Exercise 5.2.5 Rayleigh Scattering

Illustration

1. Generate some numbers for *scattering cross sections* using the equations given.

- Look, e.g., at "air" molecules including some water vapor or ozone as scatterers, and wave lengths from the **IR** to the **UV**.

2. Derive or justify the equation $\boldsymbol{l_{sc} = 1/n\sigma}$. Show that for air we get $\boldsymbol{l_{sc}\ (=)\ 160 \cdot \lambda^4}$ if we give ***l*** in **km** and λ in **µm**.

- *Hint 1:* Consider the particle to be a cube with σ being the area of a face. All light will be scattered if the total area of those cubes projected on a surface perpendicular to the light beam covers that area completely. λ_{sc} then is the length of a cube that contains enough particle to meet that condition.
  Hint 2: The volume of an air "molecule" can be estimated from the fact the *liquid* air has about the same density as water.

3. Generate some numbers for penetration depths in air. How thick does an ozone ($\mathbf{O_3}$) layer with a density $\boldsymbol{n_{Oz}}$ **= 8 ml/m^3** have to be to absorb most of the incoming ultraviolet radiation (especially "**UV-B**"; $\lambda \approx$ **300 nm**)

Link to the solution