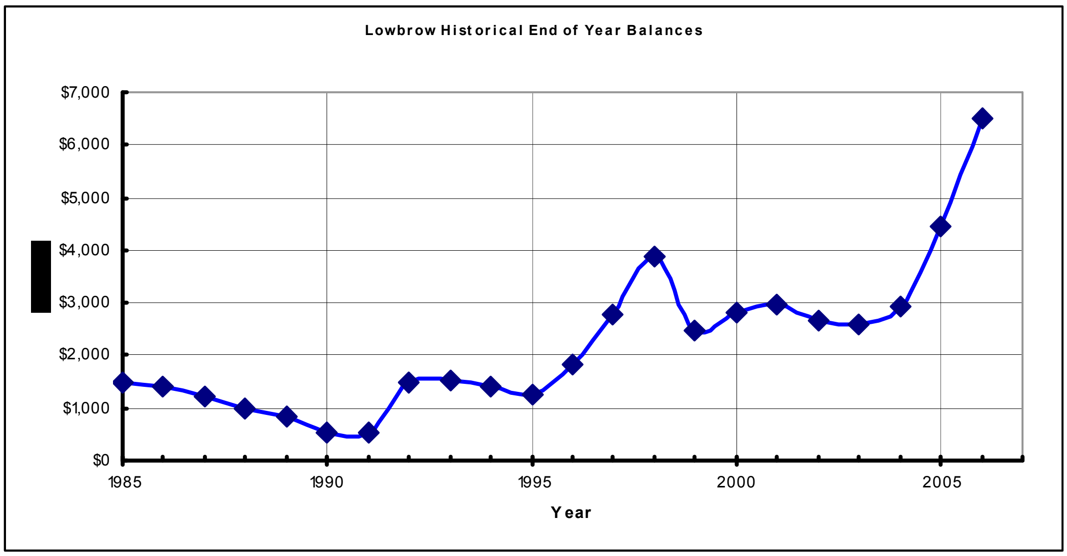
REFLECTIONS / REFRACTIONS
REFLECTIONS \ REFRACTIONS
University Lowbrow Astronomers
Ann Arbor, Michigan
March 2007
Volume 31 Issue 3

Lowbrow Financial History

By Kathy Hillig

Now that I'm finishing up my third and last year as Lowbrow Treasurer, I have gone back into the records to plot the financial history of the club. There are many ways to look at this – number of members, amount spent, annual balance, etc. – but the easiest is to just plot the amount of money in the account at the end of each year. There are some advantages, like it is really easy to get the numbers from the ledger and it really makes me look good. The disadvantage is that it really doesn't show how healthy the club is. It is only a snapshot each year and doesn't show if the number of members has gone up or down each year, or that we don't send out very many hard copies of the Newsletter any more or whether the Observatory committee has spent a lot or a little money each year.

The one interesting observation is that there seems to be an up-tick of money after each of our T-shirt sales. The first order in 1993 took a few years to sell them all. The reprinting in 2000 of a smaller number gave a small up-tick, too. And then in 2006, the revised design gave another increase in funds.



THE MESSIER MARATHON

Messier Marathon is a term describing the attempt to find as many Messier objects as possible in one night. Depending on the location of the observer, and season, there is a different number of them visible, as they are not evenly distributed in the celestial sphere. There are heavily crowded regions in the sky, especially the Virgo Cluster and the region around the Galactic Center, while other regions are virtually empty of them. In particular, there are no Messier objects at all at Right Ascensions 21:40 to 23:20, and only the very northern M52 is between RA 21:40 and 0:40. This chance effect leads, at considerably low northern latitudes on Earth (best around 25 degrees North), to the chance to observe all 110 Messier objects in one night! This opportunity occurs once every year, around mid- to end-March; the best time to try is of course when the Moon is near its new phase. In 2007 the prime dates are March 16th—18th. On pages 2-4 is one version of the proper order in which to observe them for our latitude on March 17th. (list compile by MSD)

Inside this issue:

Important Club Info

- **Saturday, March 10, 2007.** Open House at Peach Mountain. *May be cancelled if it's cloudy or too cold.* (Starting at Sunset).
- **Friday, March 16, 2007.** (7:30PM). Monthly Club Meeting

Object	Cross Ref	Type	Con	RA	Decl	Size	Mag	SA pg	Best (Alt)	Observed
M 79	NGC 1904	GC	Lep	05h24m30s	-24°33'.0	8'.7	8	19	19:30(23°)	
M 77	NGC 1068	GX	Cet	02h42m42s	-00°01'.0	6'.9	8.8	10	19:30(33°)	
M 74	NGC 628	GX	Psc	01h36m42s	+15°47'.0	10'.2	9.2	10	19:30(34°)	
M 52	NGC 7654	OC	Cas	23h24m12s	+61°35'.0	13'.0	6.9	3	19:30(35°)	
M 110	NGC 205	GX	And	00h40m24s	+41°41'.0	17'.4	8	4	19:30(38°)	
M 32	NGC 221	GX	And	00h42m42s	+40°52'.0	7'.6	8.2	4	19:30(38°)	
M 31	NGC 224	GX	And	00h42m42s	+41°16'.0	178'.0	3.5	4	19:30(38°)	
M 33	NGC 598	GX	Tri	01h33m54s	+30°39'.0	62'.0	5.7	4	19:30(42°)	
M 103	NGC 581	OC	Cas	01h33m12s	+60°42'.0	6'.0	7.4	1	19:30(50°)	
M 76	NGC 650	PN	Per	01h42m18s	+51°34'.0	4'.8	12	4	19:30(51°)	
M 34	NGC 1039	OC	Per	02h42m00s	+42°47'.0	35'.0	5.2	4	19:30(59°)	
M 45		OC	Tau	03h47m00s	+24°07'.0	110'.0	1.2	4	19:30(62°)	
M 38	NGC 1912	OC	Aur	05h28m42s	+35°50'.0	21'.0	6.4	5	19:30(83°)	
M 1	NGC 1952	NB	Tau	05h34m30s	+22°01'.0	6'.0	8.4	5	19:33(70°)	
M 42	NGC 1976	NB	Ori	05h35m24s	-05°27'.0	66'.0	4	11	19:34(42°)	
M 43	NGC 1982	NB	Ori	05h35m36s	-05°16'.0	20'.0	9	11	19:34(42°)	
M 36	NGC 1960	OC	Aur	05h36m06s	+34°08'.0	12'.0	6	5	19:34(82°)	
M 78	NGC 2068	NB	Ori	05h46m42s	+00°03'.0	8'.0	8	11	19:45(48°)	
M 37	NGC 2099	OC	Aur	05h52m24s	+32°33'.0	24'.0	5.6	5	19:51(80°)	
M 35	NGC 2168	OC	Gem	06h08m54s	+24°20'.0	28'.0	5.1	5	20:07(72°)	
M 41	NGC 2287	OC	CMa	06h46m00s	-20°44'.0	38'.0	4.5	19	20:44(27°)	
M 50	NGC 2323	OC	Mon	07h02m48s	-08°23'.0	16'.0	5.9	12	21:01(39°)	
M 47	NGC 2422	OC	Pup	07h36m36s	-14°30'.0	30'.0	4.4	12	21:34(33°)	
M 46	NGC 2437	OC	Pup	07h41m48s	-14°49'.0	27'.0	6.1	12	21:40(33°)	
M 93	NGC 2447	OC	Pup	07h44m36s	-23°52'.0	22'.0	6.2	19	21:42(24°)	
M 48	NGC 2548	OC	Hya	08h13m48s	-05°48'.0	54'.0	5.8	12	22:12(42°)	
M 44	NGC 2632	OC	Cnc	08h40m06s	+19°46'.0	95'.0	3.1	6	22:38(67°)	
M 67	NGC 2682	OC	Cnc	08h51m24s	+11°49'.0	30'.0	6.9	12	22:49(60°)	
M 81	NGC 3031	GX	UMa	09h55m36s	+69°04'.0	25'.7	6.9	2	23:53(63°)	
M 82	NGC 3034	GX	UMa	09h55m48s	+69°41'.0	11'.2	8.4	2	23:53(63°)	
M 95	NGC 3351	GX	Leo	10h44m00s	+11°42'.0	7'.4	9.7	13	00:45(59°)	
M 96	NGC 3368	GX	Leo	10h46m48s	+11°49'.0	7'.1	9.2	13	00:48(60°)	
M 105	NGC 3379	GX	Leo	10h47m48s	+12°35'.0	4'.5	9.3	13	00:49(60°)	
M 108	NGC 3556	GX	UMa	11h11m30s	+55°40'.0	8'.3	10.1	2	01:13(77°)	
M 97	NGC 3587	PN	UMa	11h14m48s	+55°01'.0	3'.2	11.2	2	01:16(77°)	
M 65	NGC 3623	GX	Leo	11h18m54s	+13°05'.0	10'.0	9.3	13	01:20(61°)	
M 66	NGC 3627	GX	Leo	11h20m12s	+12°59'.0	8'.7	9	13	01:21(61°)	
M 109	NGC 3992	GX	UMa	11h57m36s	+53°23'.0	7'.6	9.8	2	01:59(79°)	
M 98	NGC 4192	GX	Com	12h13m48s	+14°54'.0	9'.5	10.1	13	02:15(63°)	
M 99	NGC 4254	GX	Com	12h18m48s	+14°25'.0	5'.4	9.8	13	02:20(62°)	
M 106	NGC 4258	GX	CVn	12h19m00s	+47°18'.0	18'.2	8.3	7	02:20(85°)	
M 61	NGC 4303	GX	Vir	12h21m54s	+04°28'.0	6'.0	9.7	13	02:23(52°)	
M 40		DS	UMa	12h22m24s	+58°05'.0		8	2	02:23(74°)	
M 100	NGC 4321	GX	Com	12h22m54s	+15°49'.0	6'.9	9.4	13	02:24(64°)	
M 84	NGC 4374	GX	Vir	12h25m06s	+12°53'.0	5'.0	9.3	13	02:26(61°)	

Object	Cross Ref	Type	Con	RA	Decl	Size	Mag	SA pg	Best (Alt)	Observed
M 85	NGC 4382	GX	Com	12h25m24s	+18°11'.0	7'.1	9.2	13	02:26(66°)	
M 86	NGC 4406	GX	Vir	12h26m12s	+12°57'.0	7'.4	9.2	13	02:27(61°)	
M 49	NGC 4472	GX	Vir	12h29m48s	+08°00'.0	8'.9	8.4	13	02:31(56°)	
M 87	NGC 4486	GX	Vir	12h30m48s	+12°24'.0	7'.2	8.6	14	02:32(60°)	
M 88	NGC 4501	GX	Com	12h32m00s	+14°25'.0	6'.9	9.5	14	02:33(62°)	
M 91	NGC 4548	GX	Com	12h35m24s	+14°30'.0	5'.4	10.2	14	02:36(62°)	
M 89	NGC 4552	GX	Vir	12h35m42s	+12°33'.0	4'.2	9.8	14	02:37(60°)	
M 90	NGC 4569	GX	Vir	12h36m48s	+13°10'.0	9'.5	9.5	14	02:38(61°)	
M 58	NGC 4579	GX	Vir	12h37m42s	+11°49'.0	5'.4	9.8	14	02:39(60°)	
M 68	NGC 4590	GC	Hya	12h39m30s	-26°45'.0	12'.0	8.2	21	02:40(21°)	
M 104	NGC 4594	GX	Vir	12h40m00s	-11°37'.0	8'.9	8.3	14	02:41(36°)	
M 59	NGC 4621	GX	Vir	12h42m00s	+11°39'.0	5'.1	9.8	14	02:43(59°)	
M 60	NGC 4649	GX	Vir	12h43m42s	+11°33'.0	7'.2	8.8	14	02:45(59°)	
M 94	NGC 4736	GX	CVn	12h50m54s	+41°07'.0	11'.0	8.2	7	02:52(89°)	
M 64	NGC 4826	GX	Com	12h56m42s	+21°41'.0	9'.3	8.5	7	02:58(69°)	
M 53	NGC 5024	GC	Com	13h12m54s	+18°10'.0	12'.6	7.7	14	03:14(66°)	
M 63	NGC 5055	GX	CVn	13h15m48s	+42°02'.0	12'.3	8.6	7	03:17(90°)	
M 51	NGC 5194	GX	CVn	13h29m54s	+47°12'.0	11'.0	8.4	7	03:31(85°)	
M 83	NGC 5236	GX	Hya	13h37m00s	-29°52'.0	11'.2	7.6	21	03:38(18°)	
M 3	NGC 5272	GC	CVn	13h42m12s	+28°23'.0	16'.2	6.4	7	03:43(76°)	
M 101	NGC 5457	GX	UMa	14h03m12s	+54°21'.0	26'.9	7.7	2	04:04(78°)	
M 5	NGC 5904	GC	Ser	15h18m36s	+02°05'.0	17'.4	5.8	14	05:19(50°)	
M 13	NGC 6205	GC	Her	16h41m42s	+36°28'.0	16'.6	5.9	8	06:00(80°)	
M 92	NGC 6341	GC	Her	17h17m06s	+43°08'.0	11'.2	6.5	8	06:00(76°)	
M 57	NGC 6720	PN	Lyr	18h53m36s	+33°02'.0	2'.5	9	8	06:00(55°)	
M 56	NGC 6779	GC	Lyr	19h16m36s	+30°11'.0	7'.1	8.3	8	06:00(49°)	
M 12	NGC 6218	GC	Oph	16h47m12s	-01°57'.0	14'.5	6.6	15	06:00(44°)	
M 10	NGC 6254	GC	Oph	16h57m06s	-04°06'.0	15'.1	6.6	15	06:00(42°)	
M 29	NGC 6913	OC	Cyg	20h23m54s	+38°32'.0	7'.0	6.6	9	06:00(41°)	
M 14	NGC 6402	GC	Oph	17h37m36s	-03°15'.0	11'.7	7.6	15	06:00(39°)	
M 27	NGC 6853	PN	Vul	19h59m36s	+22°43'.0	15'.2	8.1	8	06:00(37°)	
M 71	NGC 6838	GC	Sge	19h53m48s	+18°47'.0	7'.2	8.3	8	06:00(36°)	
M 39	NGC 7092	OC	Cyg	21h32m12s	+48°26'.0	32'.0	4.6	9	06:00(34°)	
M 107	NGC 6171	GC	Oph	16h32m30s	-13°03'.0	10'.0	8.1	15	06:00(34°)	
M 11	NGC 6705	OC	Sct	18h51m06s	-06°16'.0	14'.0	5.8	16	06:00(28°)	
M 9	NGC 6333	GC	Oph	17h19m12s	-18°31'.0	9'.3	7.9	22	06:00(26°)	
M 26	NGC 6694	OC	Sct	18h45m12s	-09°24'.0	15'.0	8	16	06:00(26°)	
M 16	NGC 6611	CN	Ser	18h18m48s	-13°47'.0	35'.0	6	15	06:00(25°)	
M 80	NGC 6093	GC	Sco	16h17m00s	-22°59'.0	8'.9	7.2	22	06:00(25°)	
M 17	NGC 6618	CN	Sgr	18h20m48s	-16°11'.0	46'.0	6	15	06:00(23°)	
M 23	NGC 6494	OC	Sgr	17h56m48s	-19°01'.0	27'.0	5.5	22	06:00(23°)	
M 18	NGC 6613	OC	Sgr	18h19m54s	-17°08'.0	9'.0	6.9	15	06:00(22°)	
M 24		??	Sgr	18h16m54s	-18°29'.0	90'.0	4.5	15	06:00(21°)	
M 4	NGC 6121	GC	Sco	16h23m36s	-26°32'.0	26'.3	5.9	22	06:00(21°)	
M 19	NGC 6273	GC	Oph	17h02m36s	-26°16'.0	13'.5	7.2	22	06:00(20°)	

Object	Cross Ref	Type	Con	RA	Decl	Size	Mag	SA pg	Best (Alt)	Observed
M 25	IC 4725	OC	Sgr	18h31m36s	-19°15'.0	32'.0	4.6	22	06:00(19°)	
M 21	NGC 6531	OC	Sgr	18h04m36s	-22°30'.0	13'.0	5.9	22	06:00(19°)	
M 20	NGC 6514	CN	Sgr	18h02m18s	-23°02'.0	29'.0	6.3	22	06:00(19°)	
M 8	NGC 6523	NB	Sgr	18h03m48s	-24°23'.0	90'.0	5.8	22	06:00(17°)	
M 62	NGC 6266	GC	Oph	17h01m12s	-30°07'.0	14'.1	6.6	22	06:00(16°)	
M 28	NGC 6626	GC	Sgr	18h24m30s	-24°52'.0	11'.2	6.9	22	06:00(15°)	
M 22	NGC 6656	GC	Sgr	18h36m24s	-23°54'.0	24'.0	5.1	22	06:00(15°)	
M 15	NGC 7078	GC	Peg	21h30m00s	+12°10'.0	12'.3	6.4	16	06:00(14°)	
M 6	NGC 6405	OC	Sco	17h40m06s	-32°13'.0	15'.0	4.2	22	06:00(12°)	
M 7	NGC 6475	OC	Sco	17h53m54s	-34°49'.0	80'.0	3.3	22	06:00(9°)	
M 69	NGC 6637	GC	Sgr	18h31m24s	-32°21'.0	7'.1	7.7	22	06:00(8°)	
M 54	NGC 6715	GC	Sgr	18h55m06s	-30°29'.0	9'.1	7.7	22	06:00(7°)	
M 70	NGC 6681	GC	Sgr	18h43m12s	-32°18'.0	7'.8	8.1	22	06:00(6°)	
M 75	NGC 6864	GC	Sgr	20h06m06s	-21°55'.0	6'.0	8.6	23	06:00(4°)	
M 2	NGC 7089	GC	Aqr	21h33m30s	-00°49'.0	12'.9	6.5	17	06:00(4°)	
M 72	NGC 6981	GC	Aqr	20h53m30s	-12°32'.0	5'.9	9.4	16	06:00(3°)	
M 73	NGC 6994	OC	Aqr	20h59m00s	-12°38'.0	3'.0	9	16	06:00(2°)	
M 55	NGC 6809	GC	Sgr	19h40m00s	-30°58'.0	19'.0	7	22	06:00(1°)	

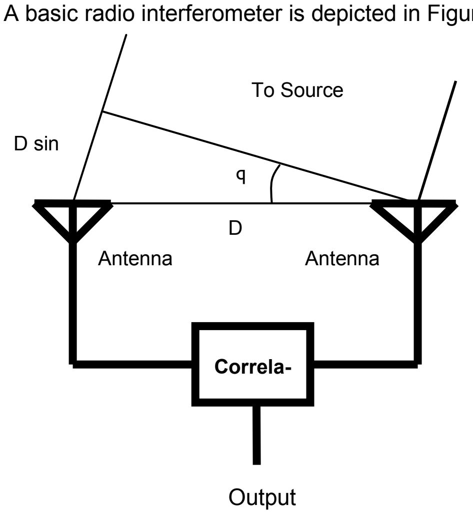
Amateur Radio Astronomy: 400 MHz Interferometer

Jim Abshier January 2007

After posting an example plot of my radio telescope output on the Lowbrows list, I received a couple of requests for more information. One request was for an explanation of the plot, and another was for pictures of my equipment. This brief article is in response to these requests, and I hope that it is of general interest to the rest of the club members.

My present radio telescope is an interferometer operating at about 400 MHz. It consists of two antennas separated by about 7.5 meters distance in roughly an east, west direction. The interferometer produces a distinctive cyclical pattern as a source passes through the beams of the two antennas. The interferometer has certain advantages over single antenna radio telescopes. It is primarily sensitive to small isolated sources rather than extended sources and background radiation. It is also somewhat insensitive to interference of a continuous nature such as broadcast station spurious signals.

A basic radio interferometer is depicted in Figure 1. In this diagram, many of the details have been omitted for clarity.



Signals from a source off axis by the angle θ produce wave-fronts that are intercepted by the two antennas at slightly different times. The time delay is equal to D sinθ / c, where D is the baseline distance between the antennas, and c is the speed of light. For simplicity, it is convenient to consider monochromatic signals. The time delay then produces a phase difference between the two signals from the two antennas. Each of the antennas has a beam pattern A(θ) that modulates the signals from the source as it passes through the beam. The signals produced in the two feed-lines could be approximately modeled as: $S_1 = A(\theta)V \sin(2\pi f t)$ &

$$S_2 = A(\theta)V \sin\left(2\pi f\left(t - \frac{D\sin\theta}{c}\right)\right)$$

where V represents the voltage induced in the feed-lines by the electromagnetic field impinging on the antennas. These two signals are correlated to form the output interferogram. The correlation process is a multiplication followed by averaging or low pass filtering. The signal that results from multiplication is:

$$p = \frac{V^2 A(\theta)^2}{2}\left(\cos\left(\frac{2\pi D\sin\theta}{\lambda}\right) - \cos(4\pi f t)\cos\left(\frac{2\pi D\sin\theta}{\lambda}\right) - \sin(4\pi f t)\sin\left(\frac{2\pi D\sin\theta}{\lambda}\right)\right)$$

Where: $\lambda = \frac{c}{f}$ The low pass filtering removes high frequency terms leaving an output signal of the form: $p = \frac{V^2 A(\theta)^2}{2} \cos\left(\frac{2\pi D \sin\theta}{\lambda}\right)$

The output signal is seen to be proportional to input signal power (V^2) and is modulated by the antenna power pattern $A(\theta)^2$. It is a cosine waveform with frequency proportional to the baseline D divided by the wavelength λ.

The output signal would look something like the plot shown in Figure 2.

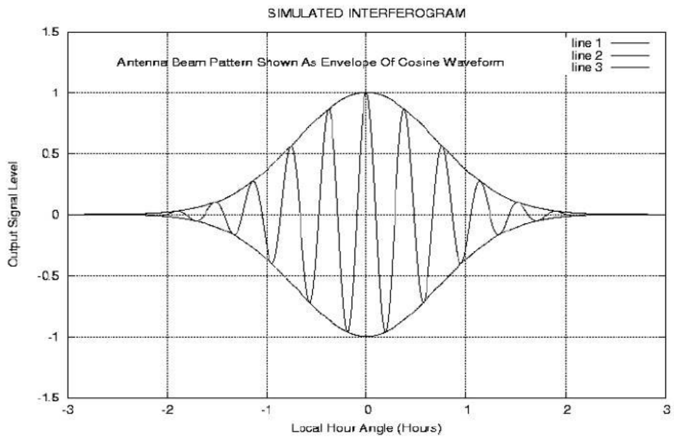


Figure 2. Simulation of Cosine Waveform Modulated by Antenna Beam Patterns

If the baseline is laid out in an east, west direction and has been accurately measured, certain information about the source can be learned from the waveforms. Assuming the antenna beam patterns are narrow enough that the center lobe of the interferogram waveform can be identified, then the source transit time (Local Mean Sidereal Time LMST) and hence its right ascension can be determined. This is done by noting the Greenwich mean sidereal time (GMST) at the peak of the central lobe. The longitude of the interferometer must, of course, also be known.

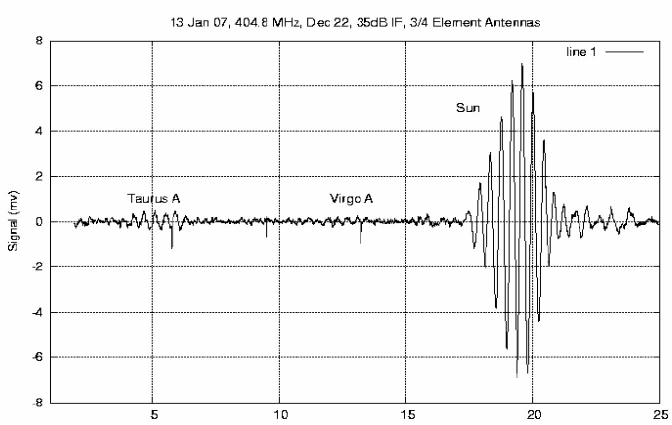
Right Ascension = GMST – Longitude/15 = LMST

It can be shown that $\sin\theta = \cos\delta \sin H$, where δ is the source declination and H is the local hour angle. Since the frequency of the cosine waveform with respect to hour angle is proportional to declination, the declination of the source can be determined by measuring the frequency of the interferogram. To do this precisely requires more than simply taking a Fourier transform because the frequency is not constant over the antenna beam pattern. Nevertheless, the declination can be determined by least squares fitting a mathematical model of the waveform to the output interferogram. The third thing that can be determined is, of course, signal power V^2. This requires calibration of the system using a source of known flux density.

The interferometer that I am presently using has two small broadside array antennas. One antenna consists of 3 full-wave dipoles over a reflector, and the other antenna has 4 full-wave dipoles over a reflector. The two antennas of my interferometer are shown in Figure 3.

The antennas are about 7.5 meters or about 10 wavelengths apart. The baseline distance, declination and wavelength, determine the frequency of the cosine waveform or interferogram. With a wavelength of 0.75 meters (400 MHz), a source at zero declination (on the Equator) will produce a frequency of about 10 cycles per radian of source travel across the sky. The total beam-width of my antennas is about one radian (from null to null), so the interferograms that I get from sources at or near the Equator have a total of about 10 cycles.

Figure 4. shows an example plot of the output signal from my present radio interferometer. The plot shows interferograms from Taurus A (M1), Virgo A (M87) and the Sun. The antenna beams were set to a declination of 22 degrees to be centered on Taurus A. Virgo A at a declination of about 12 degrees is still well within the antenna beam, so it appears on the plot. The sun, which normally produces a much greater response, was at a declination of about - 21 degrees, so it was not even in the main antenna beam. Nevertheless, it produced the largest response of the three objects seen in the plot!



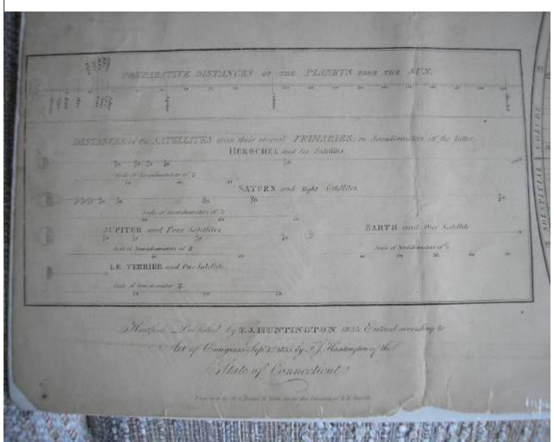
The indoor equipment used in my radio interferometer is shown in Figure 5. There are two computers, one for recording data and the other one for program development while recording data. Within the rack, the upper unit contains RF and back-end processing hardware. This equipment is home made. It consists of RF amplifiers, a phase switch, IF amplifiers, a square law detector, DC amplifiers and a low pass filter. I am using a phase switched interferometer with square law detection to implement the multiplying function of the interferometer described earlier. The signal from one of the antennas is switched in phase by 180 degrees periodically, and the detected signal is also synchronously phase switched to recover only the desired output product term from the

square law detector. The synchronous detection is performed by a lock-in amplifier, which is located below the home made equipment chassis as seen in the figure. The output of the lock-in amplifier is sent to an A/D converter in the computer for data recording. An ICOM R8500 receiver is used for converting the 400 MHz incoming RF signal to a 10.7 MHz IF signal. The receiver is located below the lock-in amplifier. The small gray box to the right of the receiver is the phase switch driver. Either computer shown in the figure can be used for data recording or program development. The computer programs are run under the DOS operating system. This allows complete control of computer resources during data recording.

My future plans for this radio interferometer include developing antenna rotators for both antennas so that a source can be tracked over an 8 to 10 hour data collection period. This will provide the long interferograms needed for producing images by aperture synthesis. In the past, I have done aperture synthesis using small fixed dipole antennas that had very broad beams. The dipole antennas allowed collection of interferogram data over about 8 hours, and produced reasonable images, but the sensitivity of the system was severely limited by the small antennas. The solution to this problem is to use higher gain antennas with smaller beam-width, and track the source by keeping the antenna beams centered on the source. By installing rotators on the present larger antennas, I hope to produce images of weaker sources than the images I obtained previously with the small fixed dipole antennas.

The Geography of the Heavens, Pluto and the State Street Art Fair

By Jack Brisbin



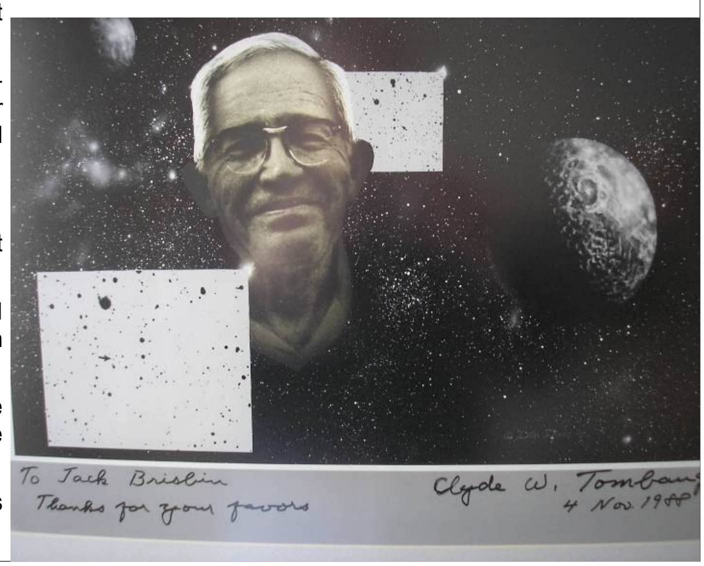
Now that Pluto is no longer a planet, thanks to the International Astronomical Union (IAU), a rare atlas titled “The Geography of the Heavens” by Elijah H Burritt is now politically correct. I happened to acquire a copy of this atlas in the late 1970’s while I was attending the State Street Art Fair, when there were several Antiquarian booksellers on State Street. This is in the olden days before State Street became restaurant alley.

I purchased the atlas in the early evening just before the store closed. In the early years of the State Street Art Fair, State Street was roped off in the evening and a band platform was erected and you just partied in the street. I didn’t think it was a good idea to party in the street with a 150 year old star atlas, so I hid it in my car. I forgot to tell you that the atlas was published in 1835. But if Pluto wasn’t discovered until 1930 then the atlas would not list Pluto as part of the solar system anyway, right!

Maybe it doesn’t matter since the I.A.U. has demoted Pluto from its planet status. Does it matter if the star atlas ever listed Pluto at all? Almost 180 years later the star atlas is still correct to show only eight (8) planets, according to the I.A.U. This means the star atlas correctly stated the solar system a 180 years ago, so is it worth more?

Figure 1. “*Plan of the Solar System Exhibiting its Relative Magnitudes and Distances*”. The copied section shows a comparative distance of the planets from the Sun.

You will not see a planet named Uranus because it was called Herschel, after its discoverer William Herschel in 1781. But the atlas does refer to the planet as “Herschel or Uranus” in different sections of the atlas. You will also notice Neptune is named Le Verrier. This was somewhat controversial. Two astronomers, working independently, John Couch Adams (England) and Urbain-Jean-Joseph Le Verrier (France) calculated the position of this unknown planet. James Challis an English astronomer using Adams predictions observed the planet on the night of August 4, 1846, but did not compare his observations with the previous night and did not recognize the planet. Johann Galle a German astronomer found the planet on September 23, 1846 using LeVerriers prediction.



Then to make matters worse, at a later date an International Astronomical organization decided the planets should be named after the mythological Roman Gods. For those of you that studied mythology you already know that Uranus is the Greek God of the Sky!

So much for understanding mythology!

Figure #2 is a poster given to me by Clyde Tombaugh, the discoverer of the planet Pluto.

In 1988 I helped promote and sponsor a lecture featuring Clyde Tombaugh and I spent part of the day with him, his wife and a university representative traveling with him.

As I drove them from the hotel room to the university, we talked about the lecture and his discovery of Pluto. Later on during the day we discussed amateur telescope making and some of the work he did at White Sands Missal base.

I never thought to ask Clyde the question - Do you think Pluto will lose its status as a planet? As I look back in time, that would have been a great question to ask him.

Belize and the Magellanic Clouds

by Dave Snyder

I spent Christmas in Belize. Formerly known as the "British Honduras," it is one of the northernmost countries in Central America, it is well known for scuba diving and Mayan ruins. I could go on, but I want to talk about something else; the Magellanic Clouds.

I was hoping to get a chance to observe the Magellanic Clouds while in Belize.

What are the Magellanic Clouds? In 1519, Ferdinand Magellan attempted to find a route from Spain to the Spice Islands; in the process his expedition circumnavigated the earth (though Magellan himself was killed before the ships returned home). Some crew members on Magellan's ship noticed two fuzzy cloud-like patches in the night sky. They are not visible from Europe, but people living in the Southern Hemisphere must have seen them, but until Magellan, little had been written about them. We now know these fuzzy patches are galaxies, the larger is known as the Large Magellanic Cloud (LMC) and the smaller is known as the Small Magellanic Cloud (SMC).

The Magellanic Clouds are not visible from North America either (except for the extreme southern part of Mexico), but they are visible from Central America provided you observe at the right time, you have a decent horizon and there are no clouds blocking the southern sky. (You may see statements that the Magellanic Clouds are only visible from the southern hemisphere, that isn't true. Belize and rest of Central America are north of the equator).

This was not my first trip to Central America. Five years ago, I took a trip through Costa Rica. We stayed at different locations in the country, spending a couple days in one location, three days in a different location and so on. I had attempted to observe the Magellanic Clouds on that trip, however each evening, it was either overcast or I did not have a good south horizon. I hoped to have another attempt some day.

Now was the time for a second attempt. Before I left for Belize, I looked at some star charts. The Magellanic Clouds would be close to the horizon; it is best to observe them when they are as far above the horizon as possible. That happens at transit.

I used *The Sky* astronomy program to determine the transit times. First I had to set the location. Apparently by default, *The Sky* only shows U. S. cities, so I had to first switch to cities "Outside USA." That list included "Belize City" which was close enough. I set the date to December 20, 2006, and set the Daylight Saving Adjustment Option to "Not Observed." (Had I forget this last step, my times would have been off by one hour). I then used the Find object feature and searched for "SMC". It gave the following information:

Rise: 18:04 Transit: 18:48 Set: 19:32

Thus suggests I should look due south at 6:48 PM (give or take about 40 minutes; The transit times change slightly from day to day, but it's only a few minutes a days). Even at transit, the SMC would be partly below the horizon. Sunset would be at 5:23 PM. In the tropics the transition from daytime to darkness is faster than in Michigan, and it should be quite dark by 6:48.

I made a chart. In chart mode, the SMC was not marked, so marked its location by hand. (The marking is only a rough indication of size and shape). I then used Find object and searched for "LMC". It gave the following information.:

Rise: 20:37 Transit: 23:15 Set: 01:57

Ideally I should look due south at 11:15 PM (however there is a window of several hours during which it should be visible). At transit, it would be a few degrees above the horizon, low but higher than the SMC. It is also larger and brighter than the SMC and visible for a longer time. Thus the LMC should be easier to see. Again I made a chart, on this one I added a circle representing the approximate shape and location of the LMC.

I expected that the sky would somewhat different than what I am used to. While some familar constellations, like Orion, would be visible; others like Ursa Major would not be. You cannot use the big dipper to figure out which way is North (at least not on a winter evening). However there are other ways to determine directions.

When I arrived in Belize, I took a boat to the place where I would stayed over the next week, a caye about 10 miles from Belize City (a caye, pronounced "key," is a small island). The south horizon was almost perfect. There was a beach where I could look out onto the Caribbean Sea. There was another caye directly south. It was some distance away and didn't have much elevation—it shouldn't block much.

I had not brought a telescope, but I had a pair of 7x50 binoculars.

The caye had a number of houses and a few house lights. To the north, there was a visible glow. That was Belize City. In addition to the lighting you'd expect from a city of 60,000 residents plus a variable number of tourists, the city had one obnoxious bank of bright lights. I could not identify what it was, but it reminded me of some of the obnoxious lighting near Ann Arbor. In addition, ships occasionally were anchored near the caye and they had lights. Otherwise it was quite dark, especially to the south.

This was the tropics and it was warm, I didn't need a heavy winter jacket and long underwear (both are needed to observe on the coldest winter nights in Michigan).

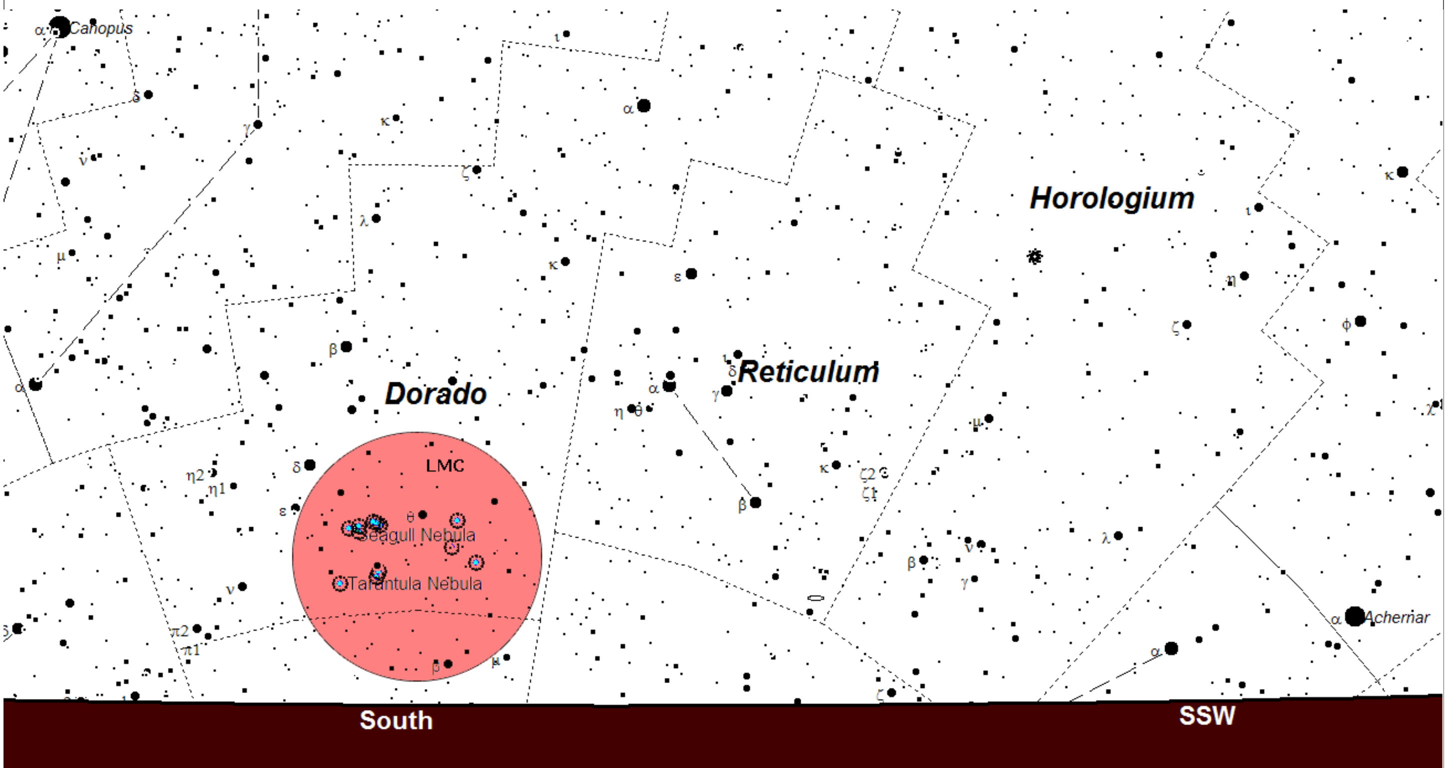
The first few nights were cloudy. However there were some clear nights. Even so, for some reason there always seemed to be a cloud bank which covered the southern horizon shortly after sunset, and I never was able to see the SMC.

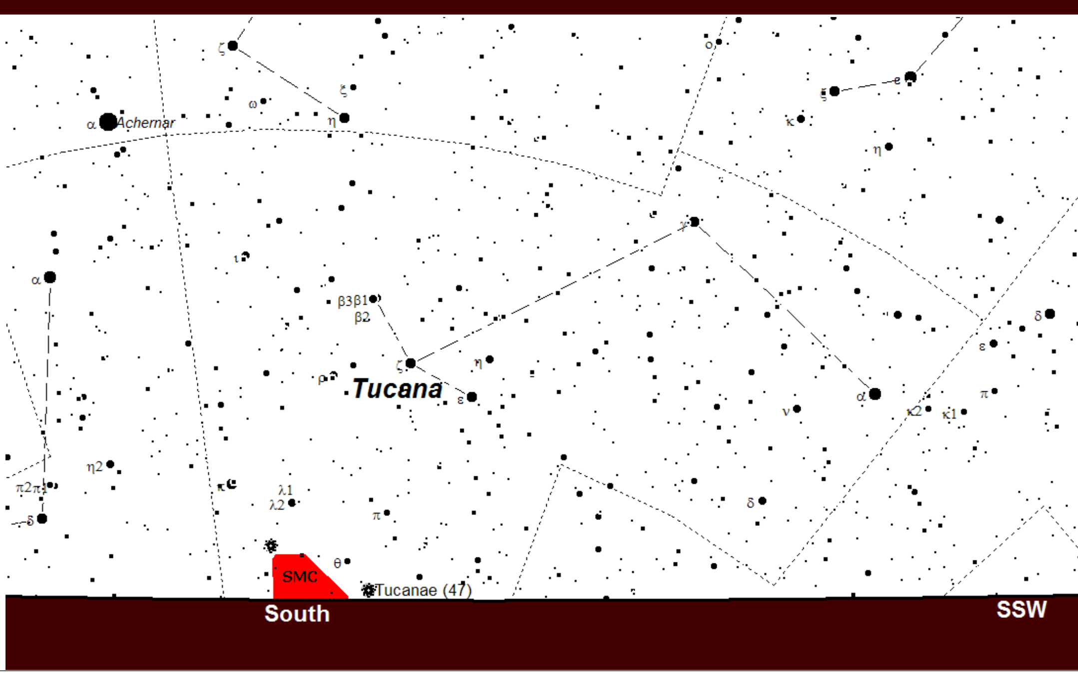
The LMC was a different story. The clouds cleared up on few nights. On one of the clear nights, I saw a fuzzy spot to the south. I wasn't sure, so I used the binoculars. It was the LMC. It is slightly too big to fit in the field of view of 7x50 binoculars and is an impressive sight.

There are a number of interesting objects located within the LMC; most notably NGC 2070 (also known as the Tarantula Nebula) and the remnant of Supernova 1987A. Only some of the objects are visible in binoculars.

The SMC has its own collection of objects. I won't mention any of them, but I will mention a nearby object. 47 Tucanae, also known as NGC 104 (it is marked in the chart just west of the SMC). This is a globular cluster, the second brightest in the sky, second only to Omega Centauri.

In theory it should be possible to see both the SMC and 47 Tucanae from Belize, but just barely. A location further south would be better. Not only would it make all the southern objects easier to see, but it gives you a chance to look for the south pole. There is no bright star anywhere near the south celestial pole—you can use the LMC and SMC to determine the pole location; but that is only possible if both are visible in the sky at the same time. For that you need to be south of the equator. Perhaps some day I'll have a chance to do that.

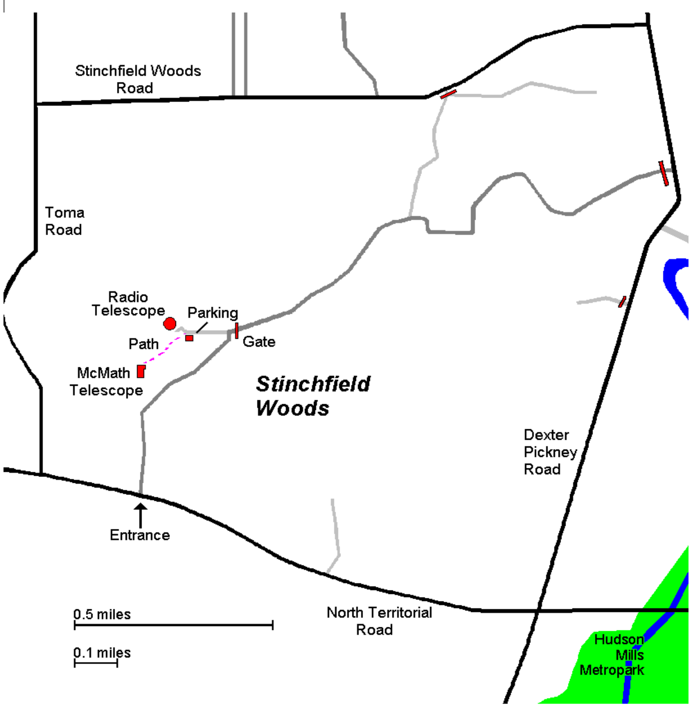




Places & Times

Dennison Hall, also known as The University of Michigan's Physics & Astronomy building, is the site of the monthly meeting of the University Lowbrow Astronomers. Dennison Hall can be found on Church Street about one block north of South University Avenue in Ann Arbor, MI. The meetings are usually held in room 130, and on the 3rd Friday of each month at 7:30 pm. During the summer months and when weather permits, a club observing session at the Peach Mountain Observatory will follow the meeting.

Peach Mountain Observatory is the home of the University of Michigan's 25 meter radio telescope as well as the University's McMath 24" telescope which is maintained and operated by the Lowbrows. The observatory is located northwest of Dexter, MI; the entrance is on North Territorial Rd. 1.1 miles west of Dexter-Pinckney Rd. A small maize & blue sign on the north side of the road marks the gate. Follow the gravel road to the top of the hill and a parking area near the radio telescopes, then walk along the path between the two fenced in areas (about 300 feet) to reach the McMath telescope building.



Public Open House / Star Parties

Public Open Houses / Star Parties are generally held on the Saturdays before and after the New Moon at the Peach Mountain observatory, but are usually cancelled if the sky is cloudy at sunset or the temperature is below 10 degrees F. For the most up to date info on the Open House / Star Party status call: (734)332-9132. Many members bring their telescope to share with the public and visitors are welcome to do the same. Peach Mountain is home to millions of hungry mosquitoes, so apply bug repellent, and it can get rather cold at night, please dress accordingly.

Membership

Membership dues in the University Lowbrow Astronomers are $20 per year for individuals or families, $12 per year for students and seniors (age 55+) and $5 if you live outside of the Lower Peninsula of Michigan.

This entitles you to the access to our monthly Newsletters on-line at our website and use of the 24" McMath telescope (after some training).

A hard copy of the Newsletter can be obtained with an additional $12 annual fee to cover printing and postage. Dues can be paid at the monthly meetings or by check made out to University Lowbrow Astronomers and mailed to:

The University Lowbrow Astronomer c/o Kathy Hillig

7654 W. Ellsworth Road
Ann Arbor, MI 48103

Membership in the Lowbrows can also get you a discount on these magazine subscriptions:

Sky & Telescope - $32.95 / year

Astronomy - $34.00 / year or $60.00 for 2 years

For more information contact the club Treasurer. Members renewing their subscriptions are reminded to provide the renewal notice along with your check to the club Treasurer. Please make your check out to: "University Lowbrow Astronomers"

Newsletter Contributions

Members and (non-members) are encouraged to write about any astronomy related topic of interest. Call or Email the Newsletter Editor: **Mark S Deprest (734)223-0262 or msdeprest@comcast.net** to discuss length and format. Announcements, articles and images are due by the 1st day of the month as publication is the 7th.

Telephone Numbers

President:	Charlie Nielsen	(734) 747-6585
Vice Presidents:	Jim Forrester	(734) 663-1638
	Nathan Murphy	(734) 395-1043
	Kurt Hillig	(734) 663-8699
	Bob Grusczynski	(734) 461-1257
Treasurer:	Kathy Hillig	(734) 663-8699
Observatory Director:	D. C. Moons	(586) 254-9439
Newsletter Editor:	Mark S Deprest	(734) 223-0262
Key-holders:	Bernard Friberg	(734) 761-1875
	Fred Schebor	(734) 426-2363
	Charlie Nielsen	(734) 747-6585
	Mike Radwick	(734) 453-3066
	Paul Walkowski	(734) 662-0145
Webmaster	Dave Snyder	(734) 747-6537

Lowbrow's Home Page

http://www.umich.edu/~lowbrows/

Email at:

Lowbrow-members@umich.edu

University Lowbrow Astronomers

Kathy Hillig
7654 W. Ellsworth Road
Ann Arbor, MI 48103

Phone: 734-663-8699
E-mail: hilligk@hotmail.com

Reflections & Refractions

University Lowbrow Astronomers
Ann Arbor, Michigan

Website
www.umich.edu/~lowbrows/

Beauty of a Winter Night

Distant, starry universe,
Ice glazed branches,
Silent harmony.

Anna Scott
U.M. Lowbrow's Astronomy Club

University Lowbrow Astronomers
Ann Arbor, Michigan

University Lowbrow Astronomers
7654 W. Ellsworth Road
Ann Arbor, MI 48103

Check your membership expiration date on the mailing label