Monday, September 21, 2020

Example 1: Event Horizon Telescope's angular resolution

Diameter = Diameter of Earth = $2 \times R_E$

$= 12.7 \times 10^3$ km

$= 12.7 \times 10^6$ m

$\lambda = 1.3$ mm $= 1.3 \times 10^6$ nm

$= 1.3 \times 10^{-3}$ m

$= 10^9$ nm

$$\theta_{min} = 1.22 \frac{\lambda}{D}$$

(λ in m; D in m)

θ_{min} in radians

or

$$\theta_{min,\ arcseconds} = 0.000252 \frac{\lambda_{nm}}{D_m}$$

$$= (0.000252)\frac{(1.3 \times 10^6 \text{ nm})}{(12.7 \times 10^6 \text{ m})}$$

$$= 0.000026''$$

mas μas

$$\Rightarrow \boxed{\theta_{min} = 26\ \mu as}$$

Example #2: Density of the Earth

Diameter = 12,756 km $\Rightarrow$ Radius = $\frac{\text{Diameter}}{2}$

$= \frac{12756}{2}$

$\Rightarrow R_E = 6,378$ km

Mass = 59.8×10^{23} Kg

Volume of Earth $\simeq$ Volume of sphere

$= \frac{4}{3}\pi R_E^3$

$= \frac{4(3.1415926)}{3}(6378)^3$

$= 1.087 \times 10^{12}$ km^3

ρ_E = Density = $\frac{\text{Mass}}{\text{Volume}} = \frac{59.8 \times 10^{23}\ \text{Kg}}{1.087 \times 10^{12}\ \text{km}^3}$

$= 5.50 \times 10^{12}$ Kg/km^3

$= 5.50 \times 10^{3}$ Kg/m^3 (SI units)

$= 5.50$ g/cm^3