

Answer on Question 55055, Physics / Astronomy | Astrophysics

Question:

A convenient parameter for specifying the sensitivity of a radio telescope is its sensitivity in units of K/Jy; that is, the number of Kelvins of antenna temperature T_A produced by an unpolarized point source whose flux density is 1 Jy.

(a) (3 points) What is the effective collecting area A_e of a radio telescope whose sensitivity is 1 K/Jy?

Solution:

By definition, $A_e = W_v/S_{(matched)} = 2W_v/S$. Since we can equate incoming energy with a noise temperature, $W_v = kT_A$. Substituting $k = 1.38 \times 10^{-16} \text{ ergK}^{-1}$, $T_A = 1\text{K}$, and $S = 1 \text{ Jy}$ (i.e. $10^{-23} \text{ erg s}^{-1} \text{ cm}^{-2} \text{ Hz}^{-1}$), we get $A_e = 2kT_A/S = 2.76 \times 10^7 \text{ cm}^2$ (equivalent to a circle of radius about 29.6m).