Homework # 1 Solutions

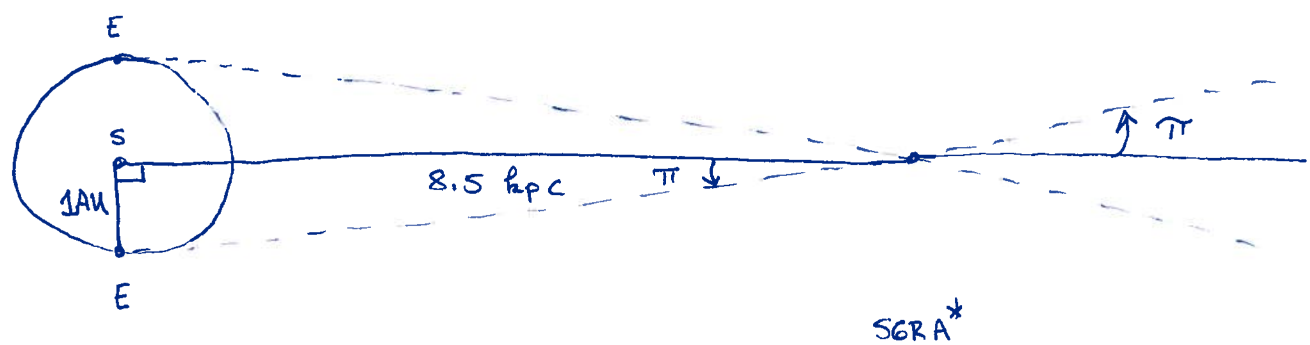
(1.) $F = ma$ and also $F = -\dfrac{GMm}{r^2}$

So $\cancel{m}a = -\dfrac{GM\cancel{m}}{r^2}$

In terms of units then $\dfrac{cm}{s^2} = \dfrac{[G]\,g}{cm^2}$

$$[G] = \frac{cm^3}{g \cdot s^2}$$

(2.)



Method 1 : $\tan \pi = \dfrac{1\ AU}{8.5\ kpc} = \dfrac{1.496 \times 10^{13}\ cm}{8500 \times 3.086 \times 10^{18}\ cm} = 5.703 \times 10^{-10}$

$\Rightarrow \pi = 5.703 \times 10^{-10}$ radian $\times \dfrac{206265''}{1\ \text{radian}} = 1.176 \times 10^{-4}\ ''$

$\pi = 117.6\ \mu as$

Method 2 : If by definition an object at ~~a~~ distance = 1 pc subtends a parallax of $\pi = 1''$, then an object at a distance of $d = 8500$ pc would subtend an angle of $\pi = \dfrac{1}{8500}'' = 1.176 \times 10^{-4}\ '' = 117.6\ \mu as$

Light travel time $= t = \dfrac{d}{c} = \dfrac{8500\ \cancel{pc} \times 3.086 \times 10^{18}\ \frac{cm}{\cancel{pc}}}{2.9979 \times 10^{10}\ cm/s} = 8.75 \times 10^{11}\ s = 27{,}700$ years

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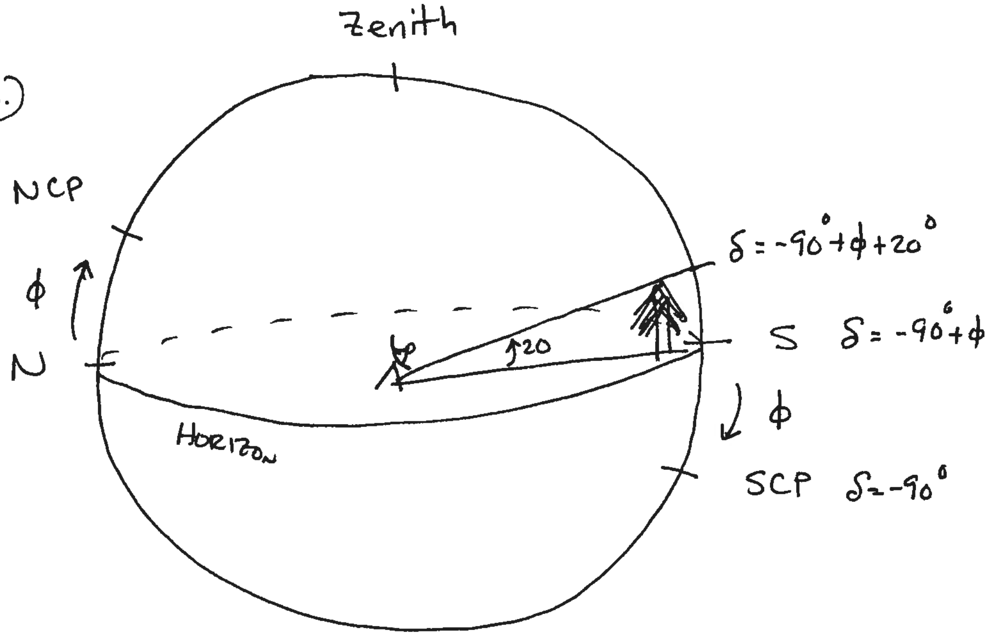
(3.)



$$
\begin{array}{rrr}
-89° & 59' & 60'' \\
\delta = \cancel{-90°} & \cancel{0'} & \cancel{0''} \\
32° & 42' & 6'' \\
20 & 0' & 0'' \\
\hline
-37° & 17' & 54''
\end{array}
$$

(4.) $LST = HA + \alpha \Rightarrow HA = LST - \alpha$

$LST = 2^h$

$\alpha = 5^h\ 35^m\ 24^s = 5^h + \frac{35}{60}^h + \frac{24}{3600}^s = 5.59^h$

$HA = LST - \alpha = 2^h - 5.59^h = -3.59^h$

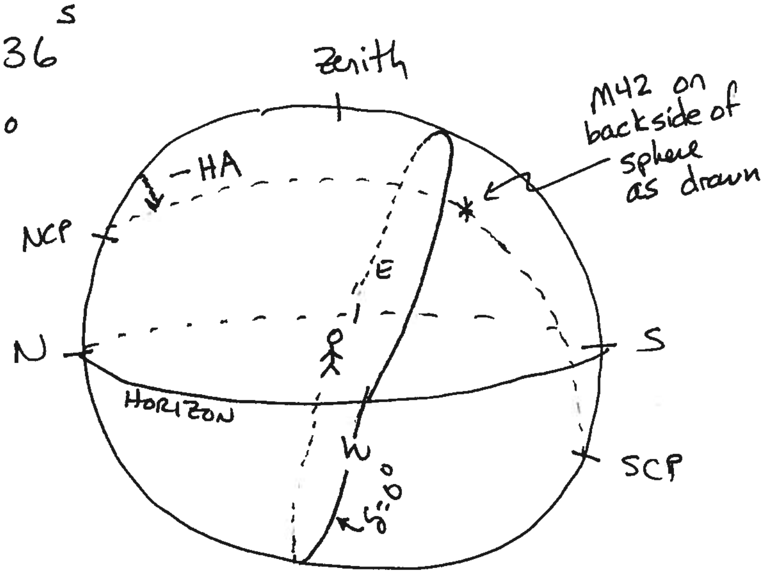
But $0^h \leq HA < 24^h$ so we must subtract this HA from 24^h

$HA = 20.41^h = 20^h\ 24^m\ 36^s$

Since $HA > 12^h$ and $\delta < 0°$

for an observer in northern hemisphere ($\phi > 0$)

$\Rightarrow$ M42 appears in SE



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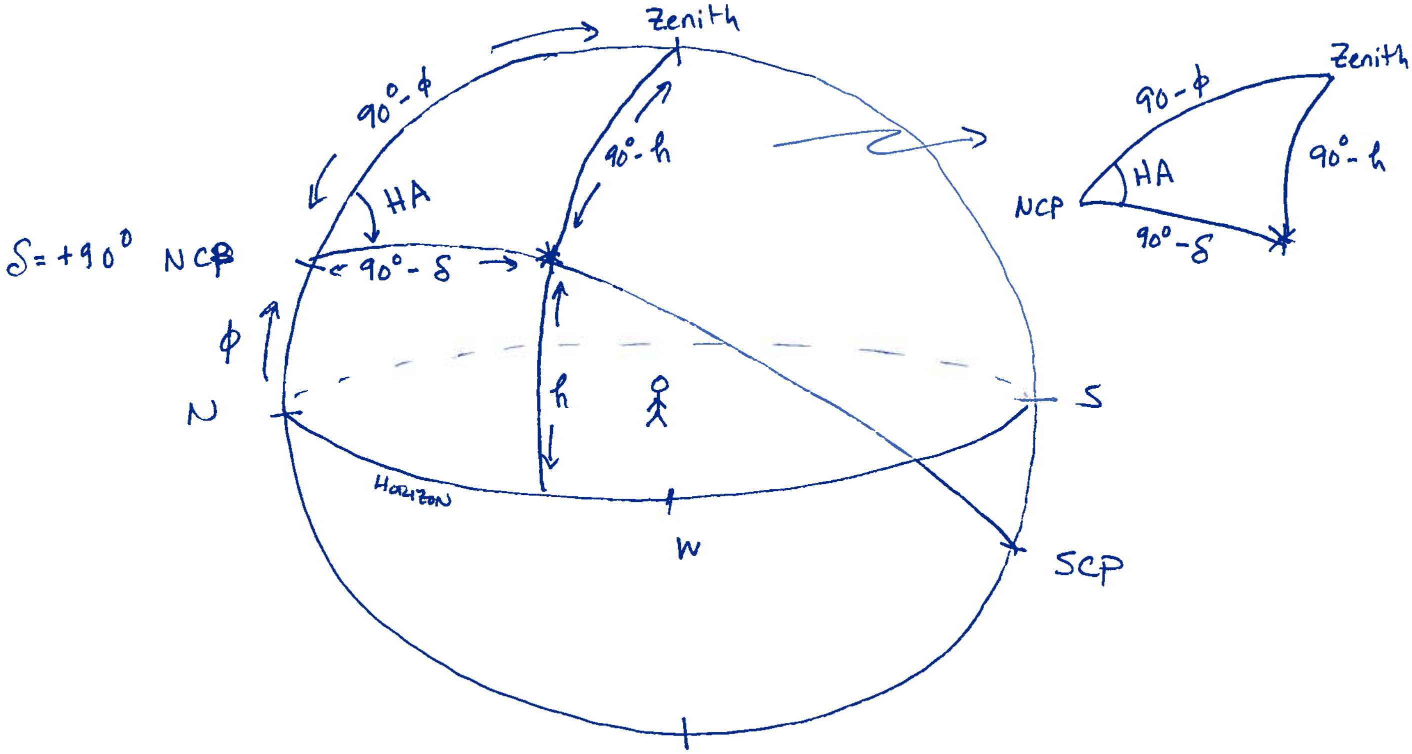
5.

$$HA = LST - \alpha$$

$$HA = \begin{array}{rrr} \overset{11^h}{\cancel{12^h}} & \overset{59^m}{\cancel{0^m}} & \overset{60^s}{\cancel{0^s}} \\ -\ 7^h & 30^m & 15^s \\ \hline 4^h & 29^m & 45^s \end{array}$$

Since $HA > 0^h$ and $HA < 12^h$ and $\delta > 0 \Rightarrow$ source is in the $\approx$ NW direction.



Law of cosines
for a spherical triangle:

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

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

$$\phi = 31° \ 57.8' = 31° + \frac{57.8°}{60} = 31.9633°$$

$$\delta = +50° \ 30' = 50° + \frac{30°}{60} = 50.5°$$

$$HA = 4^h 29^m 45^s = 4^h + \frac{29^h}{60} + \frac{45^h}{3600} = 4.4958^h \times \frac{360°}{24^h} = 67.4375°$$

$$\sin h = 0.6155 \Rightarrow h = \sin^{-1}(0.6155) = 37.9908°$$

$$h = 37° \ 59' \ 27''$$