Interstellar (between the stars) absorption of light "JFSF"

The average degree of interstellar obscuration amounts to 0·8 magnitude per 1000 parsecs (pc), or 3200 light-years. This means that, after travelling 3200 light years through space to Earth, the star is rendered 0·7 as bright as it would be were it observed much nearer. This is significant, because of the much greater distances of other celestial objects of interest.

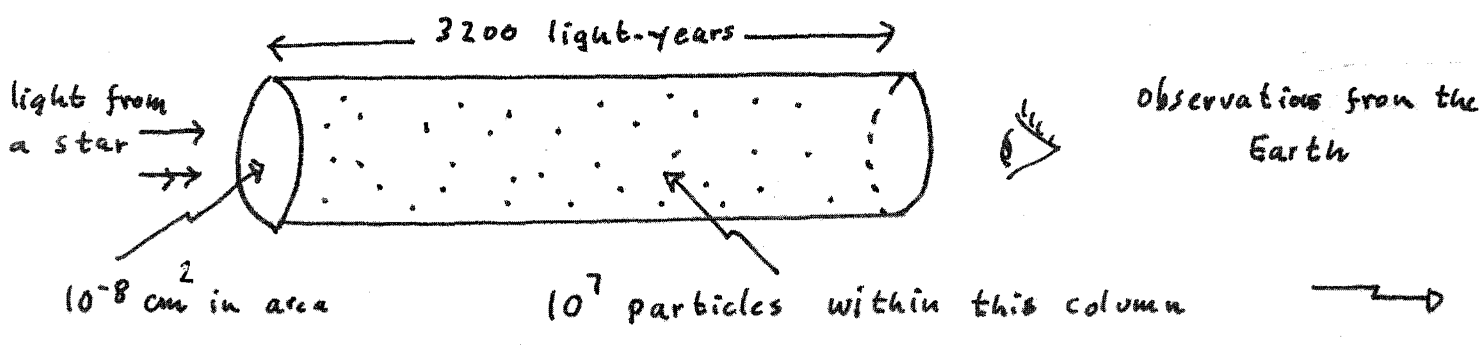
This attenuation (weakening) of starlight has been observed in many directions in space, and it has been shown that this is caused by dust particles with sizes of the order of wavelength of visible light, around 10^{-6} m (one thousandth of one millimetre). This dust attenuation involves absorption and scattering. Scattering plus absorption is called <u>extinction</u>.

Small crystals of ice, about the same diameter, and even small particles of Iron (pronounced "I-ron" — as opposed to "ion" (a charged particle). Every grain removes a small fraction of light from the incident beam.

For a crude estimate, each particle will be assumed to act as an obscuring screen of cross-sectional area

$$\pi \times (0 \cdot 5 \times 10^{-6}\ m)^2 = \pi \times (0 \cdot 5 \times 10^{-4}\ cm)^2 \approx 10^{-8}\ cm^2$$

If there are N particles that do not occult one another within a column $1\ cm^2$ in cross-section and 3200 light-years ($\sim$ 1000 pc) in length, they will reduce the light by a factor of $N \times 10^{-8}$. In order for this amount to be 0·7 (about 0·8 magnitude), N must be about 10^7.



→

For light travelling in interstellar space,

v : 3×10^{8} m s^{-1}

∴ In one year, the distance travelled

$= 3\times10^{8}$ m s^{-1} × 86400 s day^{-1} × 365 days

Look at the units : the "s^{-1}" cancels the "s" and the "day-1" cancels the "days", leaving "m" (distance)

∴ <u>1 light-year = $9 \cdot 4 \times 10^{15}$ m ≃ 10^{16} m</u>

Note that this is a unit of <u>distance</u> and <u>not</u> a way of referring to a large time interval, as it is unfortunately used in the contemporary idiom.

The companion of α - Centauri is around 4·3 light-years, around <u>4×10^{16} m</u>

Our "neighbour" in the Local Group, the Andromeda Nebula is around 2×10^{6} light-years' distance.

That is 10^{16} m $(l\text{-}y)^{-1}$ × 2×10^{6} l-y

<u>$= 2 \times 10^{22}$ m</u>

It would take light about five hours to cross the Solar System, covering a distance of

3×10^{8} m s^{-1} × 3600 s hr^{-1} × 5 hours

$= 3\times10^{8}$ m s^{-1} × 18000 s

<u>$= 5 \cdot 4 \times 10^{12}$ m</u> (Check, using your R.T.C.)

<u>Style</u> ① It is "light-year" <u>not</u> "light year", which would be a year that is not massive!

② When you make slight adjustments, do you "fine tune" or "fine-tune"?
We fine-tune. A fine tune is easily remembered.

DF
2017, January 30