**Answer on Question 55064, Physics / Astronomy | Astrophysics**

**Question:**

The Crab pulsar has a very steep radio spectral index of approximately -3 (i.e. v−3) over a frequency range from 10MHz to 10GHz. If the distance to the Crab pulsar is about 2 kpc, the measured flux density at 400MHz is 650mJy, and the spin-down luminosity (i.e. ˙E ) as derived in class is 4×1038 erg s−1, what fraction of ˙E does the radio emission account for?

**Solution:**

The distance to the Crab nebula is D = 2 kpc = $6.2\times10^{21}$ cm.

$$L_{radio} = 4\pi D^2 \int_{radio} S_{radio} dv = 4\pi(6.2\times10^{21})^2 \int_{10^7}^{10^{10}} 0.65\left(\frac{v}{4\times10^8}\right)^{-3} dv$$

$$= 2\times10^{47}\left[\frac{v^{-2}}{-2}\right]_{10^7}^{10^{10}} = 1\times10^{33} ergs\times s^{-1}$$

Therefore the fraction is:

$$\frac{L_{radio}}{E} = \frac{1\times10^{33}}{4\times10^{36}} = 2.5\times10^{-6}$$

**Answer: $2.5\times10^{-6}$ – very small**

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