Exercise 2

onsdag 23. november 2016 19.11

- The Jeans length is given by

$$\lambda_J = c_s \sqrt{\frac{\pi}{G\bar{\rho}}}$$

$$c_s = \frac{k_B T}{\mu m_p}$$

$$\bar{\rho} = \bar{n} m_p \mu$$

$$\bar{n}_H = 2 \cdot 10^{-7} (1+z)^3 \ \text{cm}^{-3}$$

$$\Rightarrow \lambda_J = \frac{k_b T}{\mu m_p} \sqrt{\frac{\pi \cdot 2 \cdot 10^7}{6 \, m_p \mu (1+z)^3}} \qquad \Rightarrow \bar{\rho} = 2 \cdot 10^{-7} (1+z)^3 m_p \mu$$

$$= k_b T \sqrt{\frac{\pi \cdot 2 \cdot 10^7}{6}} \left(m_p \mu (1+z)\right)^{-3/2}$$

$$= k_b \, 10^4 \, \text{K} \sqrt{\frac{2\pi \cdot 10^7}{6}} \left[m_p \mu (1+z)\right]^{-3/2}$$

- Velocity width

$$dv = H(z) \, ds$$

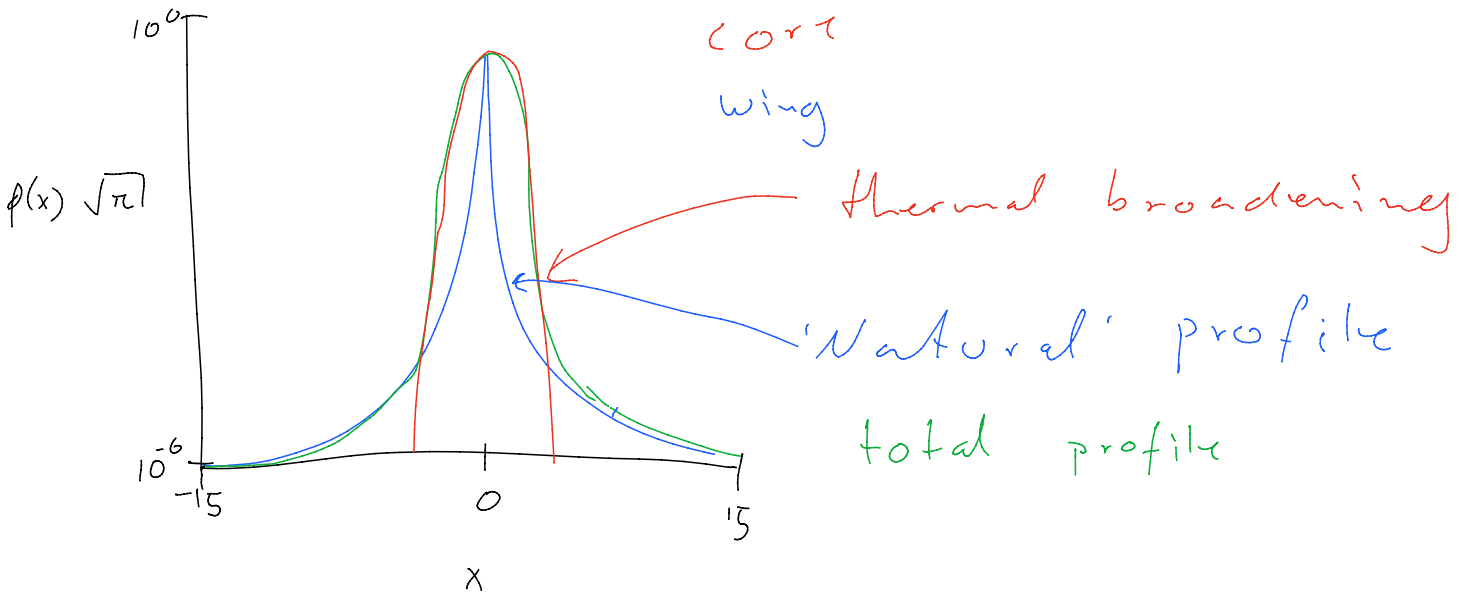
with $ds = \lambda_J$

$$D = k_b (m_p \mu)^{-3/2} \sqrt{\frac{2\pi}{6}} \, 10^{15/2} \, \text{K}$$

$$\Rightarrow \quad dv = H(z) \, D \, (1+z)^{-3/2}$$

- The finite width of the Ly α absorption cross-section indicates that the absorption lines in Ly α forest comes from different overdensities in the line of sight.

- Not sure how to interpret this exercise. We could compare dv with σ_{th} or we may look at the graph for the Ly α cross section, or something entirely different.



The "natural profile is really sharp around 0, while the total profile looks gaussian. The total profile is "broadened" by the thermal profile.