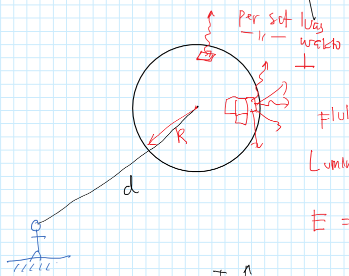
Fotometri dan Spektroskopi

Wednesday, March 27, 2019 8:19 AM

Foto metri — Foto ← chy (gel. EM); metri ← mengukur

spekro skopi — spekro ← spektrum; skopi ← melihat

- Fotometri → intensitas chy
  - Fluks pancaran
  - Intensitas spesifik → (I_λ), (I_ν)
  - Luminositas
  - Fluks

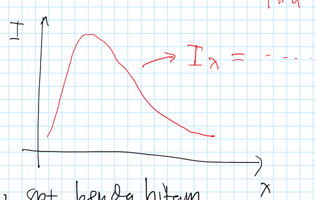


Fluks pancaran (F)

Luminositas $= F \cdot 4\pi R^2 = L$

E = fluks $= \dfrac{L}{4\pi d^2} \rightarrow \boxed{L = E \cdot 4\pi d^2}$

- Kurva Planck ← distribusi energi



Bintang berperilaku spt benda hitam.

- Hub. λ dgn T → Wien

$$\boxed{\lambda = \frac{0.2898}{T}}$$

- Energi terkuantisasi $\boxed{E = h\dfrac{c}{\lambda}}$ $\boxed{E = h\nu}$

Fluks pancaran $= \displaystyle\int_0^{2\pi} I_\lambda(\theta)\, d\theta$

Luminositas $= \int F = \boxed{F \cdot 4\pi R^2}$

Fluks $= \boxed{E = \dfrac{L}{4\pi d^2}}$

- Magnitudo $\boxed{m = -2{,}5 \log E + \text{konstanta}}$

$$\boxed{m_1 - m_2 = -2.5 \log \frac{E_1}{E_2}}$$

$d = 10$ pc

$$m_1 - m_2 = -2.5 \log \frac{\frac{L_1}{\cancel{4\pi d_1^2}}}{\frac{L_2}{\cancel{4\pi d_2^2}}}$$

$$m_1 - m_2 = 2.5 \log \frac{L_1}{L_2}$$

$$\boxed{M_1 - M_2 = -2.5 \log \frac{L_1}{L_2}}$$

modulus jarak

$$\boxed{m - M = -5 + 5 \log d}$$

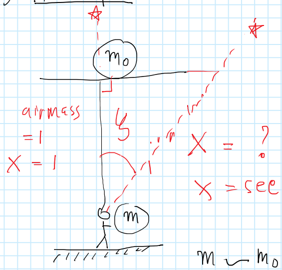
- Koreksi Bolometrik → koreksi thd m_V u/ mendapatkan mag di semua λ

Positif → $BC = m_V - m_{bol}$

negatif → $= m_{bol} - m_V$

Koreksi thd fluks
- atmosfer
- MAB

1) Atmosper



$X = ?$

$x = \sec \zeta$

$\cos \zeta = \frac{1}{X} \rightarrow X = \frac{1}{\cos \zeta}$

$= \sec \zeta$

$m \sim m_0$

$m = m_0 + \Delta m \cdot X$

$$\boxed{m = m_0 + \Delta m \cdot \sec \zeta}$$

2) MAB $\longrightarrow A_V = p \cdot E(B-V)$

$p \simeq 3.2$ u/ MAB normal

$\boxed{A_V = 3.2\, E(B-V)}$ $\boxed{E(B-V) = (B-V) - (B-V)_0}$

$$\boxed{m - M = -5 + 5 \log d + A_V}$$

$m = -2.5 \log E + c \longrightarrow m = -2.5 \log \frac{L}{4\pi d^2} + \cancel{c}$

$M = -2.5 \log \frac{L}{4\pi (10)^2} \longrightarrow M = -2.5 \log \frac{L}{4\pi (10)^2} + \cancel{c}$

$m - M = -2.5 \left(\log \frac{1}{\cancel{4\pi} d^2} - \log \frac{1}{\cancel{4\pi} (10)^2} \right)$

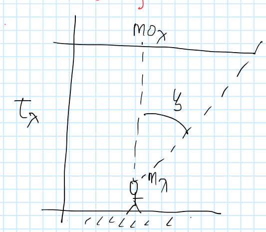
$= -2.5 \left(-2 \log d + 2 \log 10 \right)$

$= -2.5 \left(-2 \log d + 2 \right)$

$m - M = +5 \log d - 5$

$m - M = -5 + 5 \log d$

$m_\lambda - m_{0\lambda} = 1.086\, \tau_\lambda \sec \zeta$



$m_1 - \cancel{m_0} = 1.086\, \tau_\lambda \sec \zeta_1$

$m_2 - \cancel{m_0} = 1.086\, \tau_\lambda \sec \zeta_2$

$m_1 - m_2 = 1.086\, \tau_\lambda (\sec \zeta_1 - \sec \zeta_2)$

1) standar $\rightarrow$ ukur m pd ζ

$m_{std,\zeta_1} - m_{std,\zeta_2} = 1.086\, \boxed{\tau_\lambda} (\sec \zeta_1 - \sec \zeta_2)$

$$\boxed{m_\lambda - m_{0\lambda} = 1.086\, \tau_\lambda \cdot \sec \zeta}$$

Untuk mengamati magnitudo sebuah bintang program digunakan sebuah bintang standar sebagai pembanding. Dari pengamatan terhadap bintang standar ini diperoleh hasil sebagai berikut : pada waktu diamati pada jarak zenith 35^0, magnitudo semunya adalah 9,2, sedangkan pada waktu diamati pada jarak zenith 15^0, magnitudo semunya adalah 9,0. Apabila pada jarak zenith 25^0 magnitudo bintang program adalah 8,9. Tentukan magnitudo bintang program ini sebelum mengalami penyerapan oleh atmosfer Bumi.

$\zeta_1 = 35° \rightarrow m_1 = 9.2$

$\zeta_2 = 15° \rightarrow m_2 = 9.0$

$m_1 - m_2 = 1.086\, \tau_\lambda (\sec(35) - \sec(15))$

$9.2 - 9.0 = 1.086\, \tau_\lambda (\sec 35 - \sec 15)$

$\boxed{\tau_\lambda \simeq 1}$

$\zeta = 25° \rightarrow m = 8.9$

$m - m_0 = 1.086\, \tau_\lambda \cdot \sec(\zeta)$

$8.9 - m_0 = 1.086\, (1) \sec(25°)$

$m_0 = 7.78$

Dan hasil pengamatan pada sebuah bintang diperoleh magnitudo visualnya $V = 10{,}0$, dan magnitudo biru $B = 10{,}5$. Warna intrinsik untuk bintang ini adalah $(B - V)_0 = 0$ dan magnitudo mutlaknya $M_v = 0{,}8$. Apabila materi antar bintang di depan bintang ini normal tentukanlah:

a. Magnitudo intrinsiknya untuk V dan B

b. Jarak sebenarnya bintang tersebut

17. Dua bintang memiliki magnitudo +4,1 mag dan +5,6 mag. Bintang yang lebih terang memberikan 5 x 10^{-4} Watt yang dikumpulkan oleh sebuah teleskop. Berapa banyak energi yang dikumpulkan oleh sebuah teleskop dari bintang yang lebih redup?

18. Dua buah benda buatan manusia ditempatkan di angkasa luar. Yang satu, sebuah satelit yang mengorbit matahari dalam lintasan elips dengan eksentrisitas 0,5 dan jarak perihelium 80 juta km. Satelit itu dilindungi dari cahaya matahari oleh sebuah cermin besar yang memantulkan 100% cahaya yang diterimanya. Selama mengorbit, cermin tersebut selalu menghadap matahari. Benda yang lain, sebuah pengukur kuat cahaya (fotometer) tahan panas, ditempatkan di fotosfir matahari.

a. Hitung jarak aphelium orbit satelit tersebut
b. Berapa magnitudo perbedaan terang maksimum dan minimum satelit tersebut pengukuran fotometer ?

$\boxed{17}$

$m_1 = 4.1 \rightarrow E_1 = 5\times10^{-4}$ W

$m_2 = 5.6 \rightarrow E_2 = ?$

$$m_1 - m_2 = -2.5 \log \frac{E_1}{E_2} \Leftrightarrow \frac{E_1}{E_2} = 2.512^{-(m_1-m_2)}$$

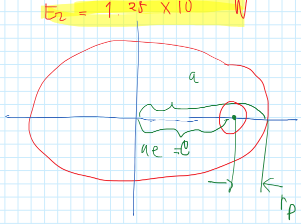
$$\frac{5\times10^{-4}}{E_2} = 2.512^{-(4.1-5.6)}$$

$$E_2 = 1.25\times10^{-4}\ W$$

$\boxed{18}$ sat orbit elips $e = 0.5$, $r_p = 80\times10^6$ km

a) r_A

b) Δm



$$r_p = a - ae = a(1-e)$$

$$a = \frac{r_p}{1-e} \rightarrow a = \frac{80\times10^6}{1-0.5}$$

$$a = 160\times10^6\ km$$

a) $r_A + r_p = 2a$

$r_A = 2a - r_p$

$= 2(160\times10^6) - 80\times10^6$ km

$= 320\times10^6 - 80\times10^6$ km

$r_A = 240\times10^6$ km

b) $\Delta m = -2.5 \log \frac{E_{max}}{E_{min}}$

$$E = \frac{L}{4\pi d^2} \longrightarrow \frac{E_{max}}{E_{min}} = \frac{\cancel{L}/\cancel{4\pi} d_{min}^2}{\cancel{L}/\cancel{4\pi} d_{max}^2}$$

asumsi : anggap sensor ada di pusat matahari (jarak dr pusat ke fotosfer <<< r_p, r_A)

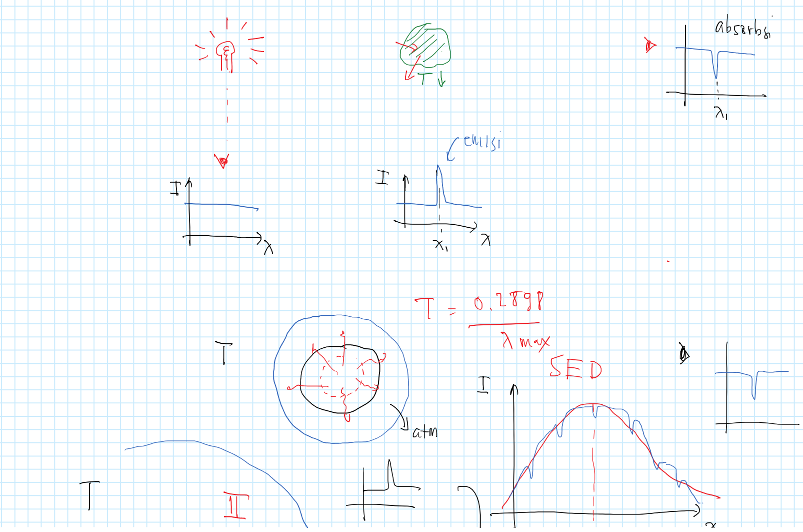
maka :

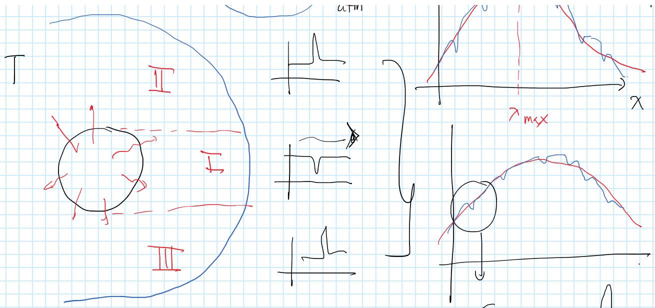
$d_{min} = r_p$, $d_{max} = r_A$ } $\frac{E_{max}}{E_{min}} = \left(\frac{r_A}{r_p}\right)^2$ dhg.

$$\Delta m = -2.5 \log \left(\frac{r_A}{r_p}\right)^2$$

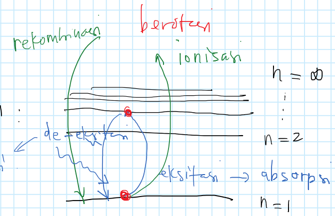
$= \ldots$

Spektroskopi . Kirchoff .





Hidrogen :



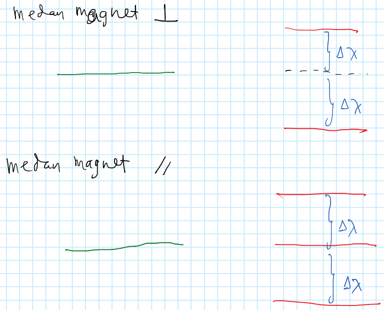
$$E_n = \frac{E_0}{n^2} \; ; n = 2, 3, \ldots$$

$$\boxed{E_n = \frac{-13.6}{n^2}} \, eV$$

Balmer $\rightarrow \frac{1}{\lambda} = R\left(\frac{1}{2^2} - \frac{1}{n^2}\right)$

Zeeman effect

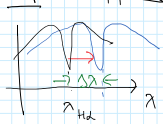
medan magnet ⊥



kuat medan magnet dlm Gauss

$$\boxed{\Delta\lambda = \frac{e H \lambda^2}{4\pi m_e c^2}}$$

Doppler Effect



$H\alpha = 6563$ Å

$$\boxed{\frac{\Delta\lambda}{\lambda_0} = \frac{V_R}{c}} \rightarrow \frac{\lambda_{obs} - \lambda_0}{\lambda_0} = \frac{V_R}{c}$$

15. Bagaimana kita membedakan gerak diri bintang (proper motion) dengan paralaksnya ? Jelaskan !

16. Panjang gelombang maksimum spektrum sebuah bintang adalah 2,898 x 10^3 Å. Berapakah temperatur bintang tersebut? Dapatkah kamu menentukan termasuk kelas apakah bintang tersebut ?

17. Dari hasil penyelidikan diketahui bahwa bintang P termasuk kelas A0 III dan bintang Q kelas A5 III. Jelaskanlah apa yang dimaksud kelas A0 V dan A5 V. Tentukan juga persamaan dan perbedaan kedua bintang tersebut dan bintang manakah yang radiusnya paling besar ? Jelaskan jawabanmu.

8. If a star is moving away from the Earth at very high speed, will the star have a continuous spectrum that appears hotter or cooler than it would if the star were at rest? Explain.

9. A quasar is observed and it is found that a line whose rest wavelength is 3000 Å is observed at 15000 Å. Estimate:
   a) How fast is the quasar receding?
   b) How far away is it if its distance is given by the Hubble relation? (The Hubble constant is H = 75 km/s/Mpc)?

$V_R = H\,d$

$d = \frac{V_R}{H} = \frac{2.77 \times 10^5 \text{ km/s}}{75 \text{ km/s/Mpc}} = 3600\text{-an MPC}$

$$\frac{\Delta\lambda}{\lambda} = \sqrt{\frac{1 + \frac{V_R}{c}}{1 - \frac{V_R}{c}}} - 1$$

$$\frac{12000}{3000} = \sqrt{\frac{1 + \frac{V_R}{c}}{1 - \frac{V_R}{c}}} - 1$$

$V_R = \frac{12}{13} c$

$\boxed{V_R = 2.77 \times 10^5 \text{ km/s}}$

58. ~~Sebuah nova diamati dengan teknik spektroskopi pada panjang gelombang diam 6563 Å teramati pada panjang gelombang 6563,49 Å. Jika diketahui gerak dirinya adalah 0",015/tahun, hitunglah sudut paralaks dari nova tersebut !~~

33. Sebuah nova diamati dengan teknik spektroskopi pada panjang gelombang diam 6563 Å teramati pada panjang gelombang 6563,49 Å. Jika diketahui gerak dirinya adalah 0",015/tahun, hitunglah sudut paralaks dari nova tersebut !

$V_R = \frac{12}{13} c$

$V_R = 2.77 \times 10^5 \ \frac{km}{s}$

34. Sebuah bintang mempunyai kecepatan radial sebesar –0,95 km/s. Deklinasi bintang ini $-13^0 41'$ dan paralaksnya 0",028. Bila gerak diri dalam arah asensiorekta dan deklinasi sebesar 0",088 / tahun dan 0",213 / tahun, hitunglah:
   a. Gerak diri bintang
   b. Kecepatan bintang
   c. Berapakah panjang gelombang yang tercatat pada pengamatan spektrum bintang ini bila dicocokkan pada panjang gelombang 4360 Å ?

Tes 1

Wednesday, March 27, 2019 4:42 PM

PELATIHAN-OSN.COM
Konsultan Olimpiade Sains Nasional
URL: http://pelatihan-osn.com
Kompleks Sawangan Permai Blok A5 No.12A,
Sawangan, Depok 16511
Telp. 021-2951 1160
CP : 0-878787-1-8585 / 0813-8691-2130

Pelatihan Akbar Jelang OSP 2019

Bidang Studi : Astronomi
Tanggal : 27 Maret 2019
Materi : AsDas, Fotometri, Spektroskopi

1. There are two photos of the Moon taken by the same camera mounted on the same telescope (telescope is placed on the Earth). The first photo has been made while the Moon was near its perigee and the second one near the apogee. Find the value of the Moon's orbit eccentricity.

2. The Ring Nebulae (M57) is located 2700 lightyear from Earth. It has an angular diameter of 1.4 × 1.0 arcmin and is expanding at the rate of 20 km/s. How long ago did the central star shed its layers?

3. Star X has a parallax of 0.2" and angular diameter of 2.67 × 10^{-3}". This star emit its energy at peak wavelength of 3864 Å. Calculate its absolute magnitude. Hint: look for our Sun's parameters in the constants table to help you.

4. There are 250 million stars in the elliptical galaxy M32. Apparent magnitude of this galaxy is 9. If luminosities of all stars are equal, calculate apparent magnitude of **one star** in this galaxy.

5. We observe two stars, A and B. Star A is dimmed because it is behind a dust cloud whereas we have a clear view of star B. Star A is observed to have 8 times the flux of star B does.

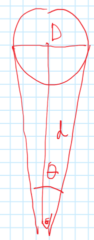
   (a) We observe a parallax of 0.1" for star A and 0.05" for star B. What is the ratio of $\frac{d_A}{d_B}$ of the distances to the two stars?

   (b) Suppose we are able to determine that both stars have the same exact diameter, but that star A has a surface temperature twice that star B. What is the ratio of $\frac{L_A}{L_B}$.

1

1

$$\left.\begin{aligned} D_p &= 5 \text{ cm} \\ D_A &= 4.2 \text{ cm} \end{aligned}\right\}$$



$w/\ \theta \ll \rightarrow \tan\theta \simeq \theta$

$$\theta = \frac{D}{d}$$

$$\frac{\theta_p}{\theta_A} = \frac{\frac{\cancel{D}}{d_p}}{\frac{\cancel{D}}{d_A}}$$

$$\frac{\theta_p}{\theta_A} = \frac{d_A}{d_p} = \frac{5}{4.2}$$

$$\frac{\cancel{a}(1+e)}{\cancel{a}(1-e)} = \frac{5}{4.2}$$

$$4.2 + 4.2e = 5 - 5e$$

$$9.2e = 0.8$$

$$\boxed{e = 0.09}$$

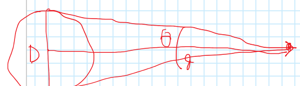
2

$d = 2700$ ly

$\theta = 1.4 \times 1$ arcmin

$V_R = 20$ km/s

$\Delta t = ?$



assume that this nebulae is concentric

→ pick the biggest ang. diameter for initial value of Δt ↳ $\theta = 1.4$ arcmin

$\theta \ll \rightarrow \tan\theta \simeq \theta$

$$\underset{\text{rad}}{\theta} = \frac{D}{d} \Rightarrow \underset{\text{arcsec}}{\theta} = \frac{D}{d} \times 206265$$

$$D = \frac{\theta \cdot d}{206265} \text{ ly} \rightarrow D = \frac{(84)\cdot(2700)}{206265} \text{ ly}$$

$$D = 1.1 \text{ ly}$$

$$R = 0.55 \text{ ly}$$

$$= 0.55 \times 365.25 \times 24 \times 3600 \times 3\times10^5 \text{ km}$$

$$\Delta t = \frac{R}{V_R} \leftarrow R = 5.2 \times 10^{12} \text{ km}$$

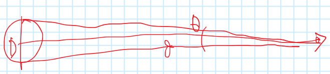
$$= \frac{5.2 \times 10^{12}}{20} \text{ s}$$

$$\Delta t \simeq 8250 \text{ tahun}$$

3 bintang X $\rightarrow$
$$\left.\begin{aligned} p &= 0.2'' \\ \theta &= 2.67 \times 10^{-3}\ '' \\ \lambda_{peak} &= 3864 \text{ Å} \end{aligned}\right\} M = ?$$

$$d = \frac{1}{p} \text{ pc} \Rightarrow d = \frac{1}{0.2} \text{ pc}$$

$$d = 5 \text{ pc}$$



$\theta \ll \rightarrow \tan\theta \simeq \theta$

$$\underset{\text{rad}}{\theta} = \frac{D}{d}$$

$$\underset{\text{arcsec}}{\theta} = \frac{D}{d} \times 206265$$

$$D = \frac{\theta \cdot d}{206265} \text{ pc}$$

$$= \frac{2.67 \times 10^{-3} \cdot 5}{206265} \text{ pc} \Rightarrow D \simeq 6.47 \times 10^{-8} \text{ pc}$$

$$D \simeq 2 \times 10^9 \text{ m}$$

$$\boxed{R = 1 \times 10^9 \text{ m}}$$

$$M - M_\odot = -2.5 \log \frac{L}{L_\odot}$$

$$L = 4\pi R^2 \sigma T^4$$

$$T = \frac{0.2898}{\lambda} = \frac{0.2898}{3864 \times 10^{-8}} \quad \boxed{\approx 7500 \text{ K}}$$

$$L = 4\pi R^2 \sigma T^4$$

$$= 4\pi (10^9)^2 (5.67\times10^{-8})(7500)^4$$

$$L = 2.25 \times 10^{27} \text{ W}$$

$$M - M_\odot = -2.5 \log \frac{L}{L_\odot} \Rightarrow M - 4.79 = -2.5 \log\left(\frac{2.25\times10^{27}}{3.9\times10^{26}}\right)$$

$$M = 2.89$$

i

4 M32 $\rightarrow N = 250 \times 10^6$

$m_{TOT} = 9 \longrightarrow E_{TOT} = E_1 \cdot N$

$m_1 = ?$ $\qquad = 250 \times 10^6\ E_1$

$$\frac{E_{TOT}}{E_1} = 250 \times 10^6$$

$$\frac{E_{TOT}}{E_1} = 2.512^{-(m_{TOT} - m_1)}$$

$$-(9 - m_1)$$

$m_1 = ?$ $= 250 \times 10^{6}\ E_1$

$$\frac{E_{TOT}}{E_1} = 2.512^{-(m_{TOT} - m_1)}$$

$$250 \times 10^6 = 2.512^{-(9 - m_1)} \Longrightarrow m_1 \approx 30$$

$\boxed{5}$. A & B $\rightarrow$ btg A absolute MAD, B clear $\Big\}$ $E_A = 8 E_B$

(a) $p = \frac{1}{d} \rightarrow \frac{d_A}{d_B} = \frac{p_B}{p_A} = \frac{0.05}{0.1} = 0.5$

b) $\left.\begin{aligned} R_A &= R_B \\ T_A &= 2 T_B \end{aligned}\right\}$ $\frac{L_A}{L_B} = \frac{\cancel{4\pi R_A^2} \cdot \cancel{\sigma} T_A^4}{\cancel{4\pi R_B^2}\ \cancel{\sigma} T_B^4}$

$$= \left(\frac{T_A}{T_B}\right)^4$$

$$\frac{L_A}{L_B} = \left(\frac{2\cancel{T_B}}{\cancel{T_B}}\right)^4 = 16$$

c) $\frac{E_{A\,true}}{E_{A\,obs}} = ?$ $E_A\big|_{obs} = 8\, E_B\big|_{obs}$ $\frac{E_{A\,true}}{E_{A\,obs}} = \frac{64}{8} = 8$

$$E_{A\,true} = ?\ E_B\big|_{true}$$

$$\frac{E_A}{E_B}\bigg|_{true} = \frac{\frac{L_A}{\cancel{4\pi} d_A^2}}{\frac{L_B}{\cancel{4\pi} d_B^2}} = \frac{L_A}{L_B} \cdot \left(\frac{d_B}{d_A}\right)^2$$

$$= 16\ (2)^2$$

$$\frac{E_A}{E_B}\bigg|_{true} = 64$$

$\boxed{6}$. $m = 7.66$

$p = 0.26''$

$V_R = 50$ km/s

$d = \frac{1}{p} = \frac{1}{0.26}$

a) Redshift, z

$$\frac{\Delta\lambda}{\lambda} = z = \frac{V_R}{c}$$

$$= \frac{50}{3 \times 10^5} = 1.67 \times 10^{-4}$$

b) $A_V = 1$

$$m - M = -5 + 5 \log d + A_V$$

$$7.66 - M = -5 + 5 \log\left(\frac{1}{0.26}\right) + 1$$

$$M = 8.73$$

c) $\frac{L}{L_\odot} = 2.512^{-(M - M_\odot)}$

$$= 2.512^{-(8.73 - 4.79)}$$

$$= 0.03 \rightarrow L = 0.03\, L_\odot$$

Astronomi posisi (lanjut)

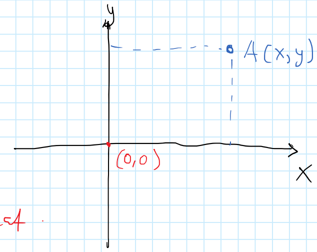
Thursday, March 28, 2019 8:04 AM

S. koordinat
- acuan
- pasangan koord.

- Geografi } pengamat

- Horizon
- Equatorial < I, II
- Ekliptika
- Galaktik

} posisi benda Langit

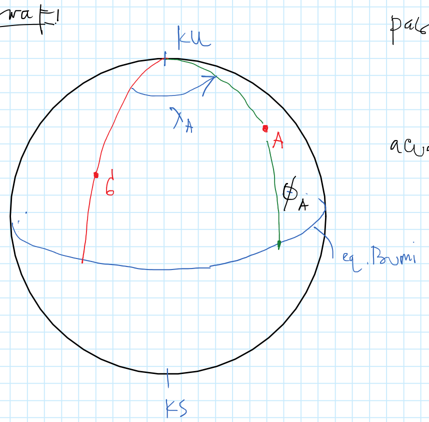


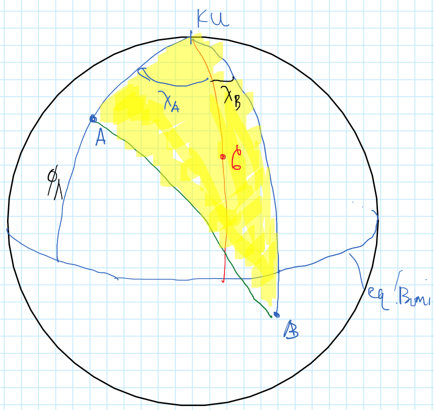
I) Geografi

pasangan : λ , ϕ

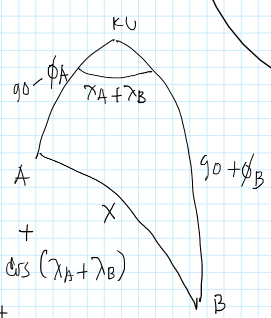
bujur (λ), lintang (ϕ) ← eq. Bumi

acuan : Greenwich





Tentukan jarak antara kota A (bujur=50 W, lintang=50 N) ke kota B (bujur=20 E, lintang=10 S)



$$\cos X = \cos(90-\phi_A)\cos(90+\phi_B) + \sin(90-\phi_A)\sin(90+\phi_B)\cos(\lambda_A+\lambda_B)$$

$$= \cos(90-50)\cos(90+10) + \sin(90-50)\sin(90+10)\cos(50+20)$$

$$X = 85^\circ\ 12'\ 40.1''$$

Dlm km → $\boxed{1' = 1 \text{ mil laut} = 1.82 \text{ km}}$

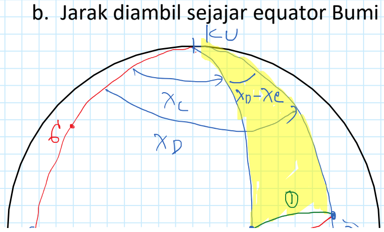
$$X = 85^\circ\ 12'\ 40.1'' \times 60'$$

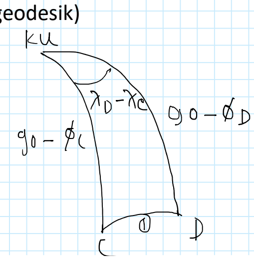
$$= 5112.67' = 5112.67 \text{ mil laut} = 9305. \text{ km}$$

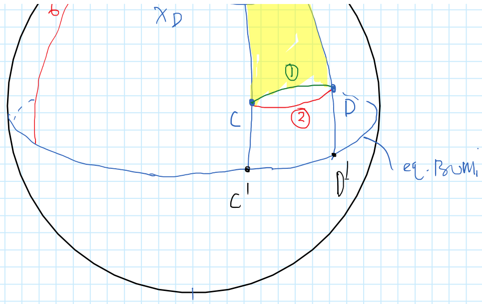
Tentukan jarak kota C dan D yang dua-duanya memiliki lintang 30 N, dan bujur masing-masing adalah 100 E dan 145 E apabila:

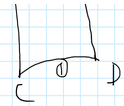
a. Jarak diambil melewati lingkaran besar (geodesik)
b. Jarak diambil sejajar equator Bumi

$$\phi_C = \phi_D = \phi = 30^\circ N$$







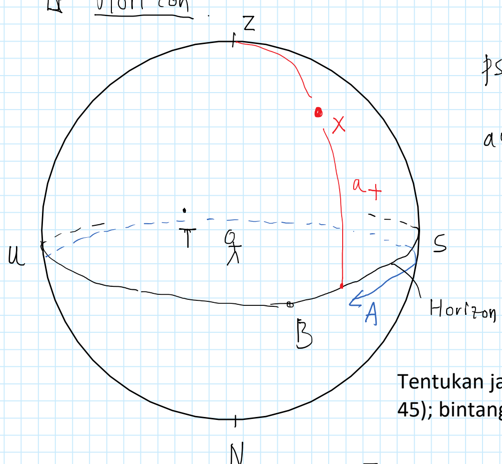


$$\cos CD = \cos(90-\phi)\cos(90-\phi) + \sin(90-\phi)\sin(90-\phi)\cos(\lambda_D-\lambda_C)$$
$$= \cos(60)\cos(60) + \sin(60)\sin(60)\cos(45)$$

a) $CD = 4227.09$ km

b) $CD = C'D' \cos\phi$
$$= (\lambda_D - \lambda_C)\cos\phi$$
$$= 45 \cdot \cos(30)$$
$$CD = 4255.65 \text{ km}$$

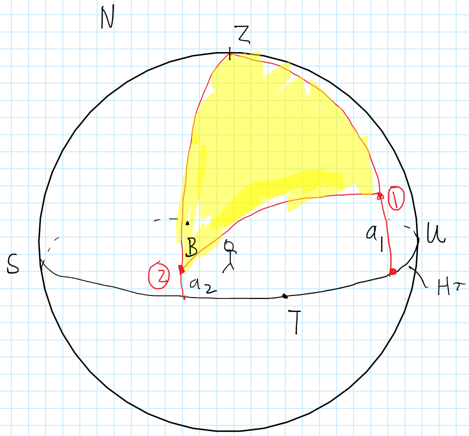
Horizon

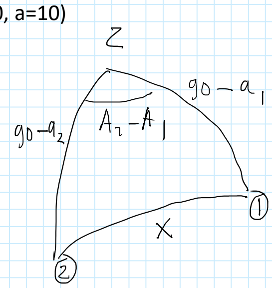


psgn koord : A , a

acuan : Utara timur → Horizon

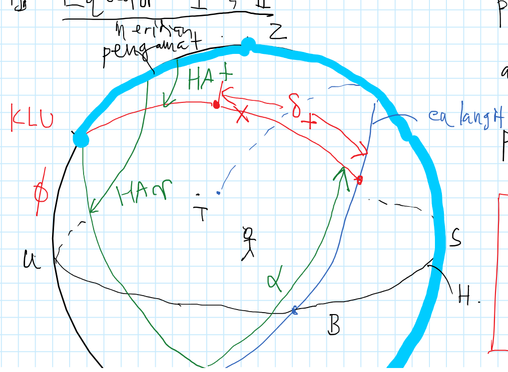
Tentukan jarak sudut 2 bintang yg memiliki koord: bintang 1 (A = 30, a = 45); bintang 2 (A=120, a=10)





$$\cos X = \cos(90-a_1)\cos(90-a_2) + \sin(90-a_1)\sin(90-a_2)\cos(A_2-A_1)$$
$$= \cos(45)\cos(80) + \sin(45)\sin(80)\cos(90)$$
$$X = 82^\circ 56' 49.12''$$

Equator I & II



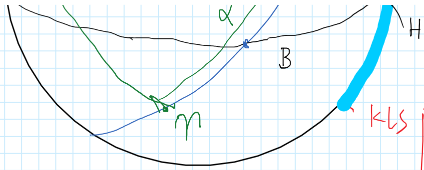
	I	II
Psgn koord :	HA , δ	α , δ
acuan :	meridian pengamat	titik γ

bid. eq.

posisi pengamat (ϕ) → Utara

$$\boxed{HA_\gamma = HA_x + \alpha_x}$$

HA_γ ← LST



LST

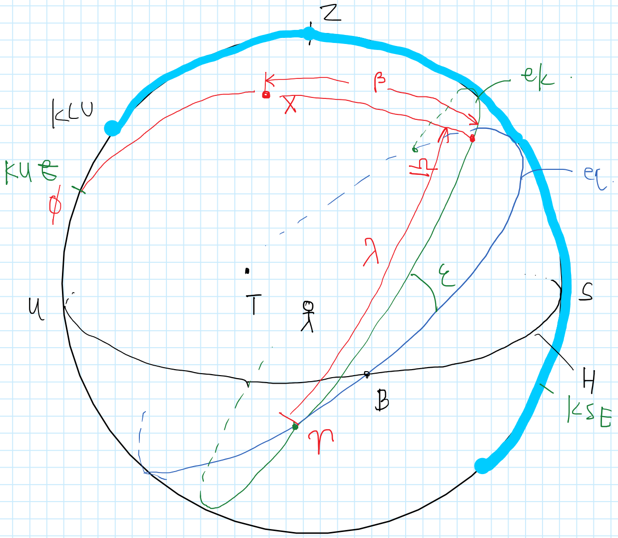
$$\boxed{LST \simeq t + \Delta N \times 4^m}$$

selisih hari dr 23/9

Hitung LST hari ini, 28 Maret 2019 pukul 09:37 WIB

$$LST \simeq t + \Delta N \times 4^m$$
$$= 9^h 37^m + 187 \times 4^m$$
$$\boxed{LST = 22^h 5^m} \rightarrow HA_{\gamma} = 22^h 5^m$$
$$\boxed{LST_{S/W} = 22^h 12^m}$$

Ekliptika



psgn. koord. : λ , β

acuan : titik γ , bid. ekliptika

$$\boxed{\varepsilon = 23^\circ 27'}$$

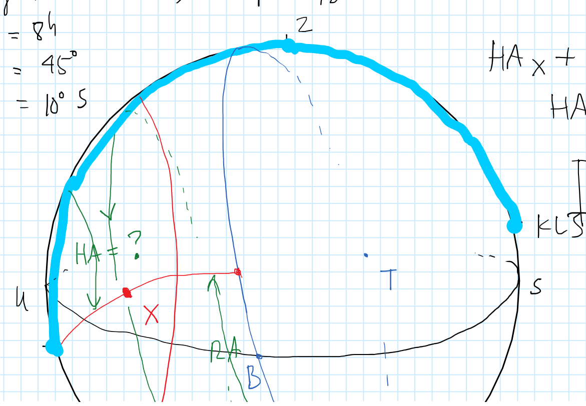
1. Tentukan HA sebuah obyek langit (RA=8h, dec=+45) jika dilihat oleh pengamat pada lintang 10 S, pada tanggal 21 Maret tengah malam.
2. Gambarkan orientasi bidang ekliptika relatif terhadap bidang equator langit untuk pengamat di lintang 30 N untuk hari ini pukul 10:30 waktu lokal
3. Perkirakan bujur ekliptika dan lintang ekliptika Matahari hari ini. (hint: cari dulu RA dan DEC Matahari dari perhitungan)

1. 21 Maret tengah malam $\rightarrow HA_{\gamma} = 12^h$

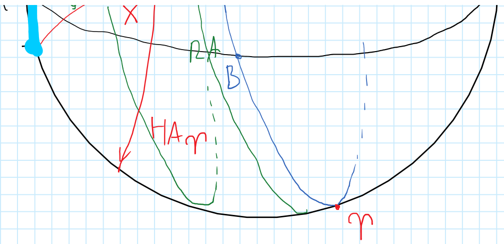
$RA = 8^h$

$\delta = 45^\circ$

$\phi = 10^\circ$ S

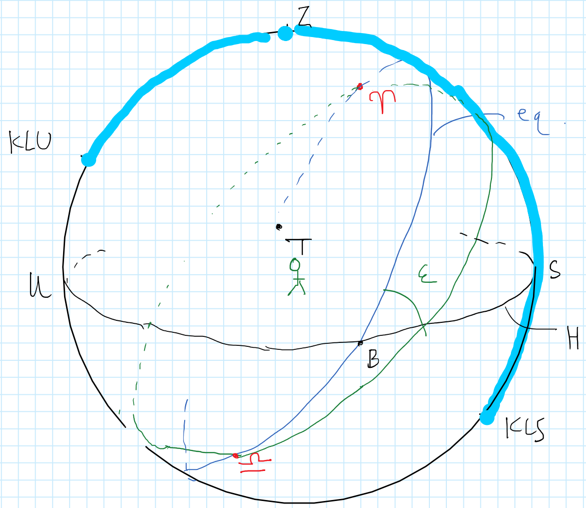


$$HA_X + RA_X = HA_{\gamma}$$
$$HA_X = HA_{\gamma} - RA_X$$
$$= 12^h - 8^h$$
$$\boxed{HA_X = 4^h}$$



2\. $\phi = 30^\circ$ N

28 Maret pukul 10 : 30 LT



$$LST = HA_{♈} \cong t + \Delta N \times 4^m$$
$$= 10^h 30^m + 187 \times 4^m$$
$$= 22^h 58^m$$

3\. tgl 28 Maret $\longrightarrow \left.\begin{array}{l} RA_\odot \\ \delta_\odot \end{array}\right\}$?

$-\varepsilon$

$$\frac{RA_\odot}{hari} = \frac{24^h}{365.25} \longrightarrow \boxed{RA_t = \Delta D \times \frac{RA_\odot}{hari}}$$

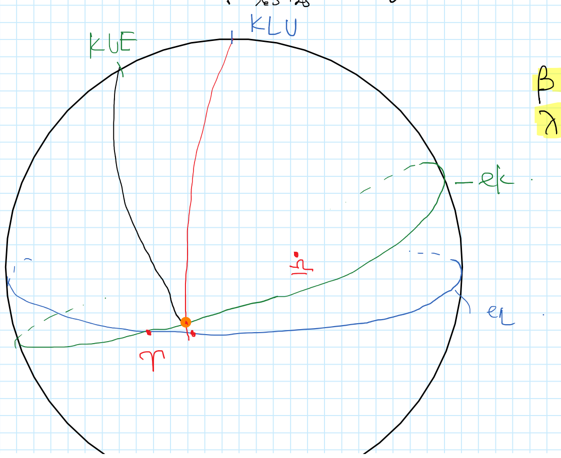
ΔD ↑ 21/3

$$\boxed{\delta_{\odot,t} \cong 23^\circ 27' \sin\left(\frac{\Delta D}{365.25} \times 360^\circ\right)}$$

u/ 28 Maret

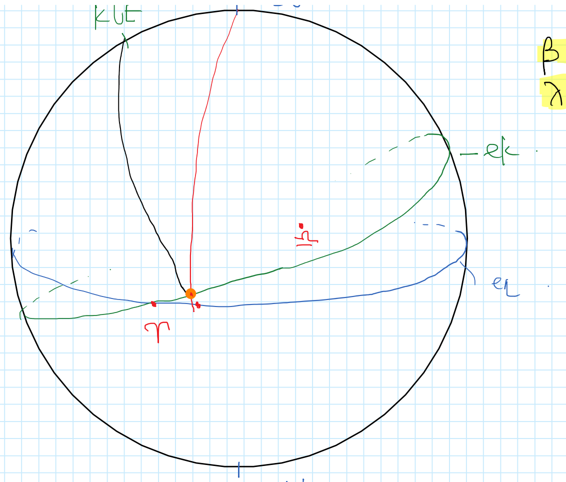
$$RA_\odot = 7 \times \frac{24^h}{365.25} = 0^h 27^m 36^s$$

$$\delta_\odot = 23^\circ 27' \sin\left(\frac{7}{365.25} \times 360^\circ\right) = 2^\circ 49'$$



$\beta = 0^\circ$

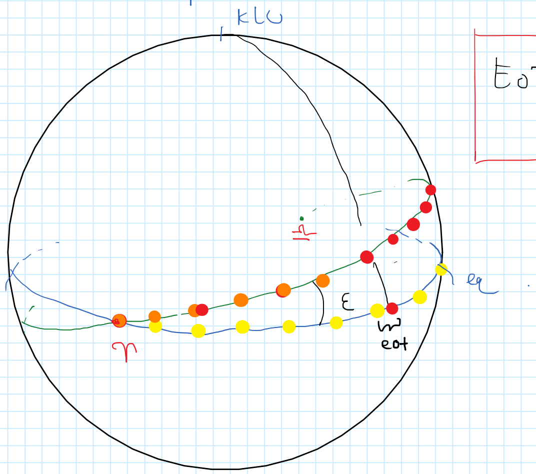
$$\lambda = \Delta D \times \frac{360^\circ}{365.25}$$
$$= 7 \times \frac{360^\circ}{365.25} = 6^\circ 54'$$



$\beta = 0^\circ$

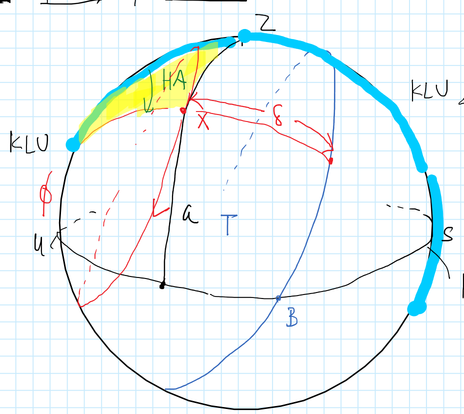
$\lambda = \Delta D \times \dfrac{360^\circ}{365.25}$

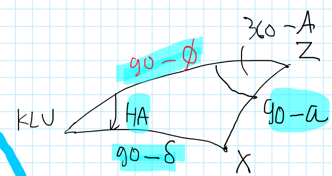
$= 7 \times \dfrac{360^\circ}{365.25} = 6^\circ 54'$



$$\boxed{\begin{aligned} EoT &= RA_{MS} - RA_{\odot} \\ &= HA_{\odot} - HA_{MS} \end{aligned}}$$

terbit & terbenam





$\cos(90-a) = \cos(90-\phi)\cos(90-\delta) + \sin(90-\phi)\sin(90-\delta)\cos HA$

H. terbit/terbenam → $a = 0$

$\underbrace{\cos 90}_{0} = \sin\phi \sin\delta + \cos\phi \cos\delta \cos HA$

$0 = \sin\phi \sin\delta + \cos\phi\cos\delta\cos HA$

$\cos HA = -\dfrac{\sin\phi \sin\delta}{\cos\phi \cos\delta}$

$$\boxed{\cos HA = -\tan\phi \tan\delta}$$

$\left.\begin{aligned} \phi &= 7^\circ \text{ LS} \\ \delta &= +2^\circ\ 49' \end{aligned}\right\}$ $\cos HA = -\tan\phi \tan\delta$

$= -\tan(-7^\circ)\tan(+2^\circ 49')$

$HA = 89^\circ\ 39'\ 19''$

$= 5^h\ 58^m\ 37^s$

Lamanya siang = 2 HA

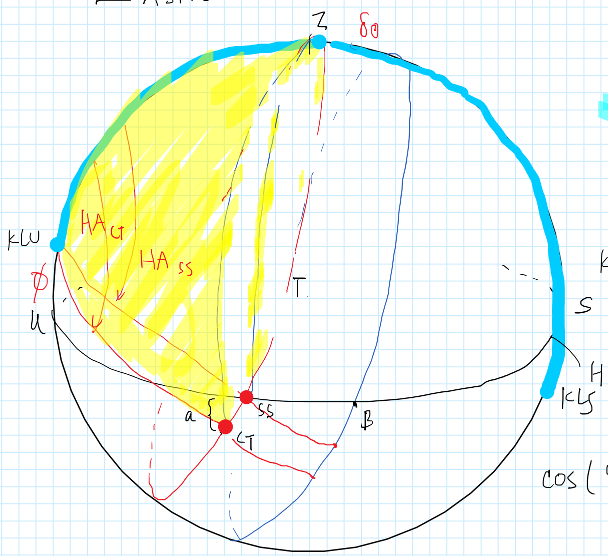
$= 5^h\, 58^m\, 37^s$

Lamanya siang $= 2\,HA$

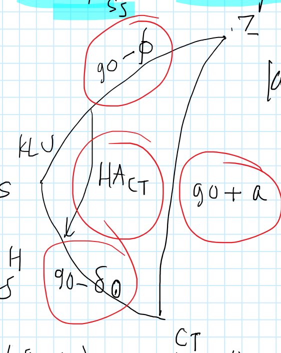
$= 11^h\, 57^m\, 14^s$

Twilight (fajar/senja)

- civil : pusat ⊙ ⇒ $a = -6^\circ$
- nautical : $a = -12^\circ$
- Astronomical : $a = -18^\circ$



$\cos HA_{SS} = -\tan\phi \tan\delta \rightarrow HA_{SS} = \ldots$



$\cos(90+a) = \cos(90-\phi)\cos(90-\delta_\odot) + \sin(90-\phi)\sin(90-\delta_\odot)\cos HA_{CT}$

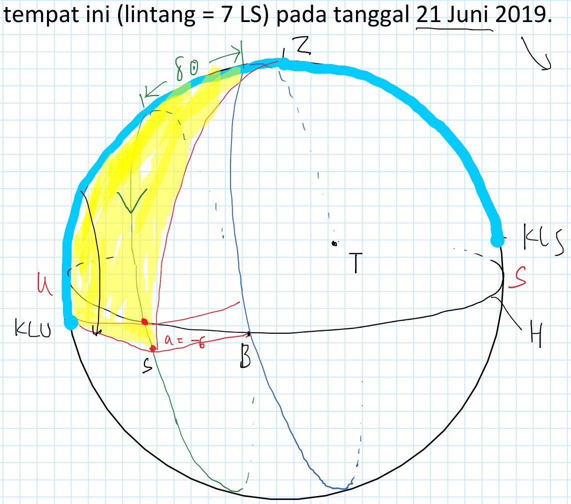
$-\sin a = \sin\phi \sin\delta_\odot + \cos\phi\cos\delta_\odot \cos HA_{CT}$

$\cos HA_{CT} = \dfrac{-\sin a - \sin\phi\sin\delta_\odot}{\cos\phi\cos\delta_\odot} \rightarrow HA_{CT} = \ldots$

$\boxed{\Delta t = HA_{CT} - HA_{SS}}$

Tentukan durasi waktu dari sunset sampai civil twilight untuk tempat ini (lintang = 7 LS) pada tanggal 21 Juni 2019.

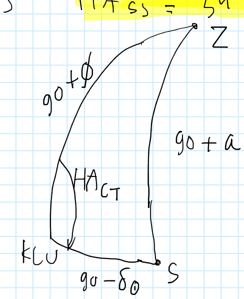
$\delta_\odot = +23^\circ 27'$



$\cos HA_{SS} = -\tan\phi\tan\delta_\odot$

$= -\tan(-7^\circ)\tan(+23^\circ 27')$

$HA_{SS} = 5^h\, 47^m\, 47^s$



$\cos(90+a) = \cos(90+\phi)\cos(90-\delta_\odot) + \sin(90+\phi)\sin(90-\delta_\odot)\cos HA_{CT}$

$-\sin a = -\sin\phi\cdot\sin\delta_\odot + \cos\phi\cdot\cos\delta_\odot\cos HA_{CT}$

$\cos HA_{CT} = \dfrac{-\sin a + \sin\phi\sin\delta_\odot}{\cos\phi\cos\delta_\odot}$

$= \dfrac{-\sin(+6^\circ) + \sin(+7^\circ)\sin(23^\circ 27')}{\cos(+7^\circ)\cos(23^\circ 27')}$

$HA_{CT} = 6^h\, 14^m\, 7^s$

$\Delta t = HA_{CT} - HA_{SS}$

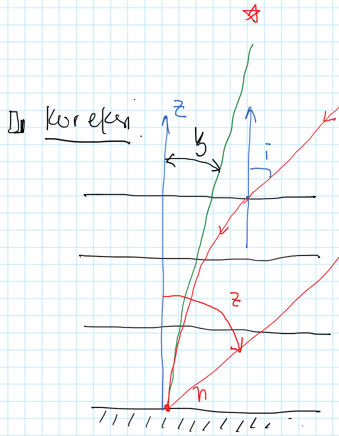
$= 6^h\, 14^m\, 7^s - 5^h\, 47^m\, 47^s$

$\Delta t = 0^h\, 26^m\, 20^s$

$= 6^h 14^m 7^s - 5^h 47^m 47^s$

$\Delta t = 0^h 26^m 20^s$

Koreksi



$\boxed{R = z - y} \rightarrow z = R + y$

sudut refraksi

$n = \dfrac{\sin(i)}{\sin y} \rightarrow \sin i = n \cdot \sin y$

$\sin z = n \cdot \sin y$

$\sin(R + y) = n \cdot \sin y$

$\sin R \cdot \cos y + \cos R \cdot \sin y = n \sin y$

krn $R \ll \rightarrow \sin R \simeq R$
$\cos R \simeq 1$

$R \cos y + \sin y = n \sin y$

$R \cos y = (n-1) \sin y$

R dlm arcsec $\rightarrow R \cos y = 206\,265\,(n-1) \sin y$

$R = \underbrace{206\,265(n-1)}_{k} \tan y$

$\boxed{R = k \tan y}$

$k = 60.3''$ (u/ atm $p = 760$ mm, $t = 0°C$)

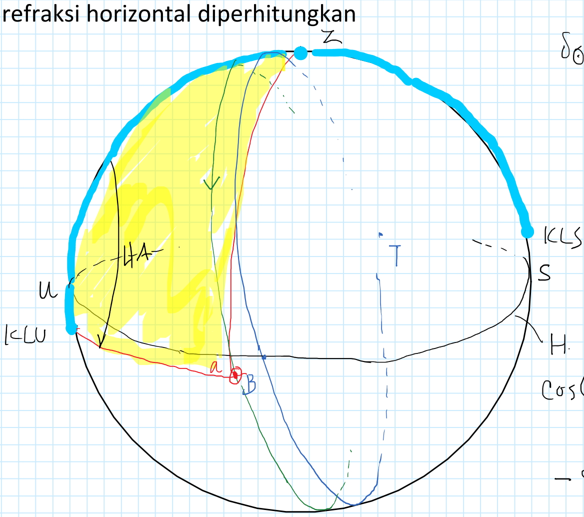
$\boxed{z = R + y}$

valid u/ $y \leq 45°$
good approx $y \leq 70°$

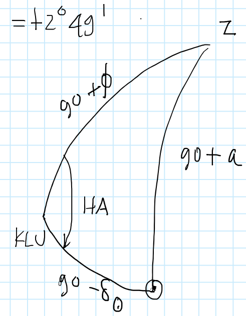
Refraksi Horizontal

$\rightarrow a = 0° \Rightarrow 35'21''$

Tentukan panjang hari ini di lokasi ini (lintang 7 LS) kalau refraksi horizontal diperhitungkan



$\delta_\odot = +2°49'$



$\cos(90+a) = \cos(90+\phi)\cos(90-\delta_\odot) + \sin(90+\phi)\sin(90-\delta_\odot)\cos HA$

$-\sin a = -\sin\phi \cdot \sin\delta_\odot + (+\cos\phi)\cos\delta_\odot \cos HA$

$\cos HA = \dfrac{-\sin a + \sin\phi \sin\delta_\odot}{\cos\phi \cos\delta_\odot}$

$$= \frac{-\sin(0^\circ 35' 21'') + \sin(7^\circ)\sin(2^\circ 49')}{\cos(7^\circ)\cos(2^\circ 49')}$$

$$HA = 6^h\ 1^m$$

$\therefore$ panjang hari $= 2HA = 12^h\ 2^m$ } $\approx 5^m$

$\hookrightarrow$ tanpa refraksi Hz $\longrightarrow 11^h\ 57^m$

Tes 2

Thursday, March 28, 2019 4:51 PM

1. Find the Zone Time on February 3rd when Procyon ($\alpha = 7^h36^m10^s$) crosses the meridian of Ottawa ($\lambda = 75°43'$ W), given that at UT 0^h February 3rd, the Greenwich Sidereal Time is $8^h48^m8^s$. The zone is $\cancel{+}5$.

3 Feb → Procyon ($RA = 7^h36^m10^s$)

Ottawa ($\lambda = 75°43'$ W) → UT − 5

Greenwich : $UT = 0^h$ → $LST_{Greenwich} = GST = 8^h48^m8^s$

Procyon melewati meridian Greenwich pada GST ?

$$LST = HA_p + RA_p \rightarrow GST = HA_p + RA_p$$

di meridian → $HA_p = 0$ → $GST = RA_p = 7^h36^m10^s$

$\Delta t|_{surya}$ $\begin{cases} UT = 0^h \rightarrow GST = 8^h48^m8^s \\ UT_p = ? \quad GST_p = 7^h36^m10^s \end{cases}$ $\Delta t|_{sideris}$

$$\Delta t|_{sid} = \Delta t_{surya}\left[1 - \frac{4^m}{24^h}\right] \rightarrow \Delta t_{surya} = \frac{\Delta t_{sid}}{\left[1 - \frac{4^m}{24^h}\right]} = \frac{1^h11^m58^s}{\left[1 - \frac{4^m}{24^h}\right]}$$

$$\Delta t_{surya} = 1^h12^m10^s$$

∴ waktu transit Procyon di Greenwich $= 0^h - 1^h12^m10^s$

$= 22^h47^m50^s$ UT

Saat kejadian di atas, di Ottawa baru pukul : $22^h47^m50^s - 5^h$

$= 17^h47^m50^s$ ZT_{Ottawa}

∴ Procyon transit di atas Ottawa $= 17^h47^m50^s + 5^h$ ZT_{Ottawa}

$= 22^h47^m50^s$ ZT_{Ottawa}

2. Pada tengah hari lokal suatu tanggal, waktu sideris lokal adalah 14^h. Tentukan waktu sideris lokal pada tengah hari lokal di tempat itu 50 hari kemudian. Ambil panjang tahun tropis sebesar 365.25 hari.

t_0 ⇒ $LST = 14^h$

$t_0 + 50$ → $LST = ?$

dlm 50 hari surya ⇒ $50 \times 4^m = \underbrace{3^h20^m}_{\Delta t|_{sideris}}$

$$LST_{t_0+80} = LST_{t_0} + 3^h 20^m$$
$$= 14^h + 3^h 20^m$$
$$= 17^h 20^m$$

3. Paralaks dua bintang diketahui sebesar 0.074 dan 0.047 detik busur. Jika kedua bintang ini memiliki RA yang sama, dan deklinasi masing–masing adalah $\underbrace{62°}_{1}$ N dan $\underbrace{56°}_{2}$ N:

   (a) Sketsakan persoalan di atas dalam bola langit

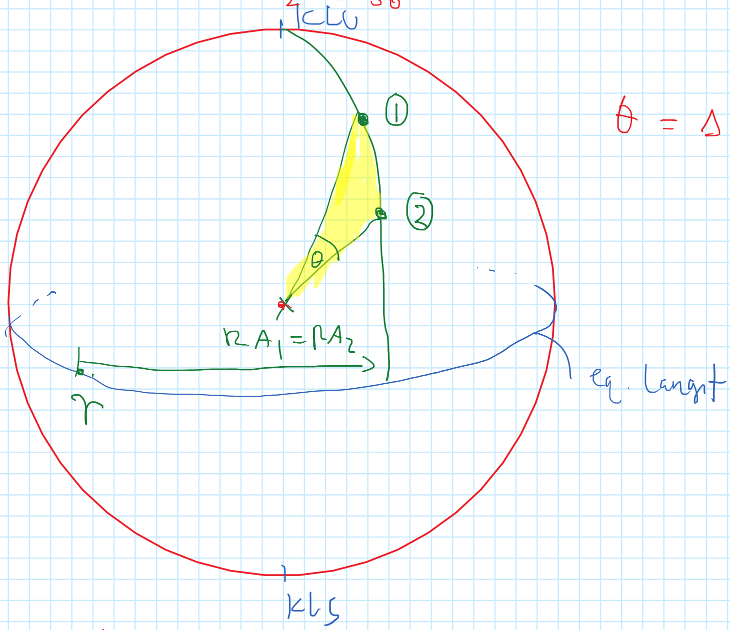
   (b) Hitung jarak kedua bintang ini dari Matahari, dan jarak antara keduanya, dalam satuan parsek (pc)

$p_1 = 0.074''$ | $RA_1 = RA_2$

$p_2 = 0.047''$ | $\delta_1 = 62°$

$\delta_2 = 56°$

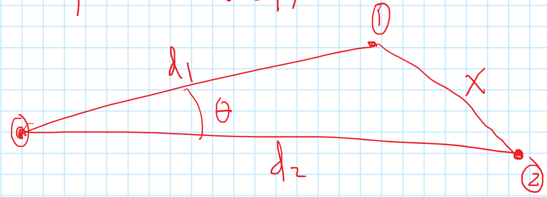
a)



$\theta = \Delta\delta = \delta_1 - \delta_2$
$= 62° - 56°$
$\theta = 6°$

b) $d_1 = \frac{1}{p_1} \rightarrow \frac{1}{0.074} = 13.51$ pc

$d_2 = \frac{1}{p_2} \rightarrow \frac{1}{0.047} = 21.28$ pc



aturan cos Δ datar

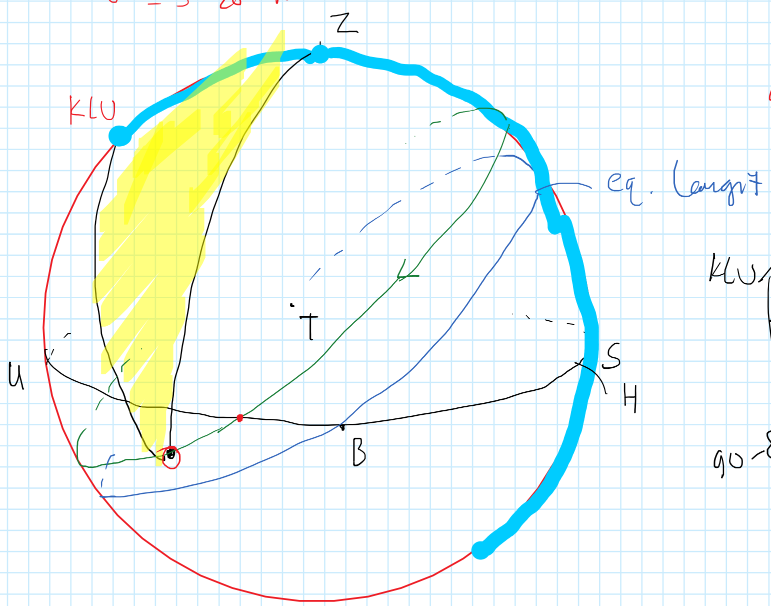
$x^2 = d_1^2 + d_2^2 - 2 d_1 d_2 \cos\theta$
$= (13.51)^2 + (21.28)^2 - 2 \cdot 13.51 \cdot 21.28 \cos(6°)$
$x = 7.97$ pc

4. Calculate the duration of evening astronomical twilight for a place in latitude 50° N when the Sun's declination is 5°20′ N.

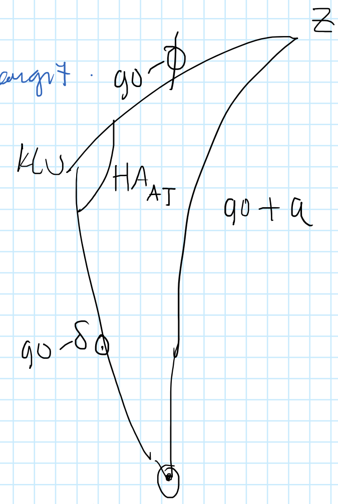
$\phi = 50°$ N
$\delta_\odot = 5°20'$ N

Z

$\delta_\odot = 5^\circ 20'$ N



$a = -18^\circ$



$$\cos(90+a) = \cos(90-\phi)\cos(90-\delta_\odot) + \sin(90-\phi)\sin(90-\delta_\odot)\cos HA_{AT}$$

$$-\sin a = \sin\phi \sin\delta_\odot + \cos\phi\cos\delta_\odot \cos HA_{AT}$$

$$\cos HA_{AT} = \frac{-\sin a - \sin\phi\sin\delta_\odot}{\cos\phi\cos\delta_\odot}$$

$$= \frac{-\sin(18) - \sin(50)\sin(5^\circ 20')}{\cos(50)\cos(5^\circ 20')}$$

$$HA_{AT} = 8^h 25^m 48^s$$

$$\cos HA_{SS} = -\tan\phi\tan\delta$$

$$= -\tan(50)\tan(5^\circ 20') =$$

$$HA_{SS} = 6^h 28^m 33^s$$

$$\boxed{\Delta t = 2^h 0^m 15^s}$$