Introductory Astronomy

Week 8: Cosmology

Clip 6: Cosmic Microwave Background

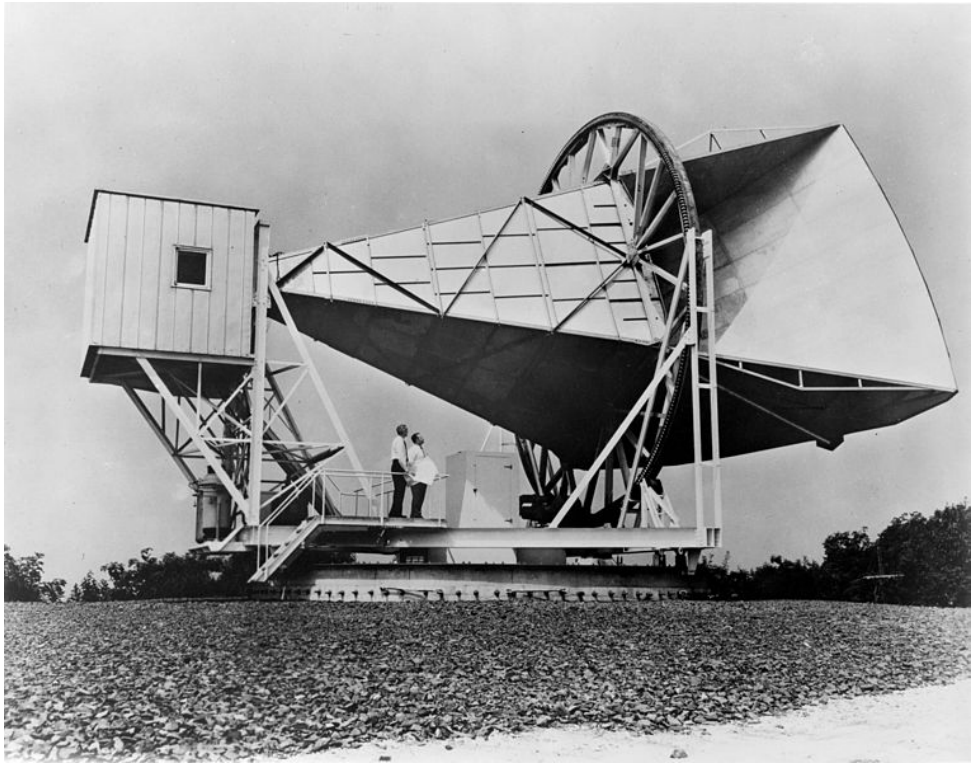
Duke UNIVERSITY

Ancient Light

- Before recombination charged dense plasma and radiation in equilibrium $T_{ion} \sim 3000K$
- After recombination radiation decouples from matter and energy conserved for each separately
- That light is still propagating $T_0 = T_{ion} a_{ion} \sim 3K$
- Dicke 1960: We could see this!

Radio Noise

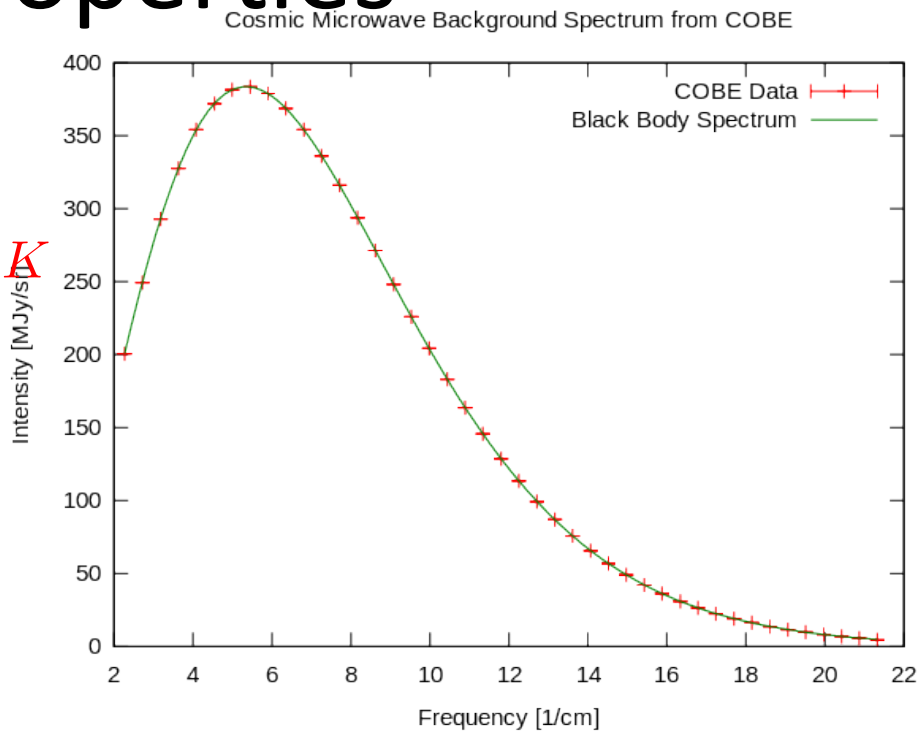
- Penzias Wilson 1965 find noise in their antenna
- Isotropic intensity rules out terrestrial or galactic source
- Call to Dicke: “we’ve been scooped”



Duke UNIVERSITY

CMB Properties

- Cosmic Microwave Background (CMB) is blackbody with $T_0 = 2.7260K$
- Isotropic to 10^{-5} validating cosmological principle
- Oldest light still around



Duke UNIVERSITY

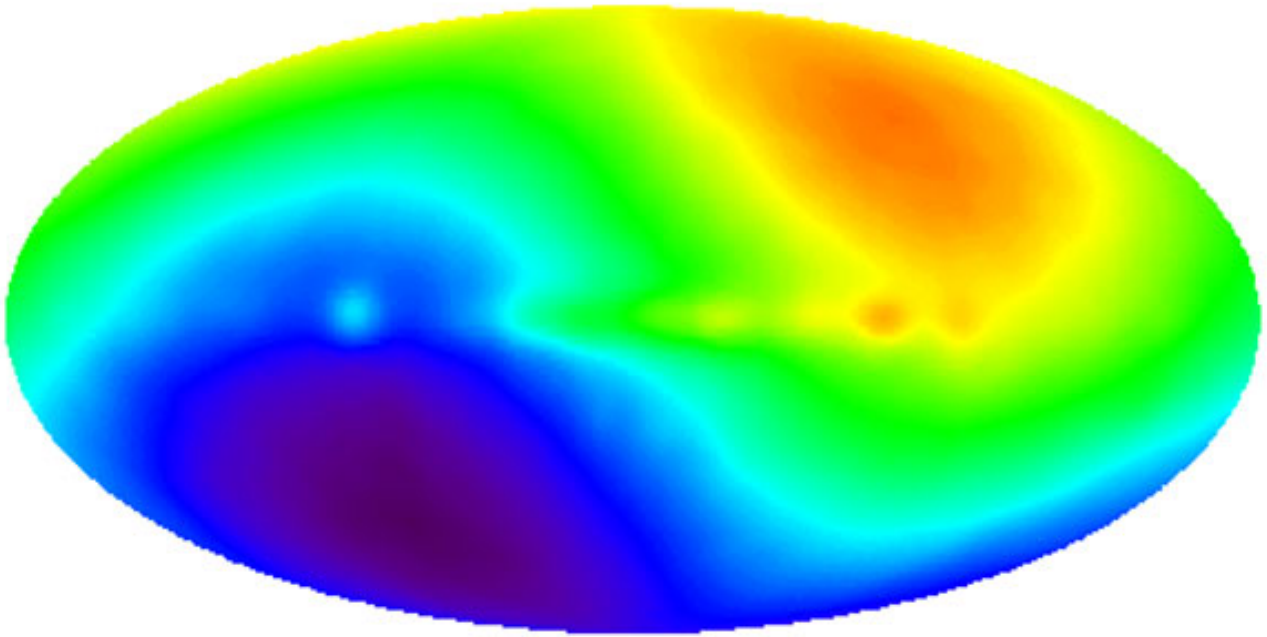
Isotropy of the Cosmic Microwave Background

MAP990004

Duke UNIVERSITY

Eppur si Muove

- Not completely isotropic
- Temperature map shows our peculiar velocity relative to local Hubble flow
- 600 km/s towards Virgo



Duke UNIVERSITY

Credits

- CMB Map: NASA/WMAP Science Team http://map.gsfc.nasa.gov/universe/bb_tests_cmb.html
- CMB Dipole: DMR, COBE, NASA, Four-Year Sky Map http://apod.nasa.gov/apod/ap010128.html