SIRIUS ASTRONOMER

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The Newsletter of the Orange County Astronomers

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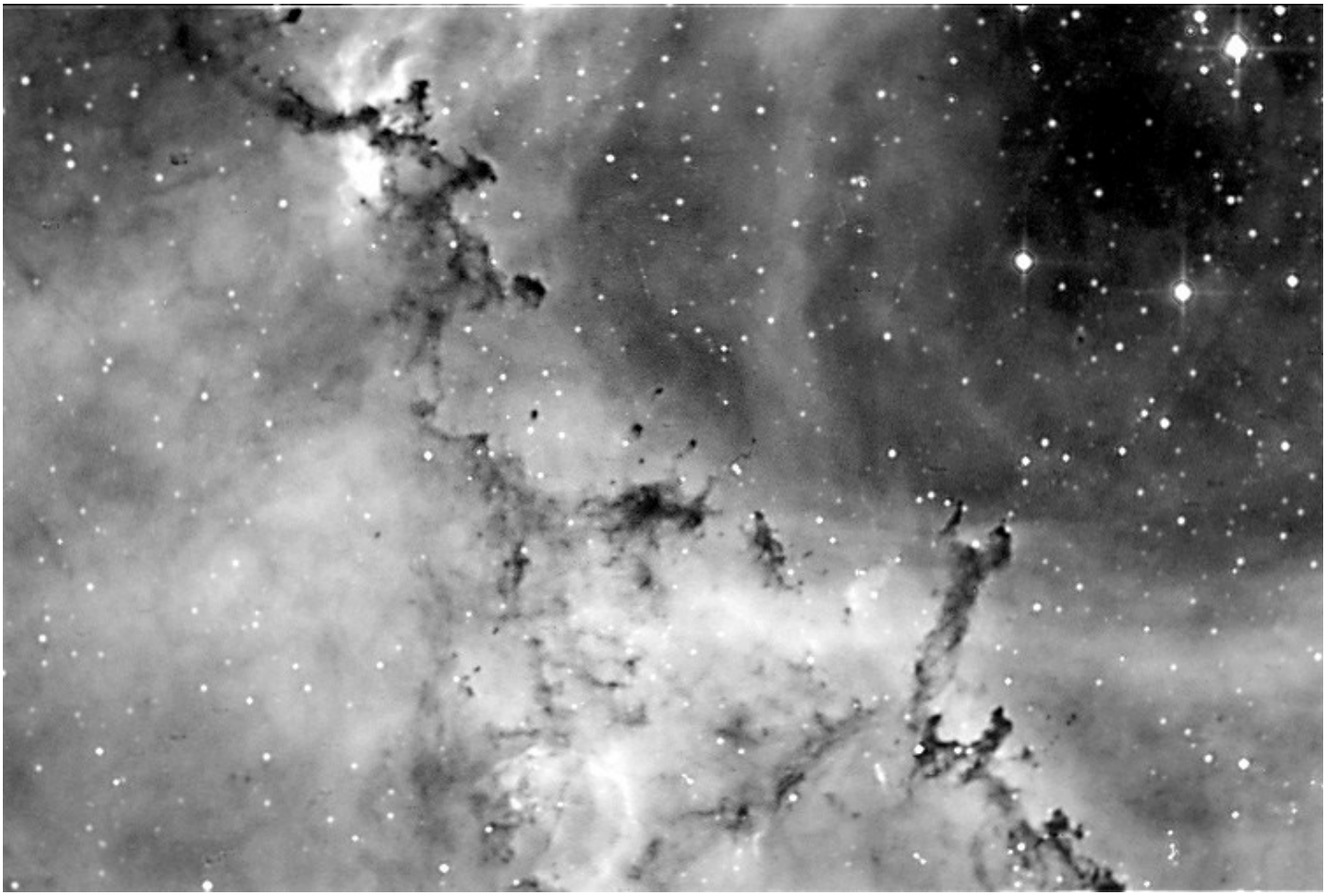
SPECIAL ECLIPSE ISSUE—DON'T MISS THE MAY 21ST ANNULAR ECLIPSE!



Part of the Rosette Nebula as imaged in H-alpha is seen here in this image by Bill and Suzanne Hall taken from Yorba Linda on January 26th. This is a 100 minute exposure (10-minute subs) taken with a 8-inch f/4 Newtonian with coma corrector.

OCA CLUB MEETING

The free and open club meeting will be held May 11th at 7:30 PM in the Irvine Lecture Hall of the Hashinger Science Center at Chapman University in Orange. This month, Robert Piccioni will speak on Einstein and Light.

NEXT MEETINGS: June 8, July 13

STAR PARTIES

The Black Star Canyon site will be open on May 12th. The Anza site will be open on May 19th. Members are encouraged to check the website calendar for the latest updates on star parties and other events.

Please check the website calendar for the outreach events this month! Volunteers are always welcome!

You are also reminded to check the web site frequently for updates to the calendar of events and other club news.

COMING UP

The next session of the Beginners Class will be held on Friday, May 4th at the Heritage Museum of Orange County at 3101 West Harvard Street in Santa Ana. The next two sessions will be on June 1st and August 3rd.

GOTO SIG: TBA
Astro-Imagers SIG: May 15, June 19th
Remote Telescopes: TBA
Astrophysics SIG: May 18, June 15th
Dark Sky Group: TBA

The May 20th Annular Solar Eclipse

By Joel K. Harris

This month, a rare and yet highly convenient astronomical event will be "coming to a neighborhood near you". Specifically, an annular, or "ring" eclipse of the sun will take place on Sunday, May 20th of this year --- an almost perfect arrangement for those who have always been curious about what a central eclipse of the sun is about, but haven't wanted to expend the time or resources to go gallivanting around the world to witness one.

The last time such an eclipse visited so close to home was back in 1994, specifically on Tuesday, May the 10th, 1994 (seems like May is a good month for annular eclipses!). While that eclipse virtually spanned the entire continental US, I personally chose to fly across the Atlantic Ocean -- to the country of Morocco – in an attempt to erase the bad memory of a failed attempt to see the "ring of fire" annular eclipse of January 4th, 1992, from Catalina Island. The normally dependable, early January weather decided to take a holiday that year, and I was forced to merely imagine what a number of others successfully witnessed back on the mainland, from such venues as Escondido, San Diego, and Ensenada, Mexico.

My effort to catch the annular eclipse that May just outside of the town of Azrou in the Lower Atlas Mountains paid off, as the photo below clearly shows. However, I almost met with a second case of failure, despite nearly ideal conditions that afternoon.

10 May 1994 Annular Eclipse from Azrou, Morocco - Joel K. Harris 1994

About 45 minutes before annularity, a car with some tourists from Denmark chanced to drive up to the turnout on highway N13, and came up to me to ask what we (myself, former OCA member Dana Matula, and another friend of ours, Mary --- whose last name currently escapes me) were doing. I eagerly explained about the annular eclipse, and the fact that it was already happening, but that it would reach a climax in just over a ½ hour.

The Danes were intrigued and said they wanted to view the partial eclipse through my spotting 'scope, and being the ever good OCA member, I obliged them. They ended up staying for annularity, catching only brief glimpses of it by quickly looking at the [almost] setting sun through some Mylar that I brought with me as a backup for curious passersby. At the peak of the eclipse, I busily took photos with both my Meade 2045 'scope and a "backup" telephoto lens of ~ 700 mm effective focal length. After sunset, my compatriots and I happily drove back to our hotel in Meknes, and went to our rooms to prepare for a celebratory dinner.

Eager to be sure to secure my images of the eclipse, I pushed the rewind button on my SLR camera that was attached to my spotting 'scope and waited until it was done rewinding. Strangely, I didn't hear any rewinding noise, as the film fed back into its canister. I then *manually* took the rewind lever and cranked it, vigorously rewinding the film. Disarmingly, *I failed to feel any sort of resistance* when I cranked the rewind lever --- even after well over a minute of winding.

My initial fear was that the film had broken/separated in the camera body, and had detached from the spindle of the canister. I quickly went into my room's bathroom, stuffed towels under the crack at the base of the bathroom door, turned off the lights in the bathroom (having done the same in the room already), and opened up the back of the camera…. Nothing.

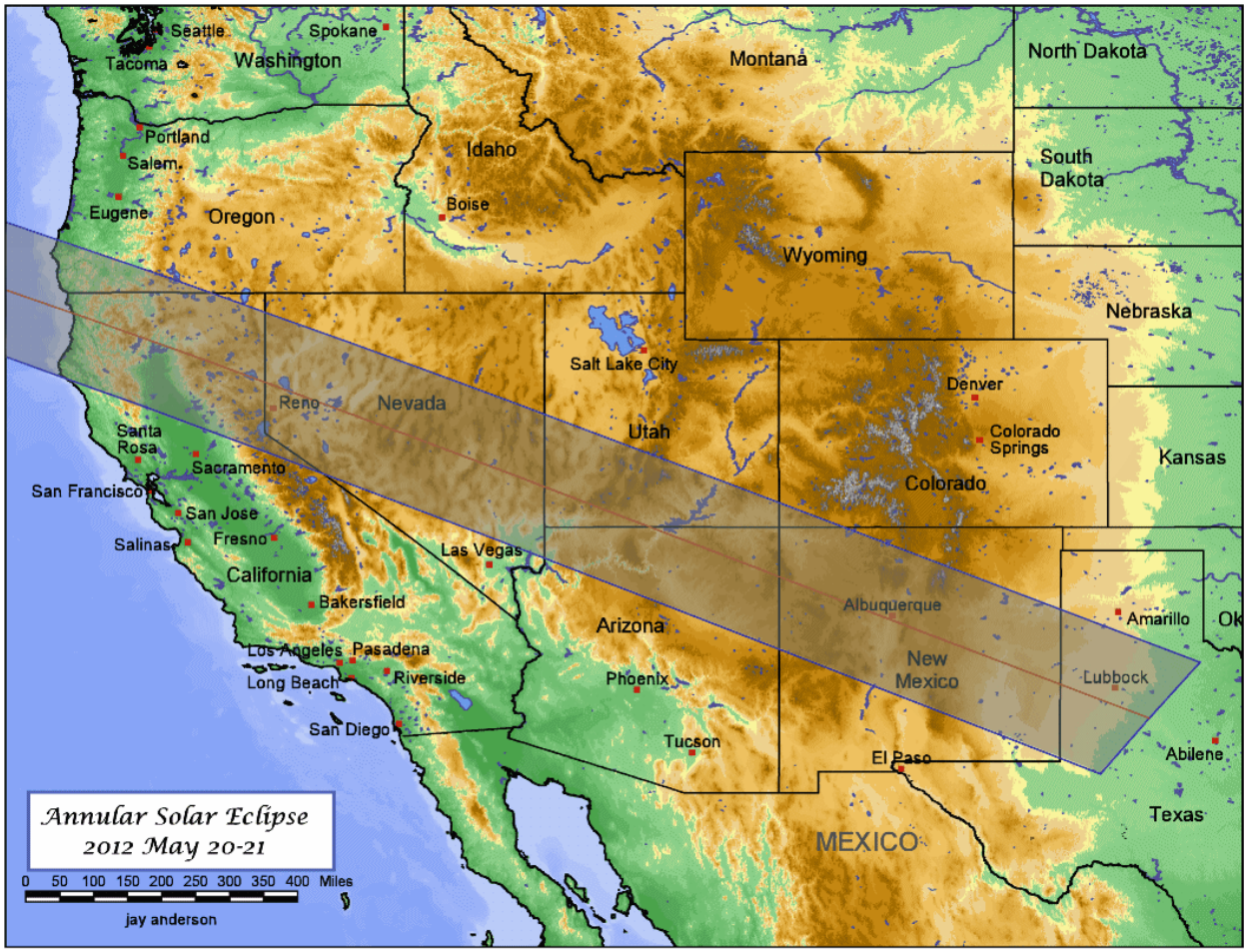
It then slowly dawned on me that during my motor-mouthed, exuberant blow-by-blow description of the eclipse for the Danish tourists, I had forgotten that I had planned to use the partial phases of the eclipse to load my camera attached to my spotting telescope with film… *All the while I was snapping photos of annularity, there was no film in the camera to record the exposures!*

Fortunately, I had my backup camera, as the image above testifies to. Of course today, that problem would never occur, as in the majority of cases, there is no "film" to load, as most astrophotographers now employ DSLR cameras…. As long as you remember to put a memory card into the device, have fully charged batteries, and take the lens cover off the camera (as well as having proper solar filter material on the objective end of your lens)….

For this month's annular eclipse, you need to take a few minutes and make some key decisions about how you plan to observe and capture it. Here are some starter questions that demand your focus, to ensure a good eclipse trip:

- How much time do you have to go see the eclipse (a day, 3 days, a week)?
- What sort of budget do you have to expend to get to the eclipse?
- Who might be traveling with you to the eclipse event?
- What sort of photography do you plan on doing for the eclipse (still, video, both)?
- How much equipment will you be taking to the eclipse (telescope, cameras, binoculars, tripods, GPS receiver, filters, etc)?
- How do you plan to get to the eclipse (drive, fly)?

A map of the eclipse track is shown below, as created by noted eclipse weather meteorologist and long-time eclipse chaser, Jay Anderson, of Environment Canada (ret.).



Map of 20 May Annular Eclipse Through the SW United States

While this is an admittedly moderate resolution map, there are other higher detailed ones on Jay's personal web site, whose URL is: http://home.cc.umanitoba.ca/~jander/ase2012/ase12intro.htm There are maps on the site for all the southwestern states that the moon's antumbra will be traversing on May 20th.

Another major consideration for anyone thinking of traveling to the eclipse will be the weather, of course. Jay's site has some detailed information to assist the amateur astronomy community in making informed decisions about the likelihood of cooperative weather, along the annular eclipse track, such as this handy synoptic weather data table:

Table 3: Annular Solar Eclipse 2012 May 21/22

May Climate Statistics for the U.S.A.

Location	Percent of possible	Percent Frequency of _____ Clouds						Calculated Average	Average Monthly	Days with	Average High Temperature	Average Low Temperature
	%	Clear	Few	Scattered	Broken	Overcast	Obscured	%	(mm)		(°C)	(°C)
USA												
Alaska												
Amchitka Island		0	6.4	0	18.3	68.8	6.4	90				
California												
Shelter Cove		36.9	14.5	4.1	14.5	24.4	5.5	45	67		19	9
Eureka	58	31.5	11.5	5.1	18.4	33.3	0.2	52	41	5.5	14	9
Arcata Airport		30.5	8.8	7.8	17.3	35.5	0.2	54			-18	-18
Redding Municipal Arpt*	91	53.6	9	6.8	14.7	15.8	0	32	42	8.0	27	11
Mount Shasta		60.2	4.2	5.5	16.9	13.1	0	29	47	7	20	4
Red Bluff Municipal		47.1	18.5	5.4	14.8	14.1	0	31	28		28	12
Chico Municipal Airport*		17.8	28.5	9.4	24.5	19.8	0	48	23		27	11
Oroville		85.4	3	1.3	2.3	8	0	11	25		27	11
Blue Canyon		50.5	7.5	5.2	8.6	25.3	2.9	38	74	7	16	7
Alturas*		57.3	9.6	5.6	10.9	16.6	0	29	34		20	1
Truckee-Tahoe*		17.2	23.4	7.9	30.1	21.4	0	52	34		18	0
Oregon												
Montague Siskiyou Aprt		44.3	21.9	2.9	15.7	15.2	0	32			-18	-18
Medford Rogue Valley		35	9.5	8.3	15.1	32.2	0	49	31	8	23	6
Klamath Falls Arpt		5.3	24.5	10.7	40.3	19.2	0	59	28		20	4
Nevada												
Reno Tahoe Arpt	81	13.9	17.6	15.6	32.6	20.3	0	55	18	2.8	23	5
Fallon NAAS		4.1	15.8	18.6	41.2	20.3	0	63	20		23	7
Lovelock Derby Field		35.8	13.5	9.8	21.8	19.2	0	43	17		23	5
Tonopah		38.1	13.8	9.5	22.8	15.8	0	40	16		23	6
Ely Yelland Field		35.1	10.9	6.8	24.9	22.3	0	46	29	5.4	20	1
Utah												
Saint George AWOS		77.2	11.2	2.2	6.4	2.9	0	11	10		31	13
Cedar City Municipal		40.9	12.1	7.7	20.9	18.3	0	40	23		22	5
Milford Municipal Ap	73	74.4	5.6	7	8.7	4.2	0	15	24	5	23	4
Bryce Canyon FAA		66.2	12.6	7.3	9.9	4	0	17	27		16	0
Arizona												
Grand Canyon Natl Park		42.8	23.6	8.8	15.8	8.8	0.2	29	16		21	2
Flagstaff Pulliam Arpt	88	42.1	18.1	8.4	19.6	11.8	0	34	20	4	20	1
Page Muni Arpt		85.6	4.7	3.9	3.6	2.2	0	7	10		26	11
Winslow Municipal Arpt		90.8	2.9	1.6	3.3	1.4	0	5	8	3	26	7
Window Rock		81.3	9.7	3.3	4	1.7	0	8	12		21	3
St John's Air Park		82.2	5.9	3.7	5.2	3	0	10	12		26	6
Colorado												
Cortez Montezuma Co.		56.7	16.1	2.2	13.2	11.9	0	26	28		22	3
New Mexico												
Gallup Senator Clark Field		43.7	15.3	9.7	15.4	15.9	0	35	16		24	1
Farmington Four Corners		40.7	26.6	2.3	25.3	5.2	0	30	14		24	6
Albuquerque Intl Arpt	79	11.1	15.8	24.6	33.4	15.1	0	54	13	2.6	27	9
Los Alamos		25.1	23.6	4.2	38.1	9.1	0	44	36		20	5
Santa Fe County		38.1	22.5	5.1	23.3	11.1	0	35	32		23	5
Clines Corner		83.6	6.3	3.8	3.8	2.4	0	8	41		22	4
Las Vegas Municipal Arpt		69.1	12.1	4.5	8.7	5.3	0.4	16	47		22	5
Sierra Blanca Regional		80.4	0.9	6.8	6.4	5.5	0	14	47			
Roswell Airpark	80	61.5	10.7	4.7	12.4	10.7	0	24	26	3.4	29	13
Clovis Muni Arpt		67.2	14	2.2	6.6	10	0	18	49		27	11
Hobbs/Lea County		26.2	15.9	25	29.8	3.2	0	40	52		30	13
Texas												
Lubbock	71	34.6	20.2	12.4	17.7	15.1	0	38	60	5.2	28	13
Midland	78	59	11	7.2	12.3	10.5	0	25	50	4.2	31	15
Abilene Regional	70	58.2	10	4.3	10.5	17	0	29	75	5.6	29	16

Another highly recommended site to visit is the Google Earth driven, interactive eclipse map compendium created and maintained by Xavier Jubier from France. Xavier's web site URL for solar eclipse mapping via Google Earth is: http://xjubier.free.fr/en/site_pages/SolarEclipsesGoogleMaps.html

Wherever you elect to go, I would also strongly suggest that well before your trip, you take time and outline what your plan is, during both the partial phases and during annularity. Doing this will not only keep you well organized, but also will [hopefully] keep you from making the sort of error that I experienced back in 1994.

Finally, while the majority of subscribers to the Sirius Astronomer already know this, it certain bears repeating for both accomplished eclipse chasers and novices alike: an annular eclipse is NOT a total eclipse. Thus, you MUST follow proper eyesight protection protocols during the ENTIRE duration of the event. *At no time, should you look at the eclipsed sun without safe, proper solar filtration.* Doing otherwise puts you at significant risk of permanently damaging your eyes through UV and/or IR exposure to your retinas. You can cause irreparable harm to your eyes, if you do not take proper steps to protect your eyesight during this eclipse!

Some good sources for safe, reliable solar filter material/viewing glasses for this eclipse include:

- Thousand Oaks Optical Co: http://www.thousandoaksoptical.com/
- Rainbow Symphony: http://www.rainbowsymphony.com/
- Baader Planetarium Solar Filters: http://www.baader-planetarium.com/sofifolie/sofi_start_e.htm

Wherever you eventually end up for the eclipse, be sure to write down your experiences, save your photos, and seriously consider sharing either or both with the rest of the club through the newsletter and/or the OCA website. And to everyone going to the eclipse, clear skies!!

AstroSpace Update

May 2012

Gathered by Don Lynn from NASA and other sources

Dark matter – One theory of what dark matter is claims that it is made of weakly interacting particles that we have not discovered yet in our particle accelerators, known as the WIMP theory. Many experts believe that on rare occasions such particles should annihilate and create gamma rays. A team of astronomers went looking for such gamma rays. They used the Fermi space telescope to look at 10 nearby dwarf galaxies known to have large amounts of dark matter (by its gravitational effect), but without other sources of gamma rays. They saw no gamma rays of the type predicted by many WIMP theorists. Either the theory is wrong, or the frequency of annihilation is much less than believed.

Dark matter in 3D – 2 teams of astronomers have used data from the Chandra X-ray space telescope and other telescopes to map the distribution of dark matter in a galaxy cluster known as Abell 383, including the 3rd dimension (depth along the line of sight). The cluster is about 2.3 billion light-years away. Both teams found that the dark matter stretches out like a gigantic football (American football shape), rather than being spherical, and that the point of the football is aligned close to the line of sight, but slightly tilted. Both teams combined the X-ray observations of the normal matter in the cluster with gravitational lensing information determined from visible light data. Anything with mass, including dark matter, bends light like a lens does, but by its gravity, according to General Relativity. The 1st team concluded that the concentration of dark matter at the center of the galaxy cluster matched theory, but the 2nd team came up with a smaller concentration. The 2nd team used star velocities near the cluster center, which the 1st team did not, so should have a more robust calculation. If this lower concentration is confirmed, some theories may have to be reworked.

Dark energy – Theoretically the acoustic oscillations (sound waves) present in the Universe in the thousands of years immediately after the Big Bang should still be visible today as a slight tendency for galaxies to bunch up at a certain distance from each other. For example there would be more galaxies separated by 500 million light-years than separated by 400 or 600 million. These are the same sound waves that made the patterns seen in the Cosmic Microwave Background. In fact these waves have been measured in galaxy patterns. A new study measured these waves in galaxy distributions to greater accuracy than before, and out to distances of 6 billion light-years. This tells us how the pattern of galaxies has changed over the last 6 billion years, since we are seeing those most distant galaxies as they were when the light left them 6 billion years ago. This change in galaxy grouping over time is highly dependent on the strength of dark energy, the force that seems to be pushing the Universe apart, speeding up its expansion. The new study shows that dark energy overcame gravity's pull to slow the expansion somewhere between 5 and 7 billion years ago. Dark energy's force seems to remain constant over time, while gravity's pull between galaxies on average gets weaker with time simply because the galaxies are farther apart due to expansion of the Universe. This new study is a more accurate measure of when dark energy overcame gravity than previous measurements. The observations on which the new study was based were part of Part III of the Sloan Digital Sky Survey (SDSS), which is currently ongoing. It has taken spectroscopic measurements of about ¼ million galaxies so far, with a goal of over a million.

More dark energy – A team of researchers has examined 100,000 quasars in the data from the SDSS and has found nearly 50 new examples of gravitational lensing, that is, where a foreground object is massive enough to bend the light from the more distant quasar. More than 100 of these lensed quasars had already been known. This study gave the 1st good estimate of what fraction of quasars are gravitationally lensed, the result being about 0.05%. The strength of dark energy, in fact its existence, is known to affect this lensed fraction, by changing the density over time of quasars and lensing objects in front of them. The new result supports the existence of dark energy, confirming its existence independent of other methods.

Supernova – A team of scientists using X-ray data has mapped the distribution of elements in the supernova remnant Cassiopeia A in unprecedented detail. It appears that the supernova explosion turned the star inside out. The elements known to be near the center of a star, starting with iron, were found to be at the outside edges of the remnant. There is no measurable iron near the center of the remnant. Silicon, sulfur and magnesium were also measured to be "inside out". The new element map shows that the mass of debris in the remnant (at least the debris hot enough to emit X-rays) is just over 3 times the mass of the Sun. It contains 0.13 solar mass of iron, 0.03 of sulfur, and 0.01 of magnesium.

Type Ia supernovas – Studies using X-ray and ultraviolet observations from the Swift satellite has helped narrow the possibilities of how a Type Ia supernova explodes. It has long been known that a white dwarf star explodes as Type Ia after it has acquired too much matter from a companion star, but debate continues over what kind of companion star and how the material is acquired. Swift's primary mission is to locate gamma-ray bursts, but in between those bursts it observes other objects, including Type Ia supernovas. 53 of the nearest Type Ia supernovas seen by Swift were examined for X-ray emission. Theory says that if the companion star was a supergiant star or red giant star, then it would have thrown off material before the supernova that would later be impacted by the matter thrown off by the supernova and glow in X-rays. No such X-ray emission was found, so likely none of the 53 supernovas involved a supergiant or red giant companion star. Another study selecting only 12 Type Ia supernovas seen by Swift, on the basis of early observations, also concluded none of them involved a red giant companion. This is because the theoretical ultraviolet emission that a red giant companion should produce right after a supernova was not seen. After the study, the recent Type Ia supernova in M-101 exploded, relatively nearby, and no such ultraviolet emission was seen. The team believes that this closer supernova now rules out any companion star larger than the Sun, at least for the M-101 case. Yet another team analyzing Swift data on the M-101 supernova has concluded that only 2 merging white dwarfs could produce the observed behavior of this supernova. That means that they are ruling out all companion stars other than white dwarfs, and they are ruling out partial transfers of matter, supporting only complete merging, but only for the one case of the M-101 supernova.

More Type Ia supernovas – A team of astronomers using data from the Sloan Digital Sky Survey (SDSS) has also been trying to determine the exact cause of Type Ia supernovas. They figured out that if merging white dwarfs cause a Type Ia, then the rate of white dwarf pairs merging should be the same as the rate of Type Ia supernovas. First they had to measure the frequency of white dwarf pairs. They cannot be seen far, so they had to measure the number nearby in our Milky Way, and assume that is typical of galaxies. Since white dwarf pairs can often not be resolved separately, they needed spectra of white dwarfs that showed a change if redshift over time, due to orbital velocity of the pair. The SDSS has lots of white dwarfs, but only a single spectrum of each. However, every spectrum taken was done 3 times to rule out certain errors. So the team got the raw data (rather than the final SDSS data) and reprocessed it to get the 3 original spectra of each white dwarf in a format where redshift could be compared. The team examined 4000 nearby white dwarfs with at least

2 high quality spectra and found that 15 of them were certainly white dwarf pairs. From the redshift changes, the orbital velocity could be determined, and from that the distance between each pair could be calculated. Then running simulation for pairs orbiting at those distances, it was determined how long they typically take to merge, and thus the white dwarf pair merge rate was calculated. From watching thousands of galaxies for Type Ia supernovas, astronomers had long ago determined the rate that they occur. Both the rate of Type Ia and the rate of white dwarf merge turned out to be about 1 per hundred years per Milky Way-sized galaxy. Their conclusion is that most Type Ia supernovas are likely to be from white dwarf pairs merging.

Stellar black hole – A team of scientists has discovered the farthest known stellar-size black hole. Supermassive black holes found at the centers of galaxies can be seen at huge distances, at least when they are sucking material in, but stellar-size ones are much more difficult to observe. They have been seen only in the Milky Way and its local group of galaxies. There are thought to be millions of stellar black holes in every large galaxy. The newly discovered black hole is in Centaurus A, a galaxy about 12 million light-years away. It was located in X-rays by its brightening and dimming in a pattern characteristic of stellar black holes sucking material from a companion star. The team plans to look at the more than 50 other X-ray source known in Centaurus A to see if they are black holes or other X-ray objects.

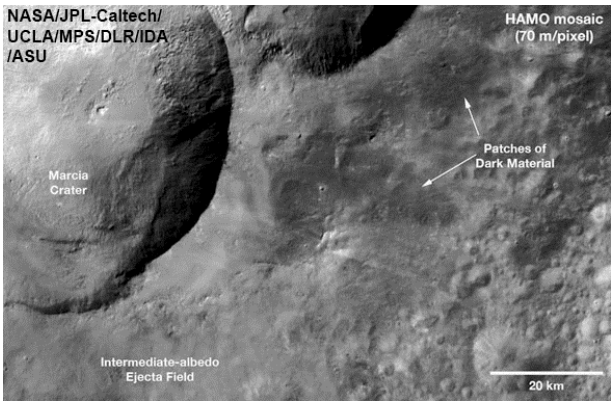
Black hole growth – Most large galaxies, perhaps all, appear to have supermassive black holes at their center. We know how stellar mass black holes form – collapse of large stars at the end of their life. But we don't know how a supermassive black hole could form. Most astronomers believe that they grow from small black holes, but the method of growth is still being debated. A new study claims to have determined how they grow. The study says that growth is accomplished by double stars wandering too close to the black hole. Single stars generally will not fall into a black hole, but orbit by it, in order to obey the conservation of energy. But double stars can still conserve energy if one star falls into the black hole and the other star carries away the energy. The study made calculations of the rate at which binary stars would undergo this process, and concluded it was roughly right to explain black hole growth rates. 3 observations could confirm this theory: observing large numbers of stars near supermassive black holes (only the brightest stars near the closest supermassive black holes can be seen with current technology), seeing more stars being shredded at a black hole (a few have been observed), and finding more hypervelocity stars (ones being flung away from a black hole, a few of which are known). If the frequency of these can be established as meeting the estimates in the new study, then the theory will be supported.

Recycled gas – The gas found in ordinary galaxies like the Milky Way was some time ago found to be inadequate to sustain the rate of star formation. One theoretical solution is that some of the gas blown out of the galaxy must fall back in (gets recycled) to keep supplying ongoing star formation. Such gas recycling has been found in local galaxies, but it was still uncertain if the process occurred in more distant galaxies, which seem to have stronger outflows. New observations have found gas falling back into 6 fairly distant galaxies (5-8 billion light-years away), adding further confirmation to the theory. Gas appears to be blown out by various processes generally perpendicular to the disk, but falls back in around the edges. 100 galaxies were examined to find the 6. The small number was expected because some orientations of galaxies should make the gas falling in undetectable. Taking this into account, it was calculated that as high as 40% of the galaxies examined might actually have material being recycled.

Unusual galaxy – Studies of the galaxy NGC 3801 using the Giant Meterwave Radio Telescope in India have found a number of unusual features. Although some astronomers classify it as a lenticular (S0) galaxy, it appears to have some spiral star-forming structure. The spiral structure may have been caused by a merger event. It contains a supermassive black hole with jets seen in radio. Observations show that the jets have been active at least 3 times, an unusual occurrence. It may be that the 3 areas of jets are visible only because a shock wave has passed through old material. A high star-birth rate in some areas, suspected from radio observations, was confirmed with ultraviolet. Yet much of the galaxy consists of old stars. The galaxy has an extremely warped gas disk. The unusual features may be explained by happening to observe the galaxy during a phase that does not last long, after post-merge star formation has declined, and feedback from the jets has not completed turning off all star formation.

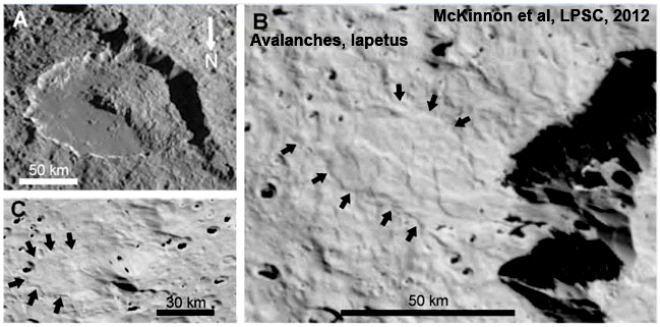
Exoplanets at red dwarfs – The results were announced of a study made with the high-resolution HARPS spectrograph on the 3.6 meter telescope in Chile. The study concentrated on over 100 selected red dwarf stars, looking for the wobbles induced by the gravity of orbiting planets. About 80% of the stars of the Milky Way are red dwarf stars. However most exoplanet searches have concentrated on brighter, more easily observed (and more Sun-like) stars. The observations are sensitive enough to detect planets generally larger than Earth. This is the 1st search of red dwarfs thorough enough to get statistics on how common their planets are. About 40% of red dwarfs were found to have a super-Earth (defined as 1-10 times the mass of Earth) in their habitable zones, that distance range over which the temperatures allow liquid water to exist on the planets. There are tens of billions of planets in the Milky Way orbiting in the habitable zones of red dwarfs. There are likely about 100 super-Earths orbiting red dwarfs in habitable zones within just 32 light-years of us. However red dwarf planets may not be likely places for life to have developed, since those stars are subject to eruptions and flares, which would bathe their planets in dangerous X-rays and ultraviolet. Gas giant planets, like Jupiter or Saturn, were found to be less common, with less than 12% of red dwarfs possessing them.

Dawn (mission orbiting asteroid Vesta) has sent more images with unexpected features on Vesta. The asteroid is generally bright (highly reflective), but some areas are nearly twice as bright as others. The bright material seems to have undergone little change since the formation of Vesta over 4 billion years ago. Bright areas appear everywhere on Vesta, but are more predominant in and around impact craters. The impacts seem to have exposed and spread this bright material. The areas vary from several hundred feet to around 10 miles (16 km). There are distinct areas of dark material also. They can appear dark gray, brown or red. They sometimes appear as small well-defined deposits around impact craters. They also can appear as larger regional deposits. Scientists theorize that carbon-rich asteroids could have hit Vesta at low speed and pro-



duced some of the smaller dark deposits. Higher-speed asteroids also could have hit Vesta's surface and melted the volcanic basaltic crust, darkening existing surface material. That melted conglomeration appears in the walls and floors of impact craters, on hills and ridges, and underneath brighter material thrown out from more recent impacts.

Iapetus – Scientists have found in Cassini spacecraft images over 2 dozen avalanches on Saturn's walnut-shaped, 2-toned moon Iapetus. They are huge, flowing unusually long distances. Just how these avalanches are occurring is somewhat of a mystery. A number of explanations have been proposed. Something appears to be heating the ice, which composes most of the surface, enough that it gives way. The large mass movements on Iapetus are less common than on Mars, but they are so large that the material moved exceeds that of Mars. Many of the slides are seen from crater and basin walls and steep scarps. There are 2 types seen on Iapetus: blocky rough looking debris and smoother lobate slides. Some locations have had multiple avalanches. These avalanches appear rare on icy

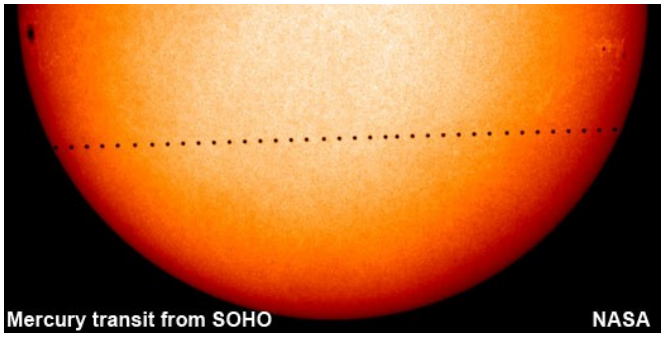


planetary bodies, though a few are known on Callisto and Phoebe.

Aurora on Uranus – Auroras were seen by Voyager during its flyby of Uranus in 1986, but attempts to observe such from Earth have been unsuccessful until now. The Hubble Space Telescope (HST) was recently turned toward Uranus at times when solar particles should be arriving at that planet, after earlier detection of the particles while passing Earth. The auroras seen by HST are not like those seen in 1986. Now they are glowing spots that last only minutes, while previously they had been glowing arcs that lasted longer. Scientists believe that the difference is caused by the seasons on Uranus, and that the rotation pole of the planet is almost horizontal compared to all other planets' vertical, and that the magnetic field of Uranus is aimed far off from the rotational pole. That means that in 1986 the magnetic pole was describing daily circles about the line toward the Sun. But a season later the magnetic pole is now describing circles around a line at right angles to the Sun direction, pointing nearly toward, then nearly away from the Sun each Uranian day. This apparently prevents particles from the Sun from arranging in a circle or arc about the magnetic pole, like they do on Earth and did on Uranus a season ago.

Messenger (Mercury orbiter) has been mapping the gravity of Mercury and measuring elevations with its altimeter. Putting these results together has resulted in some surprises about the small planet. The total range of elevations (about 6 miles or 10 km) is only about half that of the Earth or Moon, and much less than Mars. This implies that the tallest mountains that form are sinking into Mercury, or the deepest depressions are filling with material welling up from below, or both. The gravity mapping has found several mass concentrations, 3 of which appear in low areas, tending to confirm that heavy material from below has welled up. The data confirms that Mercury's core is huge (83% of the radius of the planet), in fact larger than previous calculations had indicated. It is composed of an inner solid core and an outer molten core, though the boundary between them is not well established by the data. Because the core extends closer to the surface than thought, the crust is probably hotter than thought, and this would cause the material to be more deformable, and thus allow mountains to sink in farther. This supports the altimeter data. The layer above the core was found to be much denser than previous calculations. The altimeter data found an elevated region, being called the Northern Rise, sticking up above the northern lowlands surrounding the north pole. Scientists are speculating that the Northern Rise was caused by buckling of the surface when the planet's interior cooled and contracted. Buckling is also indicated by past discoveries of scarps and ridges.

Sun's size – A group of scientists has measured the diameter of the Sun with unprecedented accuracy using data from the SOHO solar space telescope, when it observed Mercury transiting across the Sun in 2003 and 2006. Result: Sun's radius is 432,687 miles (696,342 km) with uncertainty of 40 miles (65 km). The accuracy came from not having to look through the Earth's atmosphere, as Earth-based telescopes must do. The team is preparing to observe Venus transiting the Sun on June 5, expecting to improve the accuracy of their solar size measurement.



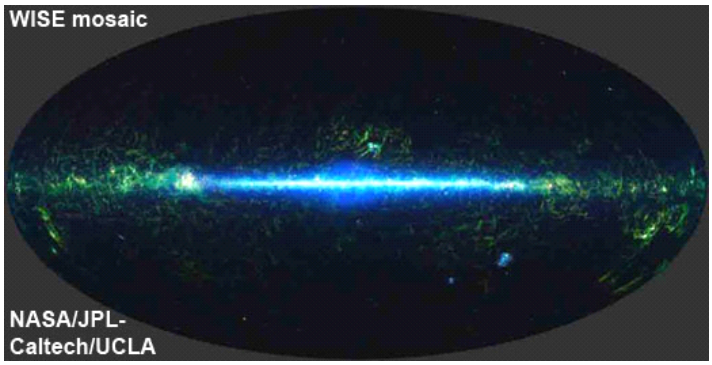
Old exoplanets – A team of astronomers has discovered a planetary system that has likely survived for 12.8 billion years. The star is known as HIP 11952 and it was found to have 2 planets, which orbit in 290 and 7 Earth days. The star is very low in heavier elements, indicating it formed early in the history of the Universe. Stars produce the elements heavier than hydrogen and helium and have continued to spread these elements into the clouds out of which new stars are made. So stars that formed later generally have more of the heavy elements. Statistically it has been shown that stars with very little heavy elements rarely have planets, so this find is unusual. Only one other extremely heavy-element-poor star has been found with planets. HIP 11952 is in Cetus about 375 light-years from us.

Planet formation – New computer simulations of the disks out of which planets form suggest that high-energy radiation from baby Sun-like stars likely creates a gap in the disk at about 1-2 AU (the distance of the Earth from the Sun). Such a gap forms no planets, and planets that form in the non-gaps tend to bunch up at the edges of the gap. The result is that planets are not distributed smoothly with distance from the star. In observations, some pileups of giant planets at certain distances have been seen. It is expected that planet finding techniques will become more sensitive to planets more distant from their stars, and that will provide more observational confirmation of the new simulation. Photoevaporation is the process that cleared the gas in the simulations. Although photoevaporation works inside the gap also, the material there did not dissipate, apparently due to stronger gravitational pull. The new simulations also showed giant planets migrating inward and then settling on a stable orbit, which theory and other simulations have shown. However this simulation showed that the migration stopped when the planet reached the gap in the disk.

More planet formation – A comparison of systems containing multiple exoplanets discovered by the radial velocity technique with those discovered by transiting in front of their stars shows that most planets lie in the

same plane within any planetary system. If planets often lie outside the plane of other planets within their system, then finding multiple planets by the transit method would happen much less often, because planets outside the plane would generally pass above or below their star, so we would not discover them by the transit method. We knew our own solar system lies quite close to a single plane, but it was not known until now if this applies to most planetary systems. This supports the theory that planets form from a relatively flat disk of material, and that disrupting events that tilt planets' orbits are rare.

WISE (infrared space telescope) – The individual exposures from the WISE mission have been combined into an atlas of more than 18,000 images covering the whole sky and a catalog listing the infrared properties of more than half a billion individual objects, mostly stars and galaxies, in roughly equal numbers. The data covered 4 different wavelengths of infrared light.



More WISE – Blazars consist of supermassive black holes actively pulling matter onto them at the cores of galaxies. What makes blazars different from other active supermassive black holes is that the jets of matter thrown out from them happen to be aimed at Earth. Normally infrared data, such as produced by WISE, is used to observe low-energy processes, but a team of astronomers decided that blazars, which are very high energy, should show up with a distinctive signature in infrared. The Fermi gamma-ray space telescope has discovered hundreds of high-energy sources that are located where no object has yet been found in any other wavelengths. Many of these are suspected to be blazars. So the team looked at the locations of a few hundred Fermi unexplained objects in the WISE infrared data. This showed that a little more than half of the unexplained Fermi objects are now explained as blazars. The team also looked at the WISE data at the locations of more than 1000 previously known blazars, and also found more than 50 new blazars (in addition to the Fermi objects). If the new technique is applied to all the WISE data (only a subset was used), it should uncover thousands more blazars. When WISE was designed, astronomers had no idea that it would be useful for studying blazars.

Milky Way in infrared – The results have been released from a 10-year project to image the entire Milky Way in infrared from 2 Earth-based telescopes (in Hawaii and Chile). It consists of a mosaic color image with more than a billion stars. Large structures of gas and dust are also seen. This data is archived at the universities of Edinburgh and Cambridge, and is available to all astronomers. It is expected to enable scientists to carry out groundbreaking research in future years without the need of further observations.

Fomalhaut disk – Observations of the dust disk about the nearby star Fomalhaut in visible light and infrared seemed to imply conflicting grain sizes and temperatures. A new theory seems to explain the contradiction. If the dust grains are large and fluffy, similar to those thrown off from comets in our own solar system, then both sets of observations are consistent. However, such grains should be blown away relatively quickly by the bright light from Fomalhaut. This would imply that the fluffy grains are continuously resupplied. It was calculated that to resupply the grains would require that thousands of small comets collide and break up every year, or a few large comets doing so per year. Then it was calculated how many comets would have to exist orbiting Fomalhaut to result in so many collisions, and it turned out to be roughly the same number as estimates of comets in the Oort Cloud of comets orbiting our Sun. So far the new theory looks good.

GRAIL (pair of spacecraft mapping the Moon's gravity) has been given an extension to complete a 2nd mapping at even lower altitude, resulting in a better resolution map. This will occur from September through November. Later they will be crashed into the Moon when they run low on fuel. There was concern that in June, when the spacecraft's solar panels get eclipsed, that would end the mission, but the latest spacecraft condition checks show they should survive the lack of sunlight. The Moon's uneven gravity field disturbs lunar orbits, particularly low ones, so frequent rocket burns are required to maintain the correct path.

Updates Updated

I reported here in November that an experiment called the OPERA Experiment had detected neutrinos traveling from Switzerland to Italy at 100.002% the speed of light, which would **violate Einstein's Special Relativity**, and reported in April that 2 malfunctioning parts of the experiment may explain the mystery. Another experiment, called ICARUS, was also measuring the same neutrino bursts, and that team has completed its analysis and they measured the neutrinos as traveling not in excess of the speed of light. The ICARUS experiment detected only 7 neutrinos of those beamed from the CERN particle accelerator in Switzerland. We are still waiting for the original team to repeat their experiment with their equipment repaired, which will probably happen this month.

Back in 2008 I reported that images from the Hubble Space Telescope showed what appeared to be a planet orbiting the star **Fomalhaut**. Later infrared images failed to find the planet, and the infrared astronomers cast doubt that the object in the Hubble images was actually a planet. Now new observations from ALMA (array of radiotelescopes) appear to resolve this contradiction. Although ALMA is not completed yet (only a fraction of the antennas in the array are done), it has made the best resolution images of the dust disk surrounding Fomalhaut. It shows very sharp edges for both the inner and outer borders of the disk. Computer simulations show that the observations could be produced only by the gravitational effects of 2 small planets, in the range of Mars-sized to somewhat larger than Earth. Previous estimates were for 1 or 2 planets near Saturn's size. Planets as small as indicated by the new observations would not have shown up in the infrared images.

Instant AstroSpace Updates

A recently discovered dwarf **galaxy** about 70 million light-years away, in the same group as NGC 1407, designated LEDA 074886, has been found to be nearly **rectangular**. The unusual shape is thought to be the result of a collision between 2 galaxies.

Another pair of colliding galaxies has been discovered in which the gas associated with galaxies has been dragged apart from the stars and matter (including dark matter), and it has been nicknamed the **Musket Ball Cluster** since it is similar to the Bullet Cluster, but older (700 million years since the collision).

Analysis of a dust grain returned to Earth from the vicinity of Comet Wild 2 by the Stardust spacecraft shows that it contains **iron**. This is probably the source of a slight reddish color of that comet, and the reason that comets "space weather", that is, change color over long time periods.

A new study of zircons (which can be accurately age dated by their oxygen isotopes) shows that 3 billion years ago the rate of growth of the Earth's **continental crust** decreased markedly from 0.7 cubic mi per year (3 km^3) to 0.2 (0.8 km^3), at which it remained until today. This may indicate the start of subduction-driven plate tectonics.

Since the geysers on Saturn's moon **Enceladus** indicate bodies of liquid water exist close to the icy surface, scientists have pointed out that it is possible that microbial life formed in this water. If so it would mean that it snows microbes on Enceladus where the geyser spray freezes and falls.

A NASA evaluation committee has recommended extending for several years the missions of all 9 of their operational **space telescopes** (3 of them shared projects with other space agencies), excluding the GALEX ultraviolet space telescope, which had previously been announced as ending. These view the Universe in gamma rays, X-rays, visible light, infrared, and microwaves.

The **Orion** spacecraft, under development for manned use, is scheduled for 2014 for a high-altitude test (unmanned) on a Delta 4 Heavy rocket, reaching 3600 miles (5800 km), 15 times higher than the International Space Station. This is the highest altitude for such a craft since Apollo trips to the Moon.

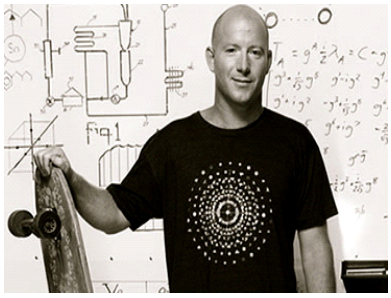
Supplies are loaded aboard the SpaceX Dragon spacecraft in preparation for its first flight to the International Space Station, set for April 30 as this is set to print. The Dragon has been contracted for 12 supply missions to ISS by NASA and could fly astronauts to the station as soon as 2015. (photo credit: SpaceX)

COSMOS
CARL SAGAN

'Cosmos: A Personal Voyage', a PBS TV docu-series which globally inspired millions to a love of science, learning, and freedom of inquiry, is being shown at the Regency Theater in San Juan Capistrano. Written, produced and hosted by the globally renowned astronomer and science popularizer Carl Sagan, one episode is presented the second Wednesday of each month by an outstanding expert in the topic covered in the episode. This is the series that created the high level mark for all science documentaries that followed.

The Regency Theater and Kepler Foundation are pleased to announce the distinctive speakers and topics of the 'Cosmos' episodes. Regency and Kepler continue to bring key authorities in the field of science to the southern Orange County community. This valuable event aims to encourage individuals in the County to take creative and innovative steps toward promoting science and mathematics to people of all ages.

May 9th - "Encyclopaedia Galactica": Is there intelligent life beyond the Earth? Dr. Sagan espoused to intelligent life on other planets and was co-founder of The Search for Extraterrestrial Intelligence (SETI), a private, nonprofit organization dedicated to scientific research, education and public outreach. This episode discusses the probability of alien life using the Drake Equation. Garrett Lisi is guest lecturer.

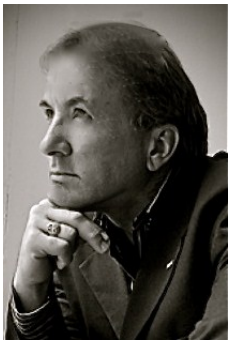


Garrett Lisi is a theoretical physicist of a different bend. He found an optimum balance between surfing and pursuing his research in Quantum Field Theory in Maui after receiving his degree at UC San Diego. He soon found a most beautiful unified model of particle physics previously unseen by anyone, An Exceptionally Simple Theory of Everything (E8 Theory). His story and work have been featured in TED, Outside Magazine, The New Yorker, and Scientific American. He is currently filming a new documentary for the History Channel called Invention USA.

June 13th - "Who Speaks for Earth?": Retracing the 15-billion-year journey from the Big Bang to the present, this episode intertwines the history of science (the martyrdom of Hypatia) with the advancement in space exploration. Dr. Sagan also takes aim at environmental issues as he illustrates the dangers of Global Warming. This episode is arguably the most passionate, the most compelling of all episodes. It points to our survival as a species, as Dr. Sagan stated:

"It is as if there were a God who said to us, 'I set before you two ways. You can use your technology to destroy yourselves … or to carry you to planets and the stars. It's up to you."

Presenters for this concluding episode will be Bill Nye 'The Science Guy'. Scientist, engineer, comedian, author, and inventor, Bill is committed to fostering a scientifically literate society. Making science entertaining and accessible is something Bill has been doing most of his life. While a student at Cornell University, Bill Nye was introduced to the wonders of astronomy in a class taught by Carl Sagan himself, one of the original founders of *The Planetary Society*. So for Nye, it was like coming full circle to become it's newest Executive Director.



Michael Shermer is an American writer and historian of science, founder of The Skeptics Society, and Editor-in-Chief of Skeptic magazine, largely devoted to investigating pseudoscientific and supernatural claims. Shermer recently spoke at the Social Singularity Summit in New York on ***Why Things are Getting Progressively Better.***

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