Answer on Question #62484 - Physics - Astronomy | Astrophysics

Question:

Assume that the disk of the Milky Way has a radius of 20 kpc (20 thousand parsecs). It contains 100 billion stars, each with a radius similar to the Sun's, 6.96 x 10^{10} cm. What fraction of the galaxy's disk is covered by stars?

Solution:

First, let's express the Milky Way disk's area as $S_{MW} = \pi R_{MW}{}^2$.

Now, we express the disk's area for one star — $S_{star} = \pi R_{star}{}^2$.

Let N is the total quantity of stars. Then we can calculate the fraction (F) of the galaxy's disk covered by stars like this:

$$F = \frac{NS_{star}}{S_{MW}} = \frac{N\pi R_{star}{}^2}{\pi R_{MW}{}^2} = N\left(\frac{R_{star}}{R_{MW}}\right)^2.$$

$N = 100 \cdot 10^9 = 10^{11}$

$R_{star} = 6.96 \cdot 10^{10}$ cm $= 6.96 \cdot 10^8$ m

$R_{MW} = 20$ kpc $= 20000 \cdot 3,0857 \cdot 10^{16}$ m $= 6.1714 \cdot 10^{20}$m

$$F = 10^{11} \cdot \left(\frac{6.96 \cdot 10^8}{6.1714 \cdot 10^{20}}\right)^2 = 10^{11} \cdot (1.13 \cdot 10^{-12})^2 = 10^{11} \cdot 1.28 \cdot 10^{-24} = 1.28 \cdot 10^{-13}.$$

Answer:

$1.28 \cdot 10^{-13}$