PHYS 800
Special Topics in Cosmology

Jeremy Tinker
Lecture 1, 9/7/16
The Fundamental Observations of Cosmology
Olber’s Paradox

• Original measurement from Hubble’s 1929 paper.

• Each dot is a galaxy outside of our own.

• Off by a factor of 5 (invalid calibration).

• Only 9 years after Shapley-Curtis debate, regarding whether extragalactic objects even existed.
Current state of the art measurements.

Note change of scale on x-axis.

Freedman WL, Madore BF. 2010.  
The Universe is Homogeneous?

CfA redshift survey, 1979+

Each dot is a galaxy.

Observer (Earth)

“distance” is in velocity

The first large-scale attempt to make a map of the local universe.
The Universe is Homogeneous
Results from the Sloan Digital Sky Survey

SDSS-I/II
2000-2009

1 Gpc

Image credit: Michael Blanton
NYU Physics
The Universe is Definitely Homogeneous

Baryon Oscillation Spectroscopic Survey (BOSS; 2010-2014)

SDSS (previous slide)
The thing that discovered the CMB
The present-day universe is clustered at small scales.
CMB Temperature Fluctuations

Hottest to coldest spots in CMB are only a milliKelvin apart
What are you looking at?
A “mollweide” projection
Cosmic Expansion is Accelerating

2011 Nobel Prize