Cosmology

The Universe: Now, Then, and Later
Introduction

- What do we know about the universe
  - On very large scales
- How do we know?
  - Looking out is looking back
    - All that we see is glow
    - All that we see is now
  - The mystery of the dark night sky
The darkness of night tells a finite story.

- When we look at the sky, we see bright stars against the darkness of space.
Even if we look at the sky with the Hubble Space Telescope we will still find patches of light against darkness.
If the Universe were infinite in age and extent, we would see a star in every direction.

The sky would glow with the light of a billion billion suns.
Olber’s Paradox

- In 1826, astronomer Heinrich Wilhelm Olber became the first to make the consequences of a dark sky popularly understood. In his time it was not clear what was happening, so the word “paradox” was applied.

Stationary Universe  Our Universe
The Receding Universe

- In 1917 astronomer Vesto Slipher observed 25 of the nearest and brightest galaxies, and measured their relative velocities using the Doppler Effect.
The Receding Universe

Much to his surprise, Slipher discovered that 21 of the galaxies had their light shifted to the red, implying that they are moving away from us.
While Slipher was able to measure the velocities of galaxies, he had no way of measuring the distance to them. In 1929, Edwin Hubble used Cepheid Variable stars, which are very luminous, and vary their luminosity in a distinctive, recognizable way, as standard stars to measure the distance to these galaxies.

The Standard Candle