

15.7: Big Bang Evidence

There is respectable and solid evidence to support a Big Bang-type development of the Universe. Three of these lines of evidence are considered major.

Cosmological Redshift

The Universe is expanding – Referred to as the **Cosmological Redshift**.

Redshift analysis confirms the Universe is expanding, and the expansion rate is accelerating. The evidence for an accelerating expansion comes from observations of the brightness of distance supernovae. We observe the redshift of a supernova, which tells us by what the factor the Universe has expanded since the supernova exploded.

The redshift of an object is the amount by which the spectral lines in the source are shifted to the red. That is, the wavelengths become **l-o-n-g-e-r**. To be precise, the redshift Z is given by:

$$Z = [\lambda_{\text{obs}} - \lambda_{\text{em}}] / \lambda_{\text{em}} \quad Z = H_0 d / c \quad (\text{for small distances})$$

Where:

- “Noise” found in all directions throughout the Universe; this “Noise” is radiation remaining from the initial Big Bang.

Background “Noise” was discovered by accident by Arno Penzias and Robert Wilson, Bell Labs in 1965. They heard a hiss at their radio telescope receiver and after investigation, thought it was due to pigeon droppings on the antenna.

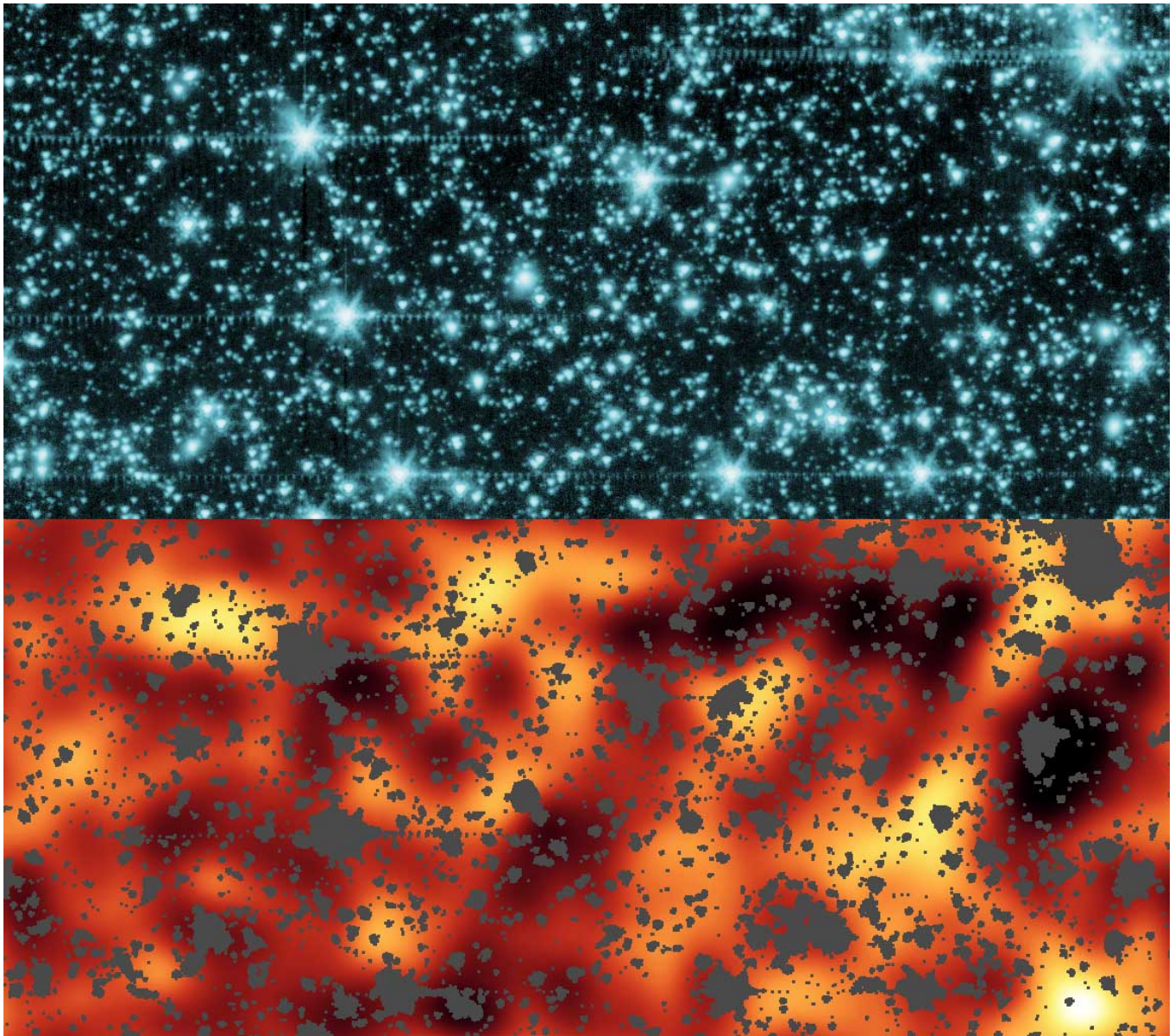
Initial Hydrogen-Helium Fusion

If the H-He early fusion theory is correct, we should find a specific amount of He in the Universe today.

Knowing the current microwave background radiation temperature of 2.73 K allowed astronomers to mathematically predict the amount of He in the Universe; **Helium should account for approximately 25% of the mass of the Universe**. (This does not include Dark Matter/Dark Energy.) So...*what is the amount of Helium found in the Universe?* 25%

Additional lines of evidence supporting a Big Bang type of development:

- We find **large-scale homogeneity** throughout the Universe.
- There is an **abundance of light elements** : Hydrogen, Helium, Lithium, and Beryllium.
- The **Cosmic Microwave Background Radiation** itself is **uniform**.
- The temperature of the Cosmic Microwave Background Radiation is extremely uniform.
- Large-scale structure of the Universe; the **distribution of objects**.
- The **ages of stars**.



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Look for that “glow” of those first stars...

- The top image was taken with the Spitzer Space Telescope. This image shows all the objects visible, as very bright lights.
- The bottom image has all objects taken out and is only in infrared. The red, orange, yellow “glow” or bright blobs are likely from the first stars: short-lived yet massive and bright

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