Ashvini Krishnan

ASTR 414 HOMEWORK 3

February 12, 2018

Netid: akrshnn6

ASTR 414

Problem 1:

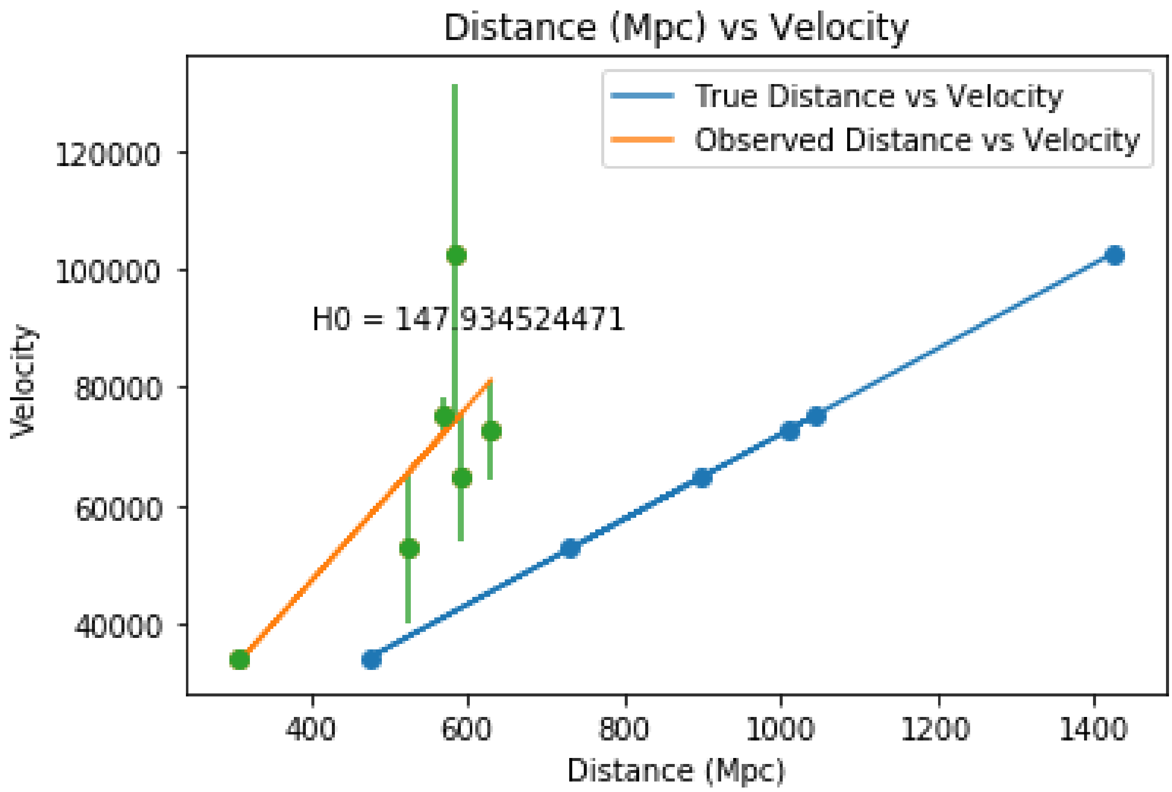


Figure 1: Distance vs Velocity plot describing the H_0 value for both true distances and observed distances when plotted against the true velocities

The reason for the discrepancy in the actual H_0 value and the value found when plotting the observed distances with the true velocities is likely due to dust obscuring the telescope, or technical errors caused by the known observable bias limit. Since the limiting magnitude corresponds to a distance modulus of 39, it implies that the maximum distance that supernova can be seen is 1000 pc. However, the true distance of a lot of these supernova points is much greater than that distance.

Problem 2:

Andromeda (M31) is at RA, DEC of 00h 42m 44.3s +41^o 16'09"
The Observatory on campus is 40.1105^o N, 88.2284^oW

A:

Given RA(α), declination(δ), and observer's latitude(ϕ), find rise, transit, and set times.
Use values in degrees for α, δ, and ϕ.
Time difference: local time = 14h25m when LST = 0h 0m

$$\alpha = 42m * \frac{1hr}{60m} + 44.3s * \frac{1m}{60s} * \frac{1hr}{60m} = 0.67hr$$

$$\alpha = 0.71hr * \frac{15^o}{1hr}$$

$$\alpha = 0.71hr = 10.68^o$$

$$\delta = 41^o 16' 09"$$

$$\delta = 41^o + 16' * \frac{1^o}{60'} + 09" * \frac{1^o}{3600"}$$

$$\delta = 41.27^o$$

$$\phi = 40.1105^o$$

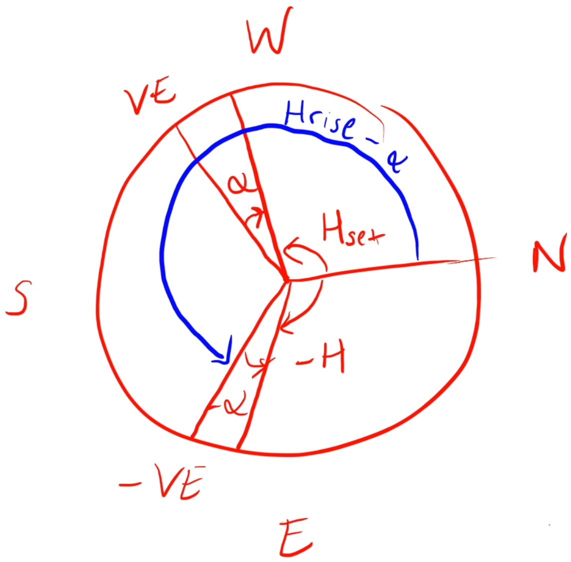
If altitude a=0, the hour angle H will give us the rise and set times when using the following equation. The set time is given by $H_{set} + \alpha$ and the rise time is given by $360 - H_{set} - \alpha$, since the hour angle is measured westward from the local meridian, as shown in Figure 2 below.

$$sin(a) = sin(\delta)sin(\phi) + cos(\delta)cos(\phi)cos(H)$$

$$cos(H) = \frac{-sin(\delta)sin(\phi)}{cos(\delta)cos(\phi)}$$

$$H = cos^{-1}(\frac{-sin(41.27^o)sin(40.1105^o)}{cos(41.27^o)cos(40.1105^o)})$$

$$\boxed{H_{set} = 137.67^o}$$



$$LST_{RISE} = 360^\circ - H_{set} - \alpha$$

$$LST_{SET} = H_{set} + \alpha$$

Figure 2: Horizon Diagram

To find the LST, we can use:

$$H = LST - \alpha$$

$$LST = H + \alpha$$

LST Rise Time:

$$H_{rise} = 360^o - H_{set}$$

$$H_{rise} = 360^o - 137.67^o$$

$$\boxed{H_{rise} = 222.33^o}$$

$$LST = (H_{rise} - 10.68^o) * \frac{1hr}{15^o}$$

$$LST = 14h + .11h * \frac{60m}{1hr}$$

$$LST = 14h : 6m + 0.58m * \frac{60s}{1m}$$

$$\boxed{LST_{rise} = \text{14h 6m 35s}}$$

LST Set Time:

$$LST = (H_{set} + 10.68^{o}) * \frac{1hr}{15^{o}}$$

$$LST = 9h + .89h * \frac{60m}{1hr}$$

$$LST = 9h : 53m + 0.42m * \frac{60s}{1m}$$

$$\boxed{LST_{Set} = \text{9h 53m 25s}}$$

Transit angle for Andromeda occurs when H = 0, since the hour angle is measured from the Local Meridian, thus

$$H = LST - \alpha$$

$$LST_{Transit} = \alpha$$

$$\boxed{LST_{Transit} = \text{0h 42m 44.3s}}$$

Therefore, using the previous relation that 14h25m local time is 0h0m LST:
Rise in local time is at:
Local Rise Time = 14h 25m + LST_{Rise}
Local Rise Time = 14h 25m + 14h 6m 35s
Local Rise Time = 28h 31m 35s = 04h 31m 35s
$\boxed{\text{Local Rise Time = 04h 31m 35s}}$
Set in local time is at:
Local Set Time = 14h25m + LST_{Set}
Local Set Time = 14h25m + 9h 53m 25s
Local Set Time = 23h 78m 25s = 24h 18m 25s
$\boxed{\text{Local Set Time = 0h 18m 25s}}$
Transit in local time is at:
Local Transit Time = 14h 25m + $LST_{Transit}$
Local Transit Time = 14h 25m + 0h 42m 44.3s
Local Transit Time = 14h 67m 44.3s = 15h 07m 44.3s
$\boxed{\text{Local Transit Time = 15h 07m 44.3s}}$

B:

As found above,
H at sunset = $\boxed{H_{set} = 137.67^{o}}$

H at sunrise = $\boxed{H_{rise} = 222.33^o}$
H at transit = $\boxed{H_{transit} = 0^o}$

Problem 3:

13:

$V = 24 = m_{max}$
Find max distance for a supernova of M=-20

$$m - M = 5log_{10}(\frac{d_{pc}}{10})$$

$$24 + 20 = 5log_{10}(\frac{d_{pc}}{10})$$

$$d_{max} = 10^{\frac{44}{5}+1}$$

$$\boxed{d_{max} = 6.3096x10^{10}pc}$$

Compute the expected redshift parameter for this object:

$$z = \frac{H_0 d}{c} = \frac{v}{c}$$

$$v = H_0 d = 72km/s/Mpc * 6.309x10^3$$

$$v = 4.54x10^5$$

$$z = \frac{72km/s/Mpc * 6.309x10^3 Mpc}{3x10^5 km/s}$$

$$\boxed{z = 1.514}$$

14:

Compare the true values to the naive calculations from eqn 3.5 and 3.6:
True value for light to reach us from IOK-1 (z = 6.96) is t = 12.88 Gyr

$$v_R = H_0 d$$

$$\beta = \frac{v_R}{c} = \frac{1(z+1)^2 - 1}{1(z+1)^2 + 1}$$

With z = 6.96 and $H_0 = 72$:

$$v_R = (\frac{1(6.96+1)^2 - 1}{1(6.96+1)^2 + 1})(3x10^5 km/s)$$

$$v_R = 2.906x10^5 km/s$$

$$d = \frac{v_R}{H_0} = \frac{2.096x10^5 km/s}{72 km/s/Mpc}$$

$$d = 4.037x10^3 Mpc(\frac{3.086x10^{19} km}{1Mpc}) = 1.245x10^{23} km$$

Therefore:

$$t = \frac{d}{v_R} = \frac{1.245x10^{23} km}{2.096x10^5 km/s} = 4.286x10^{17} s$$

$$t = 4.286x10^{17} s(\frac{1m}{60s})(\frac{1hr}{60m})\frac{1day}{24hrs}\frac{1yr}{365days}\frac{1Gyr}{10^9 yr}$$

$$\boxed{t = 13.59Gyr}$$

1:

Table of objects with parallax >=250 mas, showing parallax value, V magnitude and spectral type, starting on next page:

Portal Simbad VizieR Aladin X-Match Other Help

plx >= 250

other query modes : Identifier query | Coordinate query | Criteria query | Reference query | Basic query | Script submission | TAP | Output options | Help

C.D.S. - SIMBAD4 rel 1.5.12 - 2018.02.12CET02:52:50

Number of rows : 38 Plot

Show 100 entries Search:

N	Identifier	Parallaxes	Mag V	Sp type
1	* alf Cen	742	-0.1	G2V+K1V
2	WISE J154151.65-225024.9	351		Y0
3	WISEA J085510.74-071442.5	448		Y2
4	* eps Ind	276.06	4.69	K5V
5	* tau Cet	273.96	3.50	G8V
6	* alf CMa	379.21	-1.46	A1V+DA
7	SCR J1845-6357B	259.45		T6
8	GJ 65	375	12.08	M5.5V+M6V
9	Ross 128	295.80	11.153	M4V
10	HD 95735	392.64	7.520	M2+V
11	NAME Kapteyn's star	255.66	8.853	M1VIp
12	NAME Barnard's star	548.31	9.511	M4V
13	HD 173740	286.39	9.69	M3.5V
14	SCR J1845-6357	259.45	17.40	M8.5+T6
15	* 61 Cyg B	285.88	6.03	K7V
16	V* EZ Aqr	293.600	12.361	M5V
17	* alf Cen A	754.81	0.01	G2V
18	HD 173739	283.54	8.91	M3V
19	BD+05 1668	262.98	9.872	M3.5V
20	HIP 82724	270.53	11.772	Mp
21	V* GX And	280.74	8.13	M2V
22	V* V645 Cen	769.8	11.13	M5.5Ve
23	* 61 Cyg A	286.82	5.21	K5V
24	* eps Ind B	275.79	24.12	T1V+T6V
25	V* AX Mic	253.41	6.68	M1V
26	GJ 1061	270.86	13.07	M5.5V
27	Ross 248	316.7	12.28	M5.0V

N	Identifier	Parallaxes	Mag V	Sp type
28	Wolf 359	419.1	13.507	M6V
29	GAT 1370	260.63	15.40	M7.0V
30	Ross 154	336.72	10.495	M3.5Ve
31	HD 217987	305.26	7.34	M2V
32	* alf CMi	284.56	0.37	F5IV-V+DQZ
33	G 51-15	275.8	14.81	M6.5V
34	* eps Eri	310.94	3.73	K2V
35	V* GQ And	279.30	11.04	M3.5Ve
36	SCR J1845-6357A	259.45		M8.5V
37	* alf Cen B	796.92	1.33	K1V
38	V* YZ Cet	271.01	12.074	M4.0Ve

Showing 1 to 38 of 38 entries

Previous 1 Next

plot this list of objects ◉ Equat. ○ Gal ○ SGal ○ Ecl

Store this result in Votable, in Ascii, or in the CDS portal

To bookmark this query, right click on this link: simbad:plx >= 250 and select 'bookmark this link' or equivalent in the popup menu

2018.02.12-02:52:50

© UDS/CNRS
Contact