Nucleosynthesis

- Light element abundance depends on **baryon/photon ratio**

- Existence and temperature of **CMB** originally predicted (Gamow 1948) by light elements + visible baryons

- With the CMB photon number density **fixed** by the temperature light elements imply **dark baryons**
Spectrum

- FIRAS Spectrum
- Perfect Blackbody

\[ B_{\nu} \times 10^{-5} \]

\[ \text{GHz} \]

\[ \text{frequency (cm}^{-1}) \]

\[ \text{error} \times 50 \]
Thermalization

- Compton upscattering: $\gamma$–distortion
- Redistribution: $\mu$-distortion
Recombination

- Hung up by Ly\(\alpha\) opacity \(\left( 2\gamma \text{ forbidden transition } + \text{ redshifting} \right) \)
- Frozen out with a finite residual ionization fraction

![Graph showing ionization fraction vs. scale factor and redshift.](attachment:graph.png)