



EPHEMERIS

April 2013

SJAA Activities Calendar

Jim Van Nuland

April

- 5 Beginner Astronomy Class at Houge Park 8:15 p.m.
- 5 Houge Park star party. Sunset 7:34 p.m, 19% moon rises 4:28 a.m. Star party hours: 8:30 until 11:30 p.m.
- 6 Dark-Sky weekend. Sunset 7:35 p.m, 11% moon rises 5:02 a.m. "Half-Marathon" - attempt to observe half of the Messier catalog. Henry Coe Park.
- 7 Observing H-alpha flares and sunspots at Houge Park. Also our Telescope Tune-up Time. Sun party and tune-up hours: 2:00 - 4:00 p.m.
- 12 Hall and grounds reserved for SJAA use from 6 p.m. to 10 p.m.
- 19 Houge Park star party. Sunset 7:47 p.m, 66% moon sets 3:12 a.m. Star party hours: 8:45 until 11:45 p.m. This is part of SJAA's Astronomy Day observation.
- 27 **General Meeting.** Board meeting at 6:00; Social Time at 7:30; General Meeting at 8:00. Our speaker is Dr. Nathalie Cabrol, NASA; "A Decade of Revolution in Astrobiology: How our vision of habitability and life potential in the Solar System

has changed".

May

- 3 Beginner Astronomy Class at Houge Park 8:00 p.m. The topic: Tonight's constellations and highlights (indoors & outdoors).
- 3 Houge Park star party. Sunset 7:59 p.m, 32% moon rises 3:04 a.m. Star party hours: 9:00 until midnight.
- 4 Dark-Sky weekend. Sunset 8:00 p.m, 20% moon rises 3:36 a.m.
- 5 Observing H-alpha flares and sunspots at Houge Park. Also our Telescope Tune-up Time. Sun party and tune-up hours: 2:00 until 4:00 p.m.
- 11 Dark-Sky weekend. Sunset 8:06 p.m, 4% moon sets 9:50 p.m. Henry Coe Park's "Astronomy" lot has been reserved.
- 17 Houge Park star party. Sunset 8:11 p.m, 50% moon sets 1:43 a.m. Star party hours: 9:15 until midnight.
- 24 Houge Park full moon indoor meeting: Imaging SIG. Meeting hours: 7:30 until 9:00 pm
- 25 **General Meeting.** Board meeting at 6:00; Social Time at 7:30; General Meeting at 8:00. Our speaker: Timothy Ferris; his talk is titled "Keys to

the Universe".

- 31 Beginner Astronomy Class at Houge Park 8:00 p.m. The topic: Tonight's constellations and highlights (indoors & outdoors).
- 31 Houge Park star party. Sunset 8:22 p.m, 46% moon rises 1:39 a.m. Star party hours: 9:15 until midnight.



The Shallow Sky

Eclipses: the Long Goodbye

Akkana Peck

Jupiter is still visible in April, but it's starting to get low in the western sky. If you set up right around sunset, you can take advantage of a handy phenomenon: the seeing is often unusually steady for a short time after sunset. (A similar effect happens at dawn.) The atmosphere gets more turbulent as the night cools, so you're looking for that brief period when the air and the ground are in equilibrium, so there's no heat flowing from one to the other — and therefore no heat waves to interrupt your view. An hour or so later, as the air cools faster than the ground, you'll start seeing more heat-induced turbulence and the seeing will get a lot less steady than it was at

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24 hour news and information hotline:
(408) 559-1221
<http://www.sjaa.net>

The Shallow Sky
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sunset. That's especially true if you have to look over asphalt streets or your neighbor's roofs.

Last month I wrote about eclipses of Jupiter's moons: in particular, an event on Mar 10 where Europa popped out from behind Jupiter, then disappeared into Jupiter's shadow just a few minutes later.

I predicted, based on Sky & Telescope's online Jupiter's Moons page, that Europa would appear from behind Jupiter at 7:40, and would disappear into eclipse at 7:44.

After my column had gone to press, I found time to work on my own Jupiter's moons code to add eclipse predictions. To check my work, I simulated the Europa event in several different programs. I was amazed how much the times varied. Here's what they predicted. (Note that Stellarium evidently has a time zone bug.) [See TABLE 1]

I was itching to observe the event myself and find out what times things really happened. Who was right? I was betting on XEphem, which is generally known for accuracy.

Unfortunately, I was out of town on March 10. I brought a travel scope, an Orion 80mm f/6 Orion Express. Not the perfect planetary scope, but certainly enough to see Europa. (The Galilean moons are even visible in binoculars, if you mount them on a tripod or otherwise keep them steady.)

I synchronized my watch and had the telescope set up by 7:35, since the earliest prediction for Europa's appearance was 7:40. Sure enough, there was no Europa there. But at 7:38 on the dot, I saw the first hint of Europa peeking out. No question about it. I watched, and timed, and by 7:41 the whole disk of Europa was visible and I could start to think I could see blackness between it and Jupiter.

I'd been to a school star party a few days

earlier and hadn't cleaned my eyepieces afterward — oops! — so the view was a little foggy and it was hard to tell for sure exactly when Europa's disk cleared Jupiter.

In fact, no matter which eyepiece I used, the fogginess seemed to get worse and worse. I had a hard time seeing Europa at all. Finally I realized that I was looking through a tree branch, and moved the scope. But by the time I got it moved again, Europa had gotten even harder to see. That was when I realized that it had been going into eclipse practically the whole time I was watching it.

It was already significantly dimmed by 7:43, very dim indeed by 7:48 and gone — in the 80mm — by 7:49:20, though I suspect it still would have been visible in a larger scope with clean eyepieces.

So that's why the times in different programs varied so much! Galilean moons aren't point sources: you can't predict an exact time for a moon disappearance, appearance or eclipse. Do you want to predict the beginning of the event, the end of the event or the time at the moon's center point? For eclipses, since it takes seven minutes or more for the moon to go from full brightness to fully eclipsed, what part of that do you predict?

So it was a very interesting observing session. I'm looking forward to observing more of these eclipses, doing more timings, and tuning my program to give better predictions. (I notice my program was significantly late on both the appearance and the eclipse. I'll work on that. Better to err on the early side, and not miss anything!)

While I was adding eclipses to my Jupiter program, I also added predictions, so it would be easier to find out when these events will happen. Unfortunately, all of the whac-a-moon events for April

take place during California daytime. But there's one just before April begins, on Mar 26, when Ganymede appears at 19:29 (while Europa and its shadow are transiting Jupiter's disk) and enters eclipse at 21:40.

A long time between the events, I know, but it's easy enough to leave a scope set up in the backyard and go out to check it now and then.

TABLE 1	Europa appears	Europa eclipsed
XEphem	7:43	7:59
S&T Jupiter's Moons	7:40	7:44
my Javascript Jupiter	7:45	7:52
Stellarium	6:49	7:05

Note: these times are from my Javascript Jupiter program and may be a few minutes late. Always be ready at least five minutes early in case the predictions are off, no matter which program you use.

May 8 is better: Ganymede appears at 21:44, then disappears into eclipse at 21:46. Based on what I saw tonight with Europa, that means the moon should start to fade almost immediately after it has emerged from behind Jupiter, maybe even before it has fully emerged. Ganymede's larger size may also mean the fade-out will take longer. Stay tuned. Jupiter will be very low by then, only 7 degrees above the horizon.

Of course, there's plenty to see on Jupiter besides moons — its stormy atmosphere has been spectacular this year, though it's a little past its prime now since it's so low.

It's a good thing Jupiter is so interesting, since there aren't many other planets to look at this month. Saturn is well placed for late night viewers, though it's not as high in the sky as we might like. The rings are tilted 18 degrees to us. Nearly all the other planets are too close to the sun for good viewing. Late in the month, you can barely catch Venus low in the evening sky. Pluto rises a bit after midnight, so an ambitious Plutocrat might be able to catch it in the predawn hours. All in all, I'm happy Jupiter is there!

Board Elections

Rob Jaworski

Last week, the SJAA held its annual membership meeting, the highlight of which is election of members to the board of directors.

First, I'd like to extend heartfelt thanks to departing members of the board for their years of service in making the SJAA an engaging and sustaining organization in its mission to bring astronomy and science to the general public. Thanks go to Rod Norden, Kevin Roberts, and Mark Wagner, long time board member and most recently the club's President.

Allow me to introduce new board members, most or all of whom you may already be familiar as they are very active SJAA members, running programs and attending most events. Here they are:

Teruo Utsumi regularly participates at the school star parties, lending valuable telescope views to students and parents across the south bay. He also conceptualized and implemented the Quicker Start program, which makes available books and other beginner materials to new (and old) members alike at SJAA events. He also conceived and implemented the Half Messier Marathon that was successfully held last October, and will continue again next month. He also works to source speakers for the monthly general meetings. Teruo has been a staple attendee at board meetings, Houge star parties and other events. I am happy to see him on the board.

Dave Ittner has been an energetic member of the SJAA for a couple of years now. He is most well-known for starting the mentor program, which has evolved into the QuickSTART program, an opportunity to help ease people into amateur astronomy by providing personal guidance on things from navigating the night sky to the basics of telescope handling. Dave already has a long list of other accomplishments such as working to partner up with the Santa Clara County Open Space Authority to

open up their dark sites to astronomy related activities, the Advanced Loaner program, and the SJAA library. Welcome to the board, Dave.

Ed Wong has been an active member of the SJAA in several newer programs. He runs the Telescope FixIt program, he is also on the committee for the Astro Imaging SIG (special interest group) and regularly comes out to Houge star parties and observing and imaging opportunities at the OSA's Rancho Cañada del Oro Open Space Preserve. Ed is a proponent of binocular viewing and an avid photographer. I'm happy to see Ed bring his interest and his enthusiasm to not just the SJAA but to a leadership position as well. Welcome!

In addition to the new board members, we also have a few changes to the officer ranks.

Teruo Utsumi has been placed in the position of Secretary where he will record and keep the minutes from board meetings and generally ensure an organized administration.

Lee Hoglan, a long time SJAA member and director, has been elected to the position of Vice President, where he will provide back up to the president as well as continue to be the welcoming face of the SJAA to newcomers and others who have general questions.

Michael Packer continues in his role as club treasurer, providing prudent oversight to the organization's finances, income and expenses.

Next, allow me to first thank Greg Claytor for his work as the SJAA vice president for the past many years. Greg regularly contributes at and participates in the board meetings, acts as an excellent MC and announcer at SJAA meetings, and in the past worked to source speakers for our general meetings. I look forward to his continued thoughtful discussions at

board meetings.

And finally, let me thank Mark Wagner for the last two years of his term as president of the SJAA. Now that he has termed out, I'd like to humbly announce that I now take over the role as president. I don't take this responsibility lightly and I will work to ensure that the SJAA continues to provide a rich menu of offerings to engage the public, and especially our next generations, in astronomy and related science education. I have a few ideas of how to refine and further evolve the club, but nothing is set in stone and everything is subject to change, so I am always open to hearing about new ideas anyone may have.

The SJAA is here for its members, the amateur astronomer community and the public. Let's work together toward fulfilling the SJAA's mission of making astronomy and science accessible to everyone.

Editorial Change

Effective with the next issue of the SJAA Ephemeris, the editor will be Mina Reyes-Wagner. Mary and I have been the editors since the January 2004 issue. We have enjoyed it very much but as club members we are excited to see what Mina will do.

We want to thank the many people who have encouraged us over the years particularly Mike Koop, Mark Wagner, Jim Van Nuland and Rob Jaworski. We appreciated the many efforts of Akkana Peck, David North, Ernie Piini and Rob Hawley.

A big thank you to our predecessors, Morris Jones and Jane Houston Jones. And thanks to you, our readers. It's been a genuine honor.

PK & MK

Eyepieces from the point of view of an amateur astronomer

Rich Neuschaefer

These days eyepieces come in two barrel sizes, 1.25" and 2". A 2" eyepiece isn't necessarily better than a 1.25" eyepiece. Usually 2" eyepieces are used when you want wide true field and sometimes both a wide true field and a wide apparent field.

Some 1.25" eyepieces have inner and outer barrels. This lets them fit into either a 1.25" or 2" eyepiece holder. Often these eyepieces have a relatively wide upper body with wide apparent fields. They often have a built in Barlow that helps the eyepiece have a long eye relief.

True field is the number of degrees or arc minutes of sky that can be seen with a given telescope and eyepiece combination.

Apparent field is how large the hole seems to be when looking through the eyepiece. An eyepiece with a narrow apparent field gives the impression of looking through a soda straw. An eyepiece with a wide apparent field is more like looking through a picture window.

Exit pupil is diameter the beam of light coming out of the eyepiece. You would think a large (7 mm) exit pupil would be best for viewing deep sky objects, however, some very experienced deep sky observers feel a 1.5 mm exit pupil gives the best contrast between a deep sky object and the background sky. When observing planets at high power some of us have issues with a very small exit pupil.

The small diameter beam can be easily

interrupted by floaters in our eye. This is where it helps to have a large aperture instrument because it will increase the diameter of the beam of light for a given magnification.

Eyepiece Exit pupil = telescope aperture / magnification A 6" aperture (153mm) telescope running 300x will give a 0.5mm exit pupil. A 14" aperture (355.6mm) telescope running 300x will give a 1.18mm exit pupil.

When observing the planets or tight double stars I don't mind not seeing the full field of view because the objects of interest usually don't take up much of the field of view. When observing the moon I very much enjoy an eyepiece with a wide apparent field. This is also true when observing large open clusters or large emission nebulae.

Zoom eyepieces sometimes are more convenient than carrying several fixed focal length eyepiece. However, many of them have an annoying feature, the apparent field changes as you change the amount of zoom. At high zoom the apparent field can be very nice but when zoomed to the low end of the power range the apparent field shrinks dramatically.

Most of the better eyepieces are fully multicoated meaning that every air to glass surface has been multi-coated. A fully multi-coated eyepiece will tend to have better contrast than an eyepiece that is not fully multi-coated or just coated.

Eye relief is measured in millimeters describing how close you need to get your eye to the eyepiece to see the full field of view. Sometimes the eye relief stated would seem to give you plenty of room but some eyepiece designs have the eye lens set down into the upper body of the eyepiece making it difficult to get close enough to see the full field, especially if you wear eye glasses when observing.

The diameter of the eye lens (the lens closest to your eye) can give some idea of the eye relief of the eyepiece. Usually

the larger the eye lens the better the eye relief.

Eyepiece designs like orthos and plossls with a long focal length usually have good eye relief, but as you go to shorter focal lengths the eye relief can get very short. One way to have a higher magnification and retain good eye relief is to use a Barlow lens.

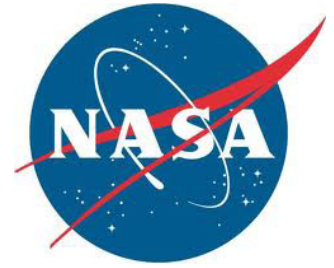
Some of the newer eyepiece designs have a number of lens elements but with good glass and being fully multi-coated the amount of light loss and scatter is quite small.

Virtually all 1.25" and 2" eyepieces have barrels that are threaded on the inside to accept a filter and to reduce light scatter. The threads are almost always painted flat black.

I find it is always nice to look through an eyepiece before buying. One benefit of attending star parties is that you can often have a look through a number of different eyepiece designs. I've had very few problems with the public looking through my good eyepieces. Today's multi-coated lenses hold up very well and are easy to clean.

It is good to resist the desire to take apart an eyepiece. If some of the lens elements fall out the chances of getting the lenses back in the right order and with the correct side up is highly unlikely. Most telescope dealers don't have diagrams of how the lens elements should go in the eyepiece. It is a good idea to put your eyepieces away, out of the reach of little hands. The only eyepiece maker that I know of who will fix one of their eyepieces is Tele Vue.

Eyepieces and other items are sometimes available in the SJAA "For Sale" section in the club's blog area. See <http://sanjoseastronomy.blogspot.com/p/for-sale-eyepieces.html>



Your Daily Dose of Astonishment

Diane K. Fisher

As a person vitally interested in astronomy, you probably have the Astronomy Picture of the Day website at apod.nasa.gov set as a favorite link. APOD has been around since practically the beginning of the web. The first APOD appeared unannounced on June 16, 1995. It got 15 hits. The next picture appeared June 20, 1995, and the site has not taken a day off since. Now daily traffic is more like one million hits.

Obviously, someone is responsible for picking, posting, and writing the detailed descriptions for these images. Is it a whole team of people? No. Surprisingly, it is only two men, the same ones who started it and have been doing

it ever since.

Robert Nemiroff and Jerry Bonnell shared an office at NASA's Goddard Space Flight Center in the early-90s, when the term "World Wide Web" was unknown, but a software program called Mosaic could connect to and display specially coded content on other computers. The office mates thought "we should do something with this."

Thus was conceived the Astronomy Picture of the Day. Now, in addition to the wildly popular English version, over 25 mirror websites in other languages are maintained independently by volunteers. (See <http://apod.nasa.gov>

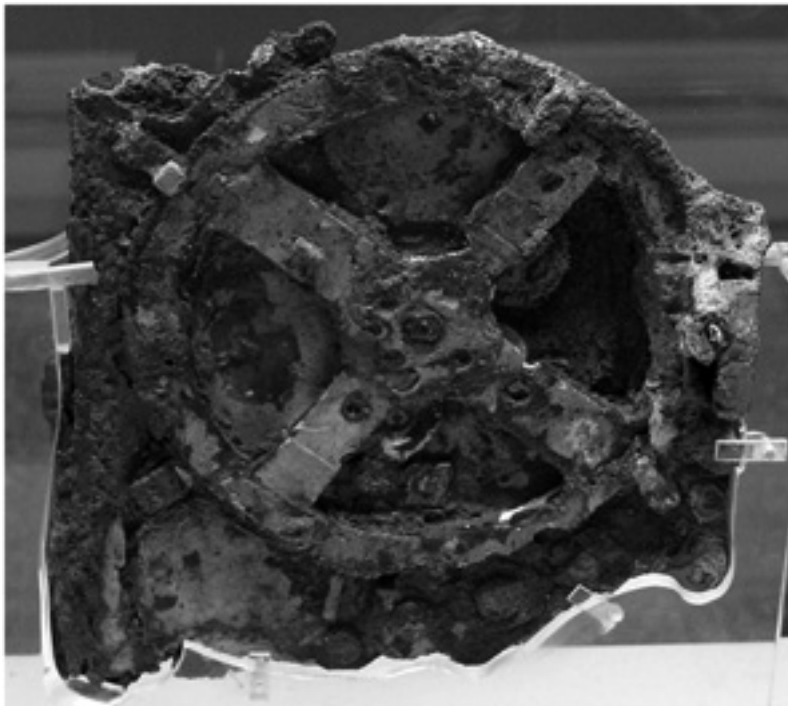
for links). An archive of every APOD ever published is at <http://apod.nasa.gov/apod/archivepix.html>. Dr. Nemiroff also maintains a discussion website at <http://asterisk.apod.com/>.

But how does it get done? Do these guys even have day jobs?

Dr. Nemiroff has since moved to Michigan Technological University in Houghton, Michigan, where he is professor of astrophysics, both teaching and doing research. Dr. Bonnell is still with NASA, an astrophysicist with the Compton Gamma Ray Observatory Science Support Center at Goddard. APOD is only a very small part of their responsibilities. They do not collaborate, but rather divide up the calendar, and each picks the image, writes the description, and includes the links for the days on his own list. The files are queued up for posting by a "robot" each day.

They use the same tools they used at the beginning: Raw HTML code written using the vi text editor in Linux. This simple format has now become such a part of the brand that they would upset all the people and websites and mobile apps that link to their feed if they were to change anything at this point.

Where do they find the images? Candidates are volunteered from large and small observatories, space telescopes (like the Hubble and Spitzer), and independent astronomers and astro-photographers. The good doctors



The January 20, 2013, Astronomy Picture of the Day is one that might fall into the "quirky" category. The object was found at the bottom of the sea aboard a Greek ship that sank in 80 BCE. It is an Antikythera mechanism, a mechanical computer of an accuracy thought impossible for that era. Its wheels and gears create a portable orrery of the sky that predicts star and planet locations as well as lunar and solar eclipses.

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receive ten images for every one they publish on APOD. But, as Dr. Nemiroff emphasizes, being picked or not picked is no reflection on the value of the image. Some of the selections are picked for their quirkiness. Some are videos instead of images. Some have nothing to do with astronomy at all, like the astonishing August 21, 2012, video of a replicating DNA molecule.

Among the many mobile apps taking advantage of the APOD feed is Space Place Prime, a NASA magazine that updates daily with the best of NASA. It's available free (in iOS only at this time) at the Apple Store.

This article was provided by the Jet Propulsion Laboratory, California Institute of Technology, under a contract with the National Aeronautics and Space Administration.

Proving that $2 = 1!$

Let: $a=b$

$$a^2=ab$$

$$a^2+a^2=a^2+ab$$

$$2a^2=a^2+ab$$

$$2a^2-2ab=a^2+ab-2ab$$

$$2a^2-2ab=a^2-ab$$

$$2(a^2-ab)=1(a^2-ab)$$

Therefore: $2=1$

Can you tell where this "proof" went wrong and why? (Answer below)

If you substitute a number, say 3, for a then you see that all of the statements are valid except for the last one. The operation needed to make the final simplification is to divide both sides by a^2-ab but that quantity will always be zero. You can't divide by zero. And this is why.

The Last Month In Astronomy

MAR-03-2013 **Dragon Succeeds** The SpaceX Dragon spacecraft successfully docked at the International Space Station (ISS). This was the second resupply mission for SpaceX. The rendezvous was delayed because of blocked valves on the Dragon. But the valves were purged and the spacecraft regained its full capabilities. In its impaired state NASA would not have allowed docking to proceed. The Dragon carried 1268 pounds of supplies and will return with twice that much stuff. Some new investigations on the ISS include seeing how microgravity affects E.coli growth, studying how space affects small batteries, and trying to produce aluminum sulfate crystals that are higher purity than any created on Earth. http://www.nasa.gov/home/hqnews/2013/mar/HQ_13-067_SpaceX_2_Berthing.html

MAR-01-2013 **New Van Allen Belt** One of the first things science discovered while using an artificial satellite was the presence of the Van Allen radiation belts. Now a new satellite has found evidence for a new Van Allen belt. This new belt extends outward from the Earth and may come and go depending on solar flare activity. <http://www.astronomy.com/en/News-Observing/News/2013/03/NASA%20Van%20Allen%20Probes%20discover%20a%20surprise%20circling%20Earth.aspx>

FEB-27-2013 **BH Spin Rate** A pair of space-based observatories, NASA's Nuclear Spectroscopic Telescope Array (NuSTAR) and ESA's XMM-Newton have collaborated to definitely determine the spin rate of a massive black hole. The black hole is at the center of the galaxy NGC 1365 and it is as massive as two million suns. The speed of the rotation is about 84% of the speed of light. <http://www.techhive.com/article/2029714/ngc-1365-is-a-supermassive-black-hole-that-spins-at-nearly-the-speed-of-light.html>

FEB-21-2013 **Juicy Mission Planned** The European Space Agency (ESA) is preparing a mission to Jupiter for 2022. The Jupiter Icy Moons Explorer (JUICE) will include science packages provided by NASA and JPL. One such package is a radar to be used studying the 3 Galilean moons that are icy: Europa, Ganymede and Callisto. The radar will penetrate to a depth of 5 miles. The JUICE spacecraft will orbit Jupiter for three years including many flybys of Callisto and Europa and then go into orbit around Ganymede. The spacecraft will not arrive at Jupiter until 2030. <http://www.jpl.nasa.gov/news/news.php?release=2013-069>

FEB-20-2013 **Smallest Planet Found** Kepler has done it again. The NASA mission has set another record, this time for the smallest exoplanet. Kepler-37b is smaller than Mercury. The star is slightly smaller and cooler than the Sun and it has at least two other planets: Venus-sized Kepler-37c and a doubled Earth designated as Kepler-37d. All 3 planets orbit the sun in orbits smaller than Mercury's which means they are not likely to be habitable. Do not expect a rash of exoplanets of this size. This star is unusual in that it is very bright but very quiet — making it ideal for transit detections. <http://www.jpl.nasa.gov/news/news.php?release=2013-066>

FEB-15-2013 **Russian Meteor** Everyone knew that asteroid 2012 DA14 would pass near the Earth. But it was a surprise that on the same day a meteor would buzz the area around Chelyabinsk in Russia. The meteor is not related to the asteroid. Hundreds were injured and thousands of windows were broken by the blast of air that was created. Some of the most interesting video came from dash cams, cameras attached to the dashboards of cars. Such cameras are apparently common as a defense against car accident scams. <http://www.jpl.nasa.gov/news/news.php?release=2013-061>

It Must Be Astronomical ...

Election Result

The following were elected to the SJAA Board of Directors at the February 24, 2013 General Meeting: Lee Hoglan, Michael Packer, Teruo Utsumi, Ed Wong, Rich Neuschaefer. Continuing Directors who are up for election next year are: Rob Jaworski, Mina Reyes-Wagner, Dave Ittner and Greg Claytor.

**“Cosmos is a Greek word for the order of the universe ... It conveys awe for the intricate and subtle way in which the universe is put together”
- Carl Sagan**

Loaners

The telescope loaner program has been revamped. The program now includes QuickSTART, program geared to those new to astronomy. Please check it out at <http://www.sjaa.net/loaners.shtml>.

School Star Parties

Completed Events					
	Total Sched.	Good Sky	Partial Success	Cloudy Fail	Cancel at noon
Jul	2	2			
Aug	1	1			
Sep	1	0	1		
Oct	7	3			4
Nov	11	4			7
Dec	13	4			9
Jan	8	7		1	0
Feb	8	5			3
Total	51	26	1	1	23
Scheduled - for the 2012/2013 school year					
	Total	Firm	Working		
Feb	1	1	0		
Mar	4	4	0		
Apr	2	1	1		
May	1	0	1		
Total	8	6	3		

As of February 20, 2013

School Star Party Link

For information on school star parties including how to schedule one see <http://www.sjaa.net/school.shtml>.

Officers and Board of Directors

Pres Rob Jaworski
VP Lee Hoglan
Sec Teruo Utsumi
Tres Michael Packer
Dir David Ittner
Dir Rich Neuschaefer
Dir Greg Claytor
Dir Ed Wong
Dir Mina Reyes-Wagner

School Star Party Chairman

Jim Van Nuland (408) 371-1307

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 Ephemeris ephemeris@sjaa.net

Other e-mail contacts are available at <http://www.sjaa.net/contacts.html>

Members Email Lists:

<http://www.sjaa.net/majordomo.html>
<http://sanjoseastronomy.blogspot.com/>
 twitter: [sj_astronomy](https://twitter.com/sj_astronomy)
<http://www.meetup.com/A-A-N-C/>

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ADDRESS SERVICE REQUESTED

San Jose Astronomical Association Membership Form

P.O. Box 28243 San Jose, CA 95159-8243

New **Renewal** (Name only if no corrections)

Membership Type:

- Regular — \$20
 Regular with Sky & Telescope — \$53
 Junior (under 18) — \$10
 Junior with Sky & Telescope — \$43

Subscribing to Sky & Telescope magazine through the SJAA saves you \$5 off the regular rate. (S&T will not accept multi-year subscriptions through the club program. Allow 2 months lead time.)

I prefer to get the Ephemeris newsletter in print form (Add \$10 to the dues listed on the left). The newsletter is always available online at <http://ephemeris.sjaa.net>
Questions?

Send e-mail to membership@sjaa.net

Bring this form to any SJAA Meeting or send to the club address (above). Please make checks payable to "SJAA".

You can join or renew online:

<http://www.sjaa.net/membership.shtml>

Name: _____

Address: _____

City/ST/Zip: _____

Phone: _____

E-mail address: _____