Ay21: Recitation 1 (Scratch Work / "Notes") 1/7/2022

Astro Units

$$8 \text{ light-min} = c \times 8 \text{ min} \quad (\text{1 yr} \downarrow) = 3\times10^{10} \text{ cm/s} \times 8 \times 60 \text{ s}$$

$$= 1500 \times 10^{10} \text{ cm}$$

$$= 1.5 \times 10^{13} \text{ cm}$$

$$1 \text{ yr} = \pi \times 10^7 \text{ s}$$

CGS

$$M_\odot = 2 \times 10^{33} \text{ g}$$

$$L_\odot = 4\times10^{26} \text{ W} = 4 \times 10^{33} \text{ erg/s}$$

$$R_\odot =$$

$$R_{Jup} = 69\,911 \text{ km}$$

$$R_\odot = 69\,911.0 \text{ km}$$

$$R_\oplus = 6991.1 \text{ km}$$

$$T_{eff} = \left(\frac{L_\odot}{4\pi\sigma_{SB} R_\odot^2} \right)^{1/4} = 5777 \text{ K}$$

O B A F G K M L T

↑ ↑ ↑

guy/girl

$$M_\oplus = 5.67 \times 10^{27} \text{ g}$$

$$F_{grav} = F_{rad}$$

$$\frac{GMm_p}{r^2} = PA$$

$$= \frac{F_\nu}{c}\sigma_T$$

$$= \frac{L}{4\pi r^2 c}\sigma_T$$

$$\Rightarrow L_{Edd} = \frac{4\pi G M m_p c}{\sigma_T} = 10^{38}\ erg/s \left(\frac{M}{M_\odot}\right)$$

$$g = \frac{GM}{r^2} = 9.8\ m/s^2 \left(\frac{M}{M_\oplus}\right)\left(\frac{R}{R_\oplus}\right)^{-2}$$

M: 10^{26} g; R: 1.7×10^8 cm; $M_\oplus$: 10^{27}; $R_\oplus$: 6991.1 km, 6400 km

$g_{moon} = ?$

$d_{moon} \sim 0.25 \times 10^6$ mi

$\theta_{moon} \sim 0.5°$

$P_{moon} \sim 28$ days

3.1×10^{18} cm

$\theta = 1''$, 1 AU, d

$$R_{moon} \sim \frac{d_{moon}\theta_{moon}}{2}$$

$d \approx 206265$ AU

~ 1180 mi

$\sim 1.7\times10^8$ cm

$$GM_{tot} = \Omega^2 a^3$$

$$G(M_\oplus + M_{moon}) = \left(\frac{2\pi}{P}\right)^2 a^3$$

$M_\oplus$: 10^{27} g; P: 28 days; a: 0.25×10^6 mi

$g_{moon} = \frac{1}{6} g_{\oplus}$

nearest star ~ 1 pc

center ~ 8 kpc

M31 ~ 1 Mpc

Virgo cluster ~ 15 Mpc

most distant ~ 10 Gpc

Monty Python's Galaxy Song

$$AB = -2.5 \log_{10}(f_\nu) - 48.6$$

const

$$m_1 - m_2 = -2.5 \log\left(\frac{F_1}{F_2}\right)$$

F_1: erg/s/cm²/Å

$$m - M = 5 \log_{10}\left(\frac{d}{10\,pc}\right)$$

m: App, M: Abs

↳ 4.74 for ⊙

$m_g = 19 \quad \lambda = [OIII] = 5007$ Å

$f_\lambda = ?$ erg/s/cm²/Å

$$\lambda f_\lambda = \nu f_\nu$$

$m_g = 19 = -2.5 \log_{10}(f_\nu) - 48.6$ ← erg/s/cm²/Å

$f_\nu = 9 \times 10^{-28}$ cgs

$f_\nu \rightarrow f_\lambda$

$f_\lambda = \frac{\nu f_\nu}{\lambda} = \frac{c f_\lambda}{\lambda^2}$

$c = \lambda \nu$

$f_\lambda = \frac{c f_\nu}{\lambda^2}$ ($c \to 3\times10^{18}$ Å/s; λ = 5007 Å)

$f_\lambda = \frac{3\times10^{18}\ \text{Å/s}}{(5007\ \text{Å})^2}(9\times10^{-28}\ \text{erg/s/cm}^2/\text{Å})$

$\Sigma = \frac{L}{2\pi r^2} \propto (1+z)^{-4}$