

4 Nov

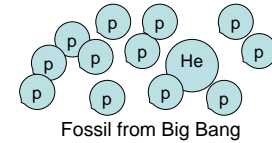
1. A fossil is a remnant or trace of the past. What is a fossil from the Big Bang?



Fossil from Burgess Shale

Helium Production in BB—4 Nov

- A fossil is a remnant or trace of the past. What is a fossil from the Big Bang?



Fossil from Big Bang

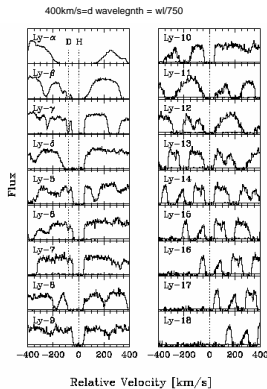
- There are 7 protons for every neutron
 - The surface of the sun is 25% He and 75% H.
- What does that fossil tell about the BB?



Fossil from Burgess Shale

“Collecting the Fossil”

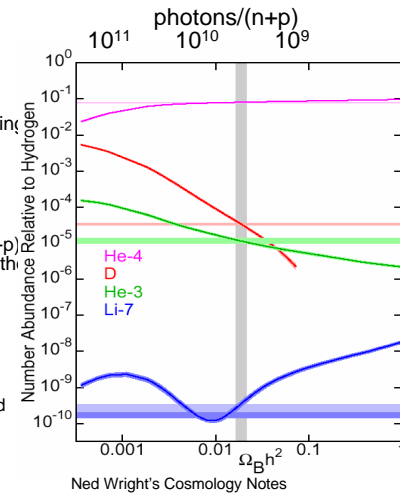
- ^4He , ^7Li , ^2H , & ^3He are made in BB.
 - Lots of ^4He
 - Trace amounts of ^7Li , ^2H , & ^3He . Diagnostics.
- Measure abundances with spectra of “primordial objects”
 - First stars
 - Dwarf galaxies
- Deuterium ^2H has same spectra as hydrogen ^1H but slightly shifted.
 - Abundance of ^2H : Strength of ^2H spectral line compared with ^1H line.



O'Meara, et al., 2001, ApJ 552, 718.

Results

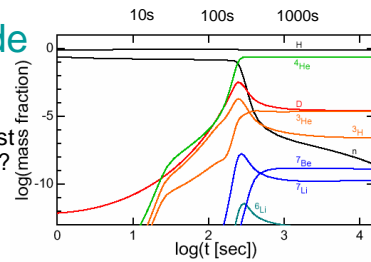
- Horizontal bars are measurements
 - Lines are models for differing amounts of photons/(n+p)
2. How many ^1H nuclei are there for every ^2H nucleus according to the measurements?
 3. The model for photons/(n+p) = 10^{11} is inconsistent with the measurements. The measured ^4He is too ____.
- Measurements are consistent with models for photons/(n+p) = 4×10^{10} .
 - ^7Li is slightly off
 - Understanding of BB (and nuclear physics and astrophysics of stars and galaxies) is confirmed.



Ned Wright's Cosmology Notes

How ^4He is made

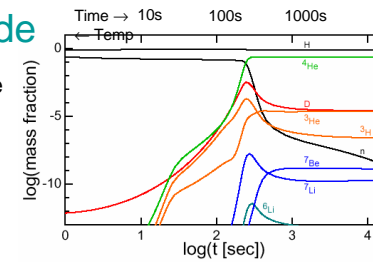
4. When U was 10s old, what were the two most abundant constituents? Same for 10,000s.
5. When U was 10,000s old, how much D (^2H) was there for every ton (1000kg) of matter?
 - Need to understand why elements changed during the first 3 minutes.



- Model of how amount of element changes with time.

How ^4He is made

- What changed during the first hour?
 - At 1 s, neutrons & protons; minute amount of ^2H (D).
 - Ratio n/p dropping slowly
 - ^2H , as well as ^3H and ^3He increases starting at 30s.
 - ^4He increases
 - At 200 s, ^2H , ^3H , and ^3He drops. ^4He stays high.
 - At 10,000s (3hr), U is primarily ^1H & ^4He with trace amounts of others.



- Need answers
 - Why does n/p drop even before 10s? Neutrons are not being incorporated in ^2H .
 - What is starting up at 30s? Why does it start then?