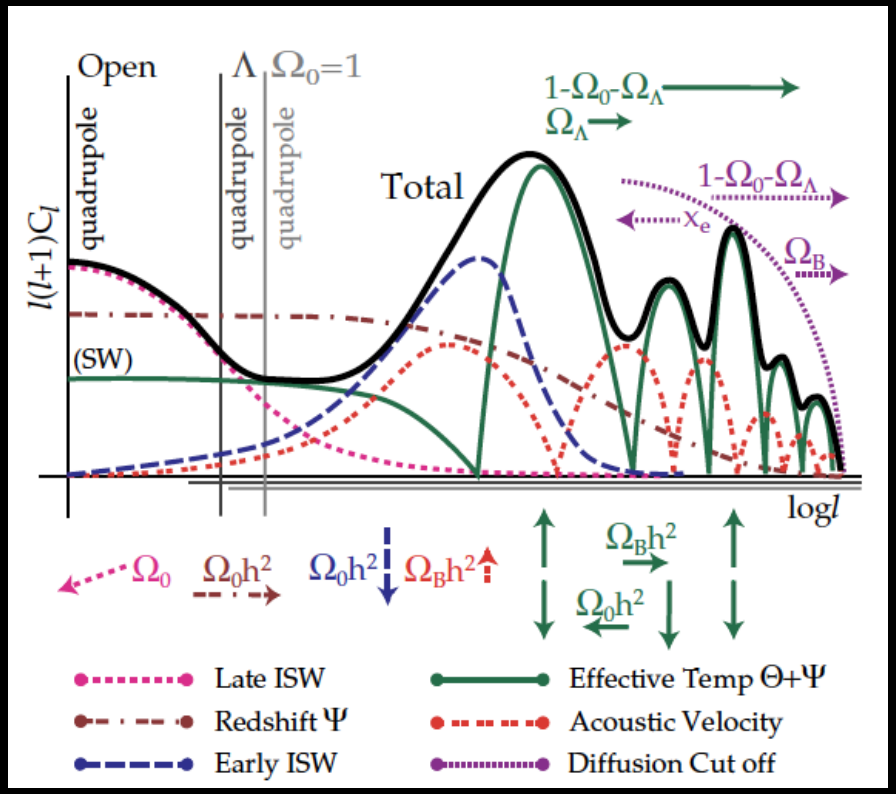
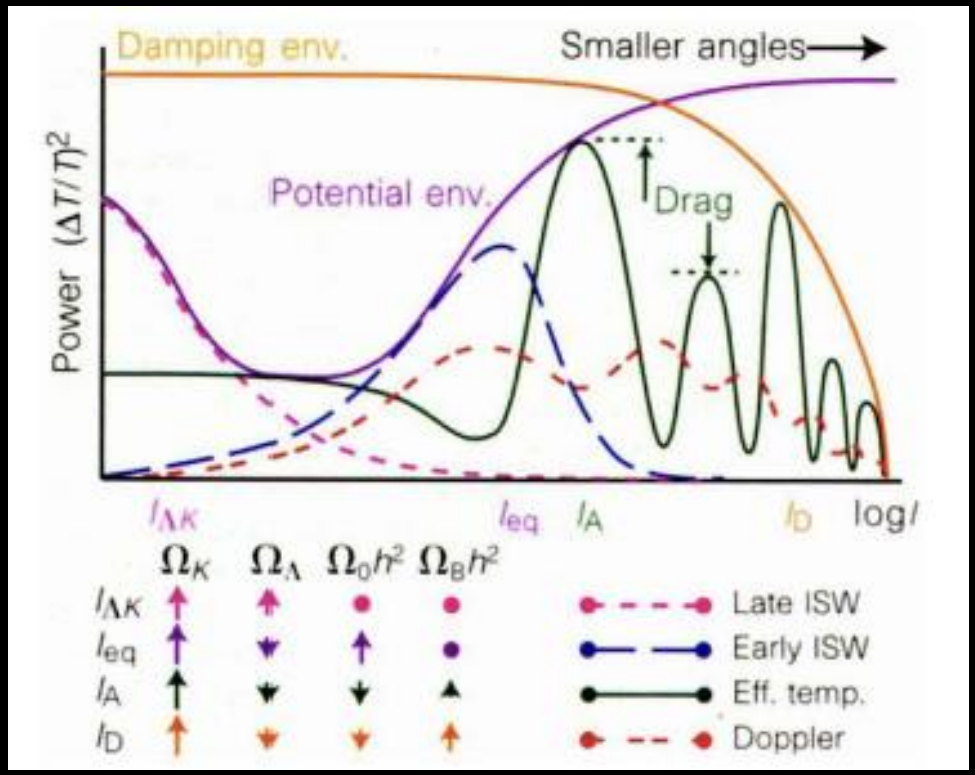
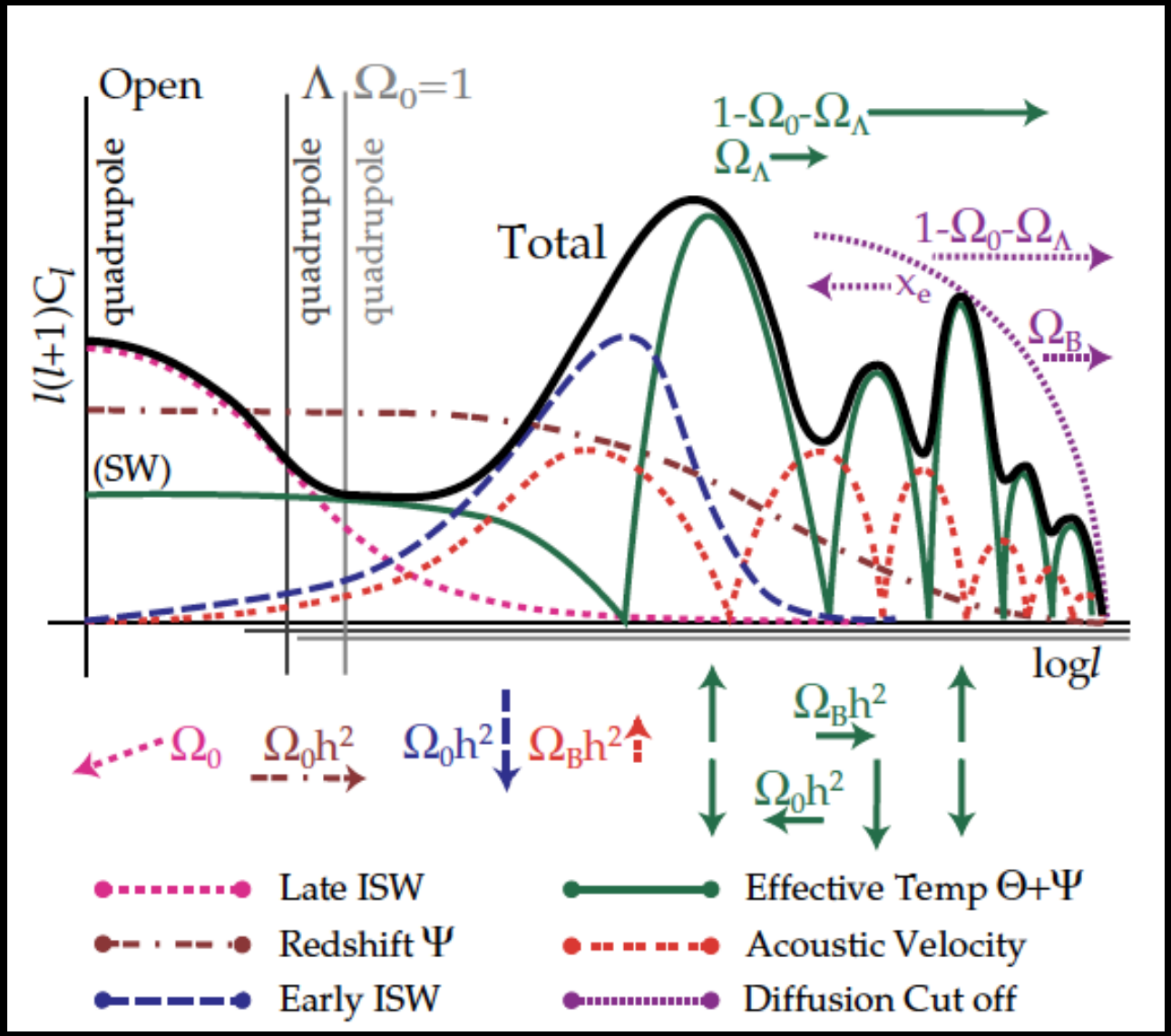




Hu, Sugiyama, & Silk
Astro-ph/9504057

Nature, 386, 37, March 6 1997



Hu, Sugiyama, & Silk Astro-ph/9504057