Question:

The Earth effectively sits in a low-density H II region made up of the ionized solar wind. The wind has is expanding constantly at about 400 kms−1 (i.e. the density decreases as r−2) and in the region of the Earth's orbit, Ne = 10 cm−3. Estimate t and Tb at an observing frequency of 100MHz due to free-free absorption from this wind, at large angles from the Sun.

Answer:

Assume that we are observing in the anti-solar direction. Then, the emission measure (EM) is given by:

$$\left(\frac{EM}{AU\,cm^{-6}}\right) = \int_1^\infty \left(\frac{N_e}{cm^{-3}}\right)^2 d\left(\frac{s}{AU}\right),$$

where the distances are measured in astronomical units (1AU = 4.848 × 10−6 pc). Ne is given by:

$$\left(\frac{N_e}{cm^{-3}}\right) = \frac{10}{\left(\frac{s}{AU}\right)^2}$$

$$\left(\frac{EM}{AU\,cm^{-6}}\right) = \int_1^\infty \frac{100}{x^4}dx = \frac{100}{3} \Rightarrow EM = 1.61\times10^{-4}\, pc \times cm^{-6}$$

Answer: EM=1.61×10⁻⁶ pc×cm⁻⁶