REFLECTIONS / REFRACTIONS

University Lowbrow Astronomers

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My 10 Favorite Astronomy Books

By Christopher Sarnecki

Recently having cleaned out a bunch of old issues of *Sky & Telescope* magazines from years past, I came upon a reoccurring article titled 'My 10 Favorite Deep-Sky Wonders'. It made me think that some day I'll write a similar article for our club newsletter, but not just yet (still working on that list). Instead I thought how about writing an article about my 10 favorite Astronomy books. Like many of my fellow Lowbrows, I have a personal collection of astronomy books that I have read over the years; and, still wrap my self around some of these texts during the long cold and cloudy Michigan winters. If you need astro book recommendations, then you have come to the right place. So here is my top 10 list, presented in no particular order…

1. **A Brief History of Time, From the Big Bang to Black Holes** by Stephen Hawkings, 1988. This is the book that started my interest in all things astronomy. Someone gave me a copy of this book; I started reading it, and couldn't put it down. Many of you are aware, that this was the book that thrust Stephen Hawkings into popular public notoriety. Its very easy reading on the complicated subject of the creation of the Universe, our passage through this thing called time, and the existence of Black Holes. It is also simply illustrated in a way that allows us understand some very complicated cosmological theories. During the reading of this book, I started going outside of the house and looking up at the night sky. Shortly after that I joined the Lowbrows, and as they say, the rest is history.

2. **The Alchemy of the Heavens, Searching for Meaning in the Milky Way** by Ken Croswell, 1995. Aside from being just another book that attempts to describe the Universe, or more specifically our Milky Way, this book provides an excellent understanding of the chemical workings (alchemy) of stars, dust and gas; and, galaxies. If some of you are like me, the study of chemistry in high school and collage did not come easy, but after reading this book, I found that the author describes this subject in a way that anyone with a general interest in the formation of stars and galaxies can understand. I have read this book twice and will probably read it again in the future. While not a book for scholastic push-overs, it is highly recommend for those agreeable to applying your gray matter to understanding the galaxy you live in.

3. **Starlight Nights, The Adventures of a Star-Gazer** by Leslie C. Peltier, 1965. An autobiography with illustrations (very good ones I might say) by the author. What can I say about this book except if you call yourself an amateur astronomer, you have better have read it. The story chronicles life in the first half of the 1900s from the coming of age, through adulthood of the epic comet discoverer and variable star observer Leslie Peltier. Written in the style of a popular novel, one could think this was science fiction but it is science fact. The updated 1999 Sky Publishing version comes with many additional photographs that further illustrate this amateur's amateur astronomer's life. Don't be caught not having read this astronomy tome or else you risk losing your amateur status.

4. **The Right Stuff** by Tom Wolfe, 1980. If you are middle age, and many of our members are; you lived through America's Space Age and the landing of men on the Moon. What book would you pick to best represent that time in our history? Well for me this book best documents the early days of America's

development of high performance jet aircraft from the X-15 to flying in (and crashing) the F-104, as well as NASA's early Mercury and Apollo programs. So strap you harness in tight, cause you gonna need it. OK, so this book blurs the line between reporting on historic fact and just plain entertainment. Do I care? Heck no girls! This book is dripping with testosterone. If you don't get enough here, I suggest you read Chuck Yeager's 1985 Autobiography by the same name. *[PS – Editor Emeritus Note – I really must talk to this guy on the importance of being PC.]*

5. **Black Holes & Time Warps, Einstein's Outrageous Legacy** by Kip S. Thorne, 1994. 600 pages of topics devoted to Relativity, Space and Time, Black Holes, White Dwarfs, and Time Travel written by one of the modern age's foremost cosmological theorist. Voted as the one book I would want to be stranded with on a deserted island (along with a good star atlas and never ending supply of *Yuengling* Black-and-Tan. Hey, why should I suffer?). Well illustrated with diagrams and photographs. Highly recommended to those among us that need professional help in understanding all things cosmological.

*Intermission**:** **Raging Bitc_**, Flying Dog Brewery, Frederick, MD, Floral, fruitiness nose, this 20th anniversary brew packs a full IPU flavor with attitude.* ***Dirty Bastar_**, Founders Brewing, Grand Rapids, MI, Earthy bourbon smoothness with a bit of a dry ending.* ***Gonzo Imperial Porter**, Flying Dog Brewery, Frederick, MD, No better porter will you ever have. Deep chocolate richness that borders on an Imperial Stout.*

6. **The Perfect Machine, Building the Palomar Telescope** by Ronald Florenee, 1994. An absolutely amazing story about George Hale's building of the 200-inch telescope and observatory on Palomar Mountain in southern California in the first half of the 1900s. I enjoyed this book so much, after leaving a copy at a car rental near LAX, I bought another copy. Here is a hyperlink to my trip to Palomar with some pics in a hope to get you interested in reading this book - http://www.umich.edu/~lowbrows/reflections/2003/csarnecki.13.html

7. **Rocket Boys** by Homer H. Hickam, Jr., 1998. A true story about a young man growing up in the coal-mining town of Coalwood, West Virginia during the 60s at the time of Russia's Sputnik launch. If you love rockets, then this book is for you. Part human drama on what it was like to live in an Appalachian coal-mining town, and part an understanding of the initial development of amateur rocketry. You may have heard of the movie based on this book, titled *October Sky*. As good as the movie was, the book is better. Not many books support the movie version as well as this book does in my opinion.

8. **Deep-Shy Wonders** by Walter Scott Houston, 1999. This book is a compilation of many years of the author's *Sky & Telescope* column. Organized by monthly observing programs for amateur astronomers. 'Scotty' as he was affectionately known by amateurs everywhere, writes on his observations by shedding new light on common objects, bring our attention to overlooked objects, and collecting insights from Sky & Telescope readers. This book has caused me to spend large amounts of time pouring over star charts following up on new objects to observe.

9. **Seeing in the Dark, How Amateur Astronomers are Discovering the Wonders of the Universe** by Timothy Ferris, 2002. See my previously report on this book at - http://www.umich.edu/~lowbrows/reflections/2004/csarnecki.14.html. Many Lowbrows know about this book having attended a lecture given by the author as part of the 2009 Ann Arbor/Ypsilanti Reads Program. Highly recommended.

10. **Brother Astronomer, Adventures of a Vatican Scientist** by Brother Guy Consolmagno, 2000. Upon hearing Brother Guy was coming to Ann Arbor to give a talk to the Lowbrows, I read this book so I could have a better understanding about the speaker (Note to self – Next time don't miss the lecture ☹). The author, raised in southeast Michigan, is a Jesuit Brother, Planetary Scientist, and curator of the Vatican's meteorite collection. Brother Guy engages his reader in the religion versus science debate that has gone on since the early days of the church. He does a great job at defusing preconceptions of perceived conflicts between the study of theology and science with out offending his reader. I came away with a respect of his place in science and a real sense of enjoyment about reading of his pursuit of meteorites during his expedition to the Antarctic.

So there it is. I could have listed my top 20 books for there are so many great texts out there for us amateur astronomers. If you have some books you would recommend, I would like to see your list of your 10 favorite Astronomy Books. After all, I am always looking for more great Astronomy Books!

University Lowbrow Library

ToolKits	Date	Where it's at / Who has it	Type
Glass & Mirrors	10/10/2009	Mark S Deprest	ToolKit
Telescopes: Eyes on the Universe	10/10/2009	Mark S Deprest	ToolKit
Supernova	10/10/2009	Dave Snyder	ToolKit
Galaxies	10/10/2009	Charlie Neilsen	ToolKit
Shadows & Silhouettes	10/10/2009	Yumi Inugi	ToolKit
Planet Quest	10/10/2009		ToolKit
Black Hole Survival Kit	10/16/2009	Mark S Deprest	ToolKit
Comet Making Kit	10/16/2009	Mark S Deprest	ToolKit
Exploring the Solar System	10/10/2009	Mark S Deprest	ToolKit

Publications / CDs / DVD's	Date	Where it's at / Who has it	Type
Brother Guy: Are Asteroids Fluffy? (DVD)	10/16/2009	Mark S Deprest	DVD
Cosmos 7 Disc Collector's Edition (DVD)	10/16/2009	Mark S Deprest	DVD
The Universe -Season One (DVD)	10/16/2009	Mark S Deprest	DVD
Cosmic Voyage -IMAX (DVD)	10/16/2009	Mark S Deprest	DVD
A Sidewalk Astronomer - A film about astronomy, cosmolgy and John Dobson (DVD)	10/16/2009	Mark S Deprest	DVD
Light Dance (DVD)	10/16/2009	Mark S Deprest	DVD
What is a Planet? (DVD)	10/16/2009	Mark S Deprest	DVD
400 Years of the Telescope (DVD)	10/16/2009	Mark S Deprest	DVD
December 2005 Sky at Night -BBC (CD)	10/16/2009	Mark S Deprest	CD
McDonald Observatoy & Hobby-Eberly Telescope (VHS)	10/16/2009	Mark S Deprest	VHS
Destination: X-Ray Milky Way -Chandra X-ray Ob. (CD)	10/16/2009	Mark S Deprest	CD
Unlocking the Mysteries: Science on the Edge of our Solar System (CD)	10/16/2009	Mark S Deprest	CD
Hubble Source Video Collection 2005 (DVD)	10/16/2009	Mark S Deprest	DVD

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Books	Date	Where it's at / Who has it	Type
Galaxies by Timothy Ferris	1/22/2010	Mark S Deprest	Book
The Cambridge Photographic Atlas of Planets by G.A. Briggs & F.W. Taylor	1/22/2010	Mark S Deprest	Book
The Mars Pathfinder: Approach to Faster-Better-Cheaper by Pritchett & Muirhead	1/22/2010	Mark S Deprest	Book
Relatvistic Astrophysics & Particle Cosmology by Akerlof & Srednicki	1/22/2010	Mark S Deprest	Book
Particles by Michael Chester	1/22/2010	Mark S Deprest	Book
We Reach The Moon by John Noble Wilford	1/22/2010	Mark S Deprest	Book
The Universe by Otto Struve	1/22/2010	Mark S Deprest	Book
Astronomy / 365 Days by Bonnell & Nemiroff	1/22/2010	Mark S Deprest	Book
Teacher's Guide to Astronomy: From the Earth to the Universe by Pasachoff	1/22/2010	Mark S Deprest	Book
Relatvistic Astrophysics, Cosmology & Fundamental Physics by Barrow, Mestel & Thomas	1/22/2010	Mark S Deprest	Book
Asimov on Numbers by Isaac Asimov	1/22/2010	Mark S Deprest	Book
The Constellations Pocket Guide by Richard Dibon-Smith	1/22/2010	Mark S Deprest	Book
Science & Superstition by Adler Planetarium	1/22/2010	Mark S Deprest	Book
The Story of the Planets by Adler Planetarium	1/22/2010	Mark S Deprest	Book
Time & Navigation by Adler Planetarium	1/22/2010	Mark S Deprest	Book
What are Stars by Adler Planetarium	1/22/2010	Mark S Deprest	Book
Astronomy by John C Duncan (1946)	1/22/2010	Mark S Deprest	Book
The Comet is Coming! By Nigel Calder	1/22/2010	Mark S Deprest	Book
Chaotic Phenomena in Astrophysics by Buchler & Eichhorn	1/22/2010	Mark S Deprest	Book
Telescopes for Skygazing by Henry E Paul	1/22/2010	Mark S Deprest	Book
Lights … Camera … Action: Getting Started in Astrophotography by Clayton Kessler (Essay)	1/22/2010	Mark S Deprest	Book
Exercises In Astronomy by Edgar Everhart	1/22/2010	Mark S Deprest	Book
1975 Yearbook of Astronomy by Patrick Moore	1/22/2010	Mark S Deprest	Book
The Look of the Universe by Patrick Moore	1/22/2010	Mark S Deprest	Book
Report of the HST Strategy Panel: A Strategy for Recovery (Aug. - Oct. 1990)	1/22/2010	Mark S Deprest	Book
Majestic Universe - Scientific American	1/22/2010	Mark S Deprest	Book
Scale Model Rocketry: A Guide for the Historian-Craftsman by Peter Always	1/22/2010	Mark S Deprest	Book
Foundations of Astronomy by Michael A. Seeds	1/22/2010	Mark S Deprest	Book
Astronomy: Fundamentals & Frontiers by Jastrow & Thompson	1/22/2010	Mark S Deprest	Book
Through Space & Time by Sir James Jeans	1/22/2010	Mark S Deprest	Book
Astronomy American Nature Guide by Ian Ridpath	1/22/2010	Mark S Deprest	Book
Relativity, Cosmology, Topological Mass & Supergravity by C. Aragone	1/22/2010	Mark S Deprest	Book
Peterson First Guide Astronomy by Jay M Pasachoff	1/22/2010	Mark S Deprest	Book

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Frontiers of Astrophysics by Avrett	1/22/2010	Mark S Deprest	Book
Interstellar Contact by Duncan Lunan	1/22/2010	Mark S Deprest	Book
Mission To Mars: An Astronaut's Vision of Our Future in Space by M. Collins	1/22/2010	Mark S Deprest	Book
Applied Optics & Optical Engineering Vols 1-5 by Kingslake	1/22/2010	Mark S Deprest	Book
Burnham's Celestial Handbook Vol 1 by Burnham	1/22/2010	Mark S Deprest	Book
Amateur Telescope Making Vols 1-3 by Ingalls (Scientific American)	1/22/2010	Mark S Deprest	Book
The Realm of the Nebulae by Edwin Hubble	1/22/2010	Mark S Deprest	Book
Red Giants & White Dwarfs by Jastrow	1/22/2010	Mark S Deprest	Book
The Summer Stargazer: Astronomy for Beginners by Robert Claiborne	1/22/2010	Mark S Deprest	Book
The Evolving Universe by Goldsmith	1/22/2010	Mark S Deprest	Book
Supernova: The Violent Death of a Star by Donald Goldsmith	1/22/2010	Mark S Deprest	Book
Gravitational Curvature by Frankel	1/22/2010	Mark S Deprest	Book
Gravitation and Relativistic Astrophysics by Prasanna, Narlikar, Vishveshwara	1/22/2010	Mark S Deprest	Book
Stars & Planets by Robin Kerrod	1/22/2010	Mark S Deprest	Book
Practical Astronomy with Your Calculator by Peter Duffett-Smith	1/22/2010	Mark S Deprest	Book
Discover the Stars: How to Use the Telescope by Johnson & Adler	1/22/2010	Mark S Deprest	Book
New Handbook of the Heavens by Bernhard, Bennett, & Rice	1/22/2010	Mark S Deprest	Book
Dictionary of Astronomical Terms (2 Copies) by Wallenquist	1/22/2010	Mark S Deprest	Book
The RASC Observer's Handbook Yrs 1981, 1984, 1992, 1995, 2000, 2001	1/22/2010	Mark S Deprest	Book

The University Lowbrow Library

By Mark S Deprest (interim Lowbrow Librarian)

Over the past few months I have been taking inventory on the Lowbrow non-monetary assets, in this process I have collected and now listed the contents of the University Lowbrow Library (above). As you can see the library consists of; Night Sky Network toolkits, DVDs, Videos, and Books. Everything listed here is available to borrow by any member of the University Lowbrow Astronomers. The contents of the Library will be stored at John Causland's Footprint's store on Main Street in downtown Ann Arbor, MI. To borrow any item from the library simply notify me that you'd like to borrow an item. I will retrieve the item, log your name and date, and then notify and make arrangements with you to get you the item you want.

I realize that this is a rather clumsy process, however up until this very moment there were very few Lowbrows that had any clue what was actually in the Library. (so basically deal with it, until we come up with something better)

This list will be available on line in the "Members Only" section of the Lowbrows webpages.

If you would like to donate something to the library please feel free to do so. Notify me as soon as possible, so, I can make arrangements to pick it up, catalog it, and add it to the list.

Please note that the NSN Toolkits are used quite often by members of the University Lowbrows at public outreach events and these need to be returned promptly, so that they can be available for the next event.

Obviously more work is needed on this system and the Officers are eager to hear your suggestions as to how these assets can be better utilized. Please sent your comment and suggestions to: lowbrow-officers@umich.edu

Thank you , Mark S Deprest

Messier Marathon

By Mark S Deprest

Yes, its that time again … for some its an annual rite of spring, for others it's a test of star-hopping skills and for the rest of us it's a chance to lose a night's sleep freezing our hoo-ha's off while frenetically searching for faint fuzzies. So what is a Messier Marathon? Its an attempt to observe all 110 Messier deep-sky objects in 1 night. Theoretically it is possible to accomplish this feat, however from our latitude, under the absolute best conditions you should be able to log better than 100 of these deep-sky beauties during a 1 night (dusk to dawn) observing session in mid-March. Now, there is bit of a catch to this whole Marathon thing … you need to observe the Messier objects in a particular order and there are a few variations to the "Correct Order" but from the most part they all get the same results. Below is a list I made using a Freeware program that I will demonstrate at next month's meeting. There are many website that contain lots of info on Messier Marathon and one of my favorites is Richard Bell's at: http://www.richardbell.net/marathon.html

Order	Object	Type	Order	Object	Type	Order	Object	Type	Order	Object	Type
1	M74	GALAXY	30	M96	GALAXY	59	M89	GALAXY	88	M19	GLOB CLUSTER
2	M77	GALAXY	31	M103	OPEN CLUSTER	60	M58	GALAXY	89	M17	NEBULA
3	M79	GALAXY	32	M81	GALAXY	61	M59	GALAXY	90	M18	OPEN CLUSTER
4	M32	GALAXY	33	M82	GALAXY	62	M3	GLOB CLUSTER	91	M24	STAR CLOUD
5	M31	GALAXY	34	M105	GALAXY	63	M49	GALAXY	92	M21	OPEN CLUSTER
6	M110	GALAXY	35	M108	GALAXY	64	M60	GALAXY	93	M20	NEBULA
7	M33	GALAXY	36	M97	PL NEBULA	65	M61	GALAXY	94	M25	OPEN CLUSTER
8	M41	OPEN CLUSTER	37	M65	GALAXY	66	M53	GLOB CLUSTER	95	M8	NEBULA
9	M42	NEBULA	38	M66	GALAXY	67	M104	GALAXY	96	M62	GLOB CLUSTER
10	M43	NEBULA	39	M109	GALAXY	68	M13	GLOB CLUSTER	97	M28	GLOB CLUSTER
11	M45	OPEN CLUSTER	40	M98	GALAXY	69	M92	GLOB CLUSTER	98	M22	GLOB CLUSTER
12	M76	PL NEBULA	41	M99	GALAXY	70	M5	GLOB CLUSTER	99	M15	GLOB CLUSTER
13	M34	OPEN CLUSTER	42	M106	GALAXY	71	M57	PL NEBULA	100	M75	GLOB CLUSTER
14	M93	OPEN CLUSTER	43	M40	DBL STAR	72	M12	GLOB CLUSTER	101	M73	ASTERISM
15	M78	NEBULA	44	M100	GALAXY	73	M10	GLOB CLUSTER	102	M72	GLOB CLUSTER
16	M50	OPEN CLUSTER	45	M84	GALAXY	74	M56	GLOB CLUSTER	103	M70	GLOB CLUSTER
17	M47	OPEN CLUSTER	46	M85	GALAXY	75	M107	GLOB CLUSTER	104	M69	GLOB CLUSTER
18	M46	OPEN CLUSTER	47	M86	GALAXY	76	M14	GLOB CLUSTER	105	M55	GLOB CLUSTER
19	M1	SN REMNANT	48	M88	GALAXY	77	M29	OPEN CLUSTER	106	M54	GLOB CLUSTER
20	M35	OPEN CLUSTER	49	M94	GALAXY	78	M39	OPEN CLUSTER	107	M30	GLOB CLUSTER
21	M36	OPEN CLUSTER	50	M64	GALAXY	79	M80	GLOB CLUSTER	108	M7	OPEN CLUSTER
22	M38	OPEN CLUSTER	51	M63	GALAXY	80	M27	PL NEBULA	109	M6	OPEN CLUSTER
23	M48	OPEN CLUSTER	52	M51	GALAXY	81	M71	GLOB CLUSTER	110	M2	GLOB CLUSTER
24	M37	OPEN CLUSTER	53	M101	GALAXY	82	M9	GLOB CLUSTER			
25	M67	OPEN CLUSTER	54	M102	GALAXY	83	M4	GLOB CLUSTER			
26	M44	OPEN CLUSTER	55	M52	OPEN CLUSTER	84	M11	OPEN CLUSTER			
27	M68	GLOB CLUSTER	56	M91	GALAXY	85	M16	NEBULA			
28	M83	GALAXY	57	M87	GALAXY	86	M26	OPEN CLUSTER			
29	M95	GALAXY	58	M90	GALAXY	87	M23	OPEN CLUSTER			

Miracles and Wonders

By Tom Ryan

Normally, I limit my writing to topics that I myself have experienced or initiated. This ensures that what you read in Reflections is new, and isn't just something cut and pasted from the web.

However, I sometimes run across things that I find really interesting and are probably not common knowledge, but which might be of interest to fellow Lowbrows. What follows are a few vignettes that are not original, but which I hope you find interesting.

Wave-Particle Duality.

One of the things I like best about light is that ordinary, familiar things about it turn out to be Quantum Mechanical. Trying to understand Pauli spin matrices? Just look at the polarization of light from the standpoint of Jones matrices. Feynman's sum-over-histories approach to quantum theory? Look at double-slit light diffraction experiments. Wave-particle duality? Just look at the behavior of light waves (or photons).

Light was first described as waves in a field by James Clerk Maxwell. Calling light a wave explained diffraction, and varying the frequency of that wave explained colors. But when light detectors became sensitive enough to detect very small quantities of light, they always detected individual particles. Even today, you can do experiments which prove that light is a wave, and experiments which prove light is a particle. You just can't do them at the same time.

The problem seems to be that light is really neither a particle nor a wave. It is a bit of quantum stuff, called a qubit. And the manner in which it appears to us depends on the tools we use to measure it.

I think of light as being a bit like music. We can produce music from plucked strings on violins, each string vibrating and making waves in the field of air that add to form a song, or we can produce music from CD disks which consist solely of discrete bits of dots and dashes, which, when their fast and slow impulses are added together in the air, produce exactly the same song. We depend upon our imperfect tools, because our present senses are inadequate to see the Universe as it really is, and because of that sad fact, for now, we see through a glass, darkly.

If Space is Curved, How Curved Is It Around Here?

Einstein says that matter causes space to curve, and the curved space tells matter how to move. He also said that anything in free fall (a falling rock, a baseball headed for the outfield fence, that buttered toast headed for the floor) is traveling in a straight line through curved space-time. So why do the curvatures of the tracks of the paths of a rock and a bullet and the baseball and the toast look so different? I mean, the radius of curvature of the track of a bullet as it flies over a field is, like, maybe a mile, and the path radius of a flipped coin is just a few inches. Is space-time curved differently for these two objects?

The answer is that space-time is curved equally for all of these objects, and their paths all look exactly alike and have the same curvature, but our view of space-time is highly distorted because our senses leave out the time part.

Let's say we took movies (one billion frames per second – this is a thought experiment) of the falling toast and of a rifle bullet shot horizontally across a field (viewed along the path), and projected them onto a screen at a 1:1 ratio with the real world. You might notice after playing the movies that both the toast and the bullet hit the ground at the same time after release, but that's just an aside here. Their actual paths through space still look

very different.

Next, we'll get few billion sticks and put LED's on the top of the sticks. Then, we'll push two sticks into the ground in front of the screen and position them so the two LEDs mark the positions of the bread and the bullet in the first frame on the screen. Then, we'll move the screen back a foot, advance to the next frame, and repeat the process with two more LED sticks.

We do this a few billion times and notice something strange, as we look back on the long line of LED sticks. The pairs of LEDs representing the positions of the bread and the bullet are tracking each other perfectly. If we were to go back and tie a wire between all of the bread LEDs and tie another wire between all of the bullet LEDs, they would describe exactly the same path through space, and the two wires would have exactly the same curvatures.

The act of moving our screen one foot for every billionth of a second allows us to sweep through space at the speed of light, and to "see" the time dimension as a space dimension. That is the part that is missing from our ordinary perceptions of space-time.

So, what is the local curvature of space-time, represented by our wires?

The toast (and the bullet) fell three feet vertically through space, which took about 0.432 seconds. The distance they traveled horizontally on our screen paths (through the time dimension of space-time) was *ct*, or 186,000mi/sec x 5,280ft/mi x 0.432sec = 424,258,560 light-feet. We thus have the sagitta (3 ft) and half-diameter HD (424 million light-feet) of a parabola, and using the telescope maker's formula for the sagitta of a parabola: $\boldsymbol{sagitta = HD^2/2RC}$, we find the local radius of curvature RC of space-time to be 3.0×10^{16} feet, or about 0.967 light-years. Close to one light year on the surface of the Earth, as it turns out.

It's a week after the Holidays, and where did all that weight come from?

Astronomers have been looking for the Missing Mass in the Universe at least since the 1930's, when Fritz Zwicky noticed that the arms of spiral galaxies were spinning a lot faster than they would if they were just orbiting the visible mass of the galaxy. There are a couple theories now about what that invisible stuff might be, which include Dark Matter and Dark Energy (the latter of which causes the expansion of the universe to accelerate. Those Science Fiction writers who predicted we'd discover anti-gravity by the year 2000 were right. We call it Dark Energy, but it could also be called anti-gravity, since it looks like matter repelling matter. It is unclear whether it works like gravity in reverse or as a uniform pressure, though), but we are concerned here with the unexpected presence of mass, which seems to come and go with the seasons.

Mercury has this problem. With each turn around the sun, when it swings in close to the sun, it seems to get heavier. Thus, it speeds up in its orbit, and the orbit's perihelion (the closest point to the sun) advances a bit. When it moves away from the sun in its orbit, it acts as if it were lighter. Newton predicted a lot, but he didn't predict this.

Einstein said $E=mc^2$, which we all know, but he also said $m=E/c^2$. (He said the latter first, but it was the former that caught on.) But this formula only refers to a body's rest mass. The formula for the total energy of a moving mass is: $\boldsymbol{E = mc^2 /[1-(v^2/c^2)^{0.5}]}$.

Thus, Mercury's mass consists not just of its rest mass, but also of the mass that comes from its added kinetic energy as it speeds up in its orbit.

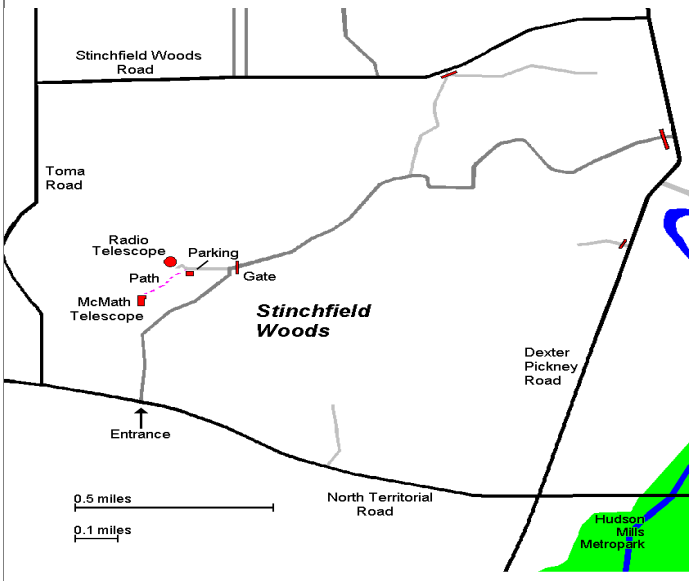
I've tried to explain to my wife that my added seasonal mass comes from kinetic energy as I approach the hors d'oeuvres table with a Martini in hand, and she just insists that I'll lose that weight if I stay farther from the center of the powerful snack attraction field.

And I thought she didn't know anything about relativity.

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 Astronomers

c/o Liz Calhoun

P.O. 4465

Ann Arbor, MI 48106

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.

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Lowbrow's Home Page

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

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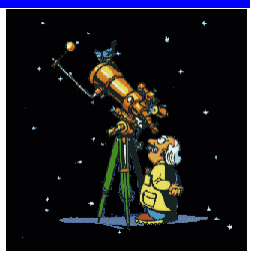
Reflections & Refractions



Website
www.umich.edu/~lowbrows/

Arp 2 a pair of interacting galaxies more than 42 million light-years away.

This is another image taken using a remote telescope in New Brunswick, CA for more info see: www.MyTelescope.com

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Check your membership expiration date on the mailing label