

Answer on Question 55052, Physics / Astronomy | Astrophysics

Question:

Giant pulses from energetic pulsars have been observed with $S_{5\text{GHz}} = 10 \text{ kJy}$, but with durations of only 10 ns. The region from where a pulse of radiation originates must be no larger than the distance that light can travel during the duration of a pulse. If the pulsars are at a distance of 1 kpc, estimate the brightness temperature of these sources.

Solution:

$$S_{5\text{GHz}} = B_{5\text{GHz}} \Omega = 10 \text{ kJy} = 10^{-19} \frac{\text{ergs}}{\text{cm}^2 \times \text{s} \times \text{Hz}}$$

$$\Omega = \pi \left(\frac{r}{R} \right)^2 \frac{\text{ergs}}{\text{cm}^2 \times \text{s} \times \text{Hz}} = 2 \times 10^{-38} \text{ sr}$$

$$B_{5\text{GHz}} = \frac{2kTv^2}{c^2}$$

$$\therefore T_b = \frac{10^{-19} \times (3 \times 10^{10})^2}{2 \times (1.38 \times 10^{-16}) \times (5 \times 10^9)^2 \times (2.9 \times 10^{-38})} = 4.5 \times 10^{35} \text{ K}$$

Answer: $T_b = 4.5 \times 10^{35} \text{ K}$