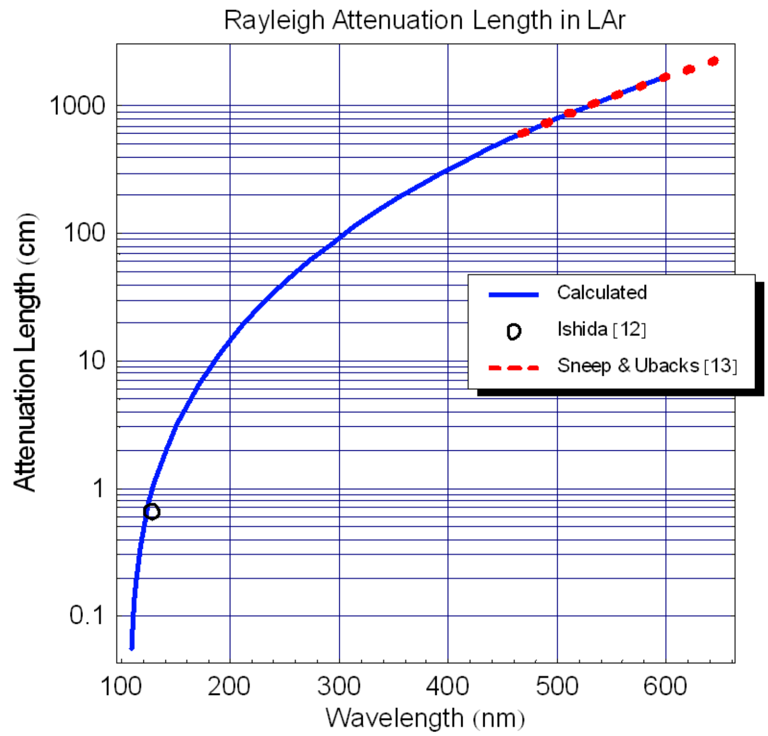
Rayleigh scattering attenuation length [11, 12, 13]



$$L_R^{-1} = \frac{k_B T \rho(T)^2 \kappa_T}{96\pi^5 \lambda^4} \left(\frac{(\epsilon(\lambda)-1)(\epsilon(\lambda)+2)}{3\rho(T)} \right)^2$$

L_R = Rayleigh scattering attenuation length

$\epsilon(\lambda)$ = dielectric constant at wavelength $\lambda = n(\lambda)^2$

$\rho(T)$ = density at temperature T

κ_T = isothermal compressibility = 2.18×10^{-10} cm^2/dyne

If the difference in the attenuation lengths calculated for Rayleigh scattering (94 cm) and measured by Ishida (66±3)[12] can be attributed to atomic absorption in the measurement, then the partial attenuation length for atomic absorption in their experiment is ~ 2 m. Absorption by atomic Ar is very small at 128 nm; the nearest resonance transition is at 106.7 nm. The absorption length determined from the dispersion, for a reasonable line width, via the Kramers-Kroenig dispersion relation is >1000 m at 128 nm. Absorption by impurities (O_2, N_2, H_2O and carbon compounds) is probably the dominant absorptive mechanism in LAr at 128 nm. The cross section for absorption by O_2 at 128 nm is about 3x10^{-19} cm^2 [40], which implies an attenuation length of 2.1 m for 800 ppb O_2 in LAr. The cross section for N_2 is about 1.2x10^{-18} cm^2 [41] so an N_2 concentration of 170 ppb contributes 2.1 m to the total absorption length. H_2O may be the dominant contributor: the cross section at 128 nm is 7.4x10^{-18} cm^2 [42] for an attenuation length of 2.1 m for 30 ppb.