

Astrophysics — ASTR-4220
Class 4
Radiative Transfer I

Exercise (10 pts)

What is the probability that a photon travels N mean free paths in a homogeneous plasma with absorbers of density n_a and cross section σ_a ?

Solution

The probability is

$$P = \exp(-\tau) \tag{1}$$

where τ is the optical depth along a path of length

$$L = \frac{N}{n_a \sigma_a}. \tag{2}$$

The optical depth is

$$\tau = n_a \sigma_a L = N \tag{3}$$

so

$$P = \exp(-N). \tag{4}$$