Answer on Question #71096, Physics / Astronomy | Astrophysics

Question: Galaxy NGC2300 has an flat disk dominating the visible light image. Surface brightness is given by the exponential law I(R) = I0 exp(−R/Rd) where I0 is the central surface brightness, R distance from the center, and Rd = 4 kpc the exponential radial scale of the disk (e-folding distance). The total luminosity of the galaxy equals L = (2.5·10^10)L(sun)Considering that the total luminosity is surface brightness I(R) integrated over the area of the whole disk from R = 0 to R = ∞ (not over the radial distance, a mistake some people make!), compute I0 (in units of L(sun)/pc^2)

Solution:

$$L = \int_0^\infty I_o e^{-\frac{r}{r_d}} 2\pi r dr = 2\pi I_0 \int_0^\infty e^{-\frac{r}{r_d}} r dr = 2\pi I_0 r_d^2$$

$$I_0 = \frac{L}{2\pi r_d^2} = 2.5 * \frac{10^{10} L_{sun}}{3.14 * 2 * 16 * 10^6 pc^2} = 248 \frac{L_{sun}}{pc^2}$$

Answer:

$$I_0 = 248 \frac{L_{sun}}{pc^2}$$