



## SJAA Activities Calendar

Jim Van Nuland

# EPHEMERIS

## 1980 occultation observation of a satellite of asteroid (216)

Gene A. Lucas

### November (late)

- 21 **Fall Swap.** Open at noon, selling 1:00 to about 4:00 p.m. In the hall at Houge Park.
- 26 Astronomy Class at Houge Park. 7:30 p.m. Topic is "What You Can See In The Sky - Part 2".
- 26 Houge Park star party. Sunset 4:52 p.m., 68% moon rises 10:04 p.m. Star party hours: 7:00 until 10:00.
- 27 Dark Sky weekend. Sunset 4:51 p.m., 57% moon rises 11:13 p.m.

### December

- 4 Dark Sky weekend. Sunset 4:50 p.m., no moon. Henry Coe Park's "Astronomy" lot has been reserved.
- 10 Astronomy Class at Houge Park. 7:30 p.m. Topic is TBD.
- 10 Houge Park star party. Sunset 4:50 p.m., 29% moon sets 9:56 p.m. Star party hours: 7:00 until 10:00.
- 18 **General Meeting** at 8 p.m. Our speaker is Dr. Tim Dubbs, speaking on Particle Physics and on his work on the LHC's particle

detector. Holiday Party follows. See page 5.

### January

- 1 Dark-Sky weekend. Sunset 5:01 p.m, 5% moon rises 5:59 a.m.
- 8 Dark-Sky weekend. Sunset 5:07 p.m, 21% moon sets 9:38 p.m. Henry Coe Park's "Astronomy" lot has been reserved.
- 14 Houge Park star party. Sunset 5:13 p.m, 75% moon sets 3:28 a.m. Star party hours: 7:00 until 10:00 p.m.
- 15 General Meeting. Our speaker is TBD. Board meeting at 6:30; General Meeting at 8:00
- 28 Astronomy Class at Houge Park. 7:00 p.m. The topic: TBA.
- 28 Houge Park star party. Sunset 5:22 p.m, 23% moon rises 3:53 a.m. Star party hours: 7:00 until 10:00 p.m.
- 29 Dark-Sky weekend. Sunset 5:29 p.m, 15% moon rises 4:46 a.m.

*The Board of Directors meets before each general meeting at 6:30 p.m. All are welcome to attend.*

Observations of a satellite of asteroid (216) Kleopatra made 30 years ago by SJAA members, Gerry Rattley and Bill Cooke, have now been substantiated professionally.

At the recent American Astronomical Society meeting in Pasadena on October 6, 2010, a presentation was made by Dr. Franck Marchis (SETI Institute, UC-Berkeley) on "Characteristics of Known Triple Asteroids in the Main Belt". One point made during Dr. Marchis' AAS talk was that the visual observations made by Gerry Rattley and Bill Cooke during the October 10, 1980 stellar occultation by (216) Kleopatra (near Loma Prieta, CA; reported to IOTA), were now deemed not only plausible, but very probable. The results for (216) Kleopatra were included with further results for five other asteroids that show duplicity and/or satellites.

(216) Kleopatra is a relatively large asteroid, measuring  $217 \times 94 \times 81$  km. It is believed to be a loosely packed metallic object, based on its radar albedo. Kleopatra is 217 km (135 miles) long, give or take 25% — about the size of the state of New Jersey. The irregular, bi-lobate ("dumbbell") elongated shape has been strongly confirmed by teams of IOTA occultation observers on several occasions (1980, 1991, 2008, and 2009).

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

*Continued on page 2*

In 2008, Marchis' team imaged (216) Kleopatra with the Keck II telescope adaptive optics, definitely showing the irregular "peanut" shape of the asteroid, along with two nearby satellites. Other researchers have previously imaged Kleopatra with the large radar dishes at Goldstone and Arecibo, producing a 3-D map of its shape and orientation. Now, Marchis and his team have plotted the orbits for two satellites of the asteroid, which strongly confirms likelihood of the visual occultation observations of a satellite by Rattley and Cooke, made in October, 1980.

This marks a distinct turning point — for now, 30 years later, professionals have at last recognized the value of such occultation observations by amateurs. For since that time, those observations have been either largely ignored, or denigrated completely

by the professionals — For many years, the thought of the existence of satellites of asteroids was held to be implausible, if not impossible — just as the concept of irregular shapes for the asteroids was also held in contempt by many theoreticians previously. Of course, direct images from spacecraft have confirmed what was previously suggested by many ground-based occultation observations. (This is also true for several of the comet nuclei which have been imaged, including recent radar results for Comet 103P Hartley.)

The details of the story are explained in an article published on the internet by Kelly Beatty, a columnist for Sky and Telescope magazine, who was in the audience at the October AAS meeting in Pasadena: <http://www.skyandtelescope.com/news/104690129.html>. The complete PPT presentation by Dr. Marchis and his team may be downloaded here: [http://astro.berkeley.edu/~fmarchis/Science/Asteroids/Triple/DPS2010/DPS2010\\_Marchis.pdf](http://astro.berkeley.edu/~fmarchis/Science/Asteroids/Triple/DPS2010/DPS2010_Marchis.pdf)

And an abstract for their forthcoming paper, submitted for publication in the professional journal ICARUS, is here: <http://adsabs.harvard.edu/abs/2010DPS....42.4605M>

— — — — —  
Gerry Rattley served as an SJAA officer and Board Member during the 1980s, and was a recipient of the A.B Gregory Award in 1982. He has continued to be an active occultation observer and member of the International Occultation Timing Association (IOTA). Since moving to Gilbert, Arizona in July, 1982, Gerry has been active in the Saguaro Astronomy Club and more recently, the East Valley Astronomy Club. Presently he is an active volunteer telescope operator at the Gilbert Rotary Centennial Observatory (GRCO) in Gilbert, AZ.

---

## The Shallow Sky

### Full of Moon

Akkana Peck

Although there are plenty of planets to watch in December — Jupiter high in the sky, Uranus and Neptune visible in the early evening, Mercury low in the evening during the first half of the month, and Venus and Saturn in the morning — the real news this month is all about the moon.

We'll see (weather permitting) a spectacular lunar eclipse on the evening of Monday December 20th, perfectly placed with the moon way up at 75 degrees. The moon will be just above the raised arm of Orion, as though the full moon were a tennis ball Orion is about to lob right through the Hyades.

The penumbral eclipse begins at 9:29pm PST. This stage is very subtle and you probably won't see any difference, but it doesn't hurt to try! Partial eclipse begins at 10:32, with totality lasting from 11:40 p.m. until 12:53 Tuesday morning. As

usual, the moon is offset within the Earth's shadow; the north limb of the moon will be brighter than the south during totality.

It's been a while since we've had an eclipse this good! But the eclipse isn't the only moon news. Our satellite has been in the science press quite a bit over the past month.

For instance, the Lunar Orbiter Laser Altimeter (LOLA) team just announced that they'd found the highest point on the moon. Unfortunately, you can't see it: it's on the lunar far side, a visually undistinguished gentle rise near Engel'gardt on the fringe of the Korolev plain. It's 10,786 meters (35,387 feet) above the lunar datum — an arbitrary point chosen to act as "sea level" on the moon. For comparison, Everest is 8,848 meters above Earth's sea level.

Prior to LOLA, the highest point on the moon was thought to be Beta in the Leibnitz Range, at 36,000 feet. That one you \*can\* see, at least in months when there's a good western libration so Mare Orientale is tilted toward us. December isn't ideal but it isn't bad. On the 20th while you're waiting for the eclipse to start, swing over to the southwestern limb of the moon, get out your Rukl and turn to chart 61 and libration chart VII. Rukl doesn't label the Leibnitzes, but they're near Valles Bouvard, just outside the southern edge of the Cordillera mountains.

Okay, so the Engel'gardt area isn't the most impressive lofty peak you've seen. But there was other moon news last month.

"Water on the moon!" screamed the headlines. The results came from several new papers analyzing the results of the

LCROSS impact. Remember LCROSS? It crashed into Cabeus crater near the moon's south pole in October 2009, and we were all disappointed that it didn't produce a big visual plume. But it did produce lots of spectral data, which has finally been processed and published — and it shows more water than expected. We're not talking oceans here: the area around Cabeus is a little wetter than the Sahara desert. But that water is thought to be in the form of ice grains, which would be relatively easy to separate from the surrounding rock.

Most articles included teasers like "There are oases of water-rich soil that could sustain astronauts on the Moon" (BBC) and "The moon is pockmarked with cold, wet oases that could contain enough water ice to be useful to manned missions" (Wired). It's all about the manned missions — not about the other interesting elements that turned out to be bound up with that water.

Several sites quote Dr. Anthony Colaprete: "In about a tonne of material, you're talking 11-12 gallons of water that you could extract." (Note the BBC spelling of tonne.) Curiously, when I went back to check, that quote had been removed from both the BBC and Wired stories. But you can still find it in the Google cache. Wonder what that means?

Am I the only killjoy who reads that and envisions small lunar bases surrounded by mountains of slag and tailings? Is the moon going to look like the Kaiser Cement quarry over by Stevens Creek,

the big bare spot in the mountainside that you can't help but notice when you fly out of San Jose? 12 gallons doesn't sound like very much compared to the needs of a working lunar base.

But how much rock is a ton of rock? Basalt, the rock making up the lunar maria, has a density of around 3 grams per cubic centimeter. A ton is about 907,185 grams, so a ton of basalt works out to only about a third of a cubic meter, or about ten cubic feet.

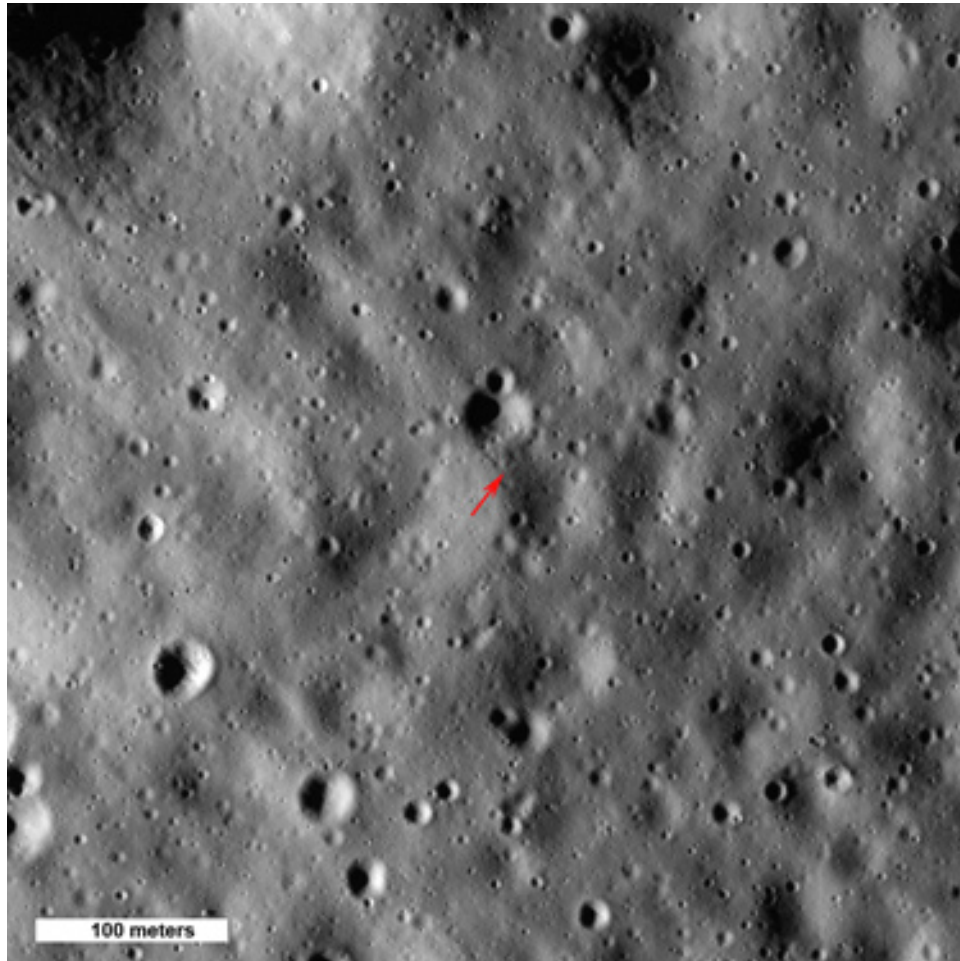
month, so you'd need somewhere around 65 tons of rock, 650 cubic feet or about 24 cubic yards, or a cube about 8.6 feet on a side.

Okay, that isn't that big a slag pile after all. Maybe I'm the dense one.

Oh! One last news item, and it's not even about the moon. Remember poor Spirit, the plucky Mars rover, stuck in one place but still doing useful science? Recently published results show that Spirit's spinning wheel, while it wasn't

enough to get her out of her sand-trap, revealed what looks like relatively recent signs of damp soil.

Spirit stopped communicating in March with what appeared to be a low-power fault. But there's still hope that with increasing sunlight she may be able to recharge her batteries and resume



Astronauts on the ISS use about 3 gallons of water per day — that's mostly for necessities like eating and drinking, not luxuries like dishwashing and bathing that you might want for an extended stay. We use more like 35 gallons down here on Earth. But say you have a lunar crew of 5 and they can keep to a very conservative 5 gallons/day each, and they don't need water for any industrial uses. That's about 750 gallons/

communication. This month is the month the Rover drivers hope to be able to re-establish communication. Cross your fingers for Spirit! You can check on status of both Mars rovers at <http://marsrover.nasa.gov>.

*Ed. Note: Photo is courtesy of NASA/GSFC/Arizona State University. More photos available at <http://roc.sese.asu.edu/news/index.php?/archives/302-Highest-Point-on-the-Moon!.html>*





## Blue Rings around Red Galaxies

Trudy E. Bell and Dr. Tony Phillips

Beautiful flat rings around the planet Saturn are one thing—but flat rings around entire galaxies?

That is the astonishing discovery that two astronomers, Samir Salim of Indiana University at Bloomington and R. Michael Rich of UCLA described in the May 10, 2010, issue of *The Astrophysical Journal Letters*.

“For most of the twentieth century,

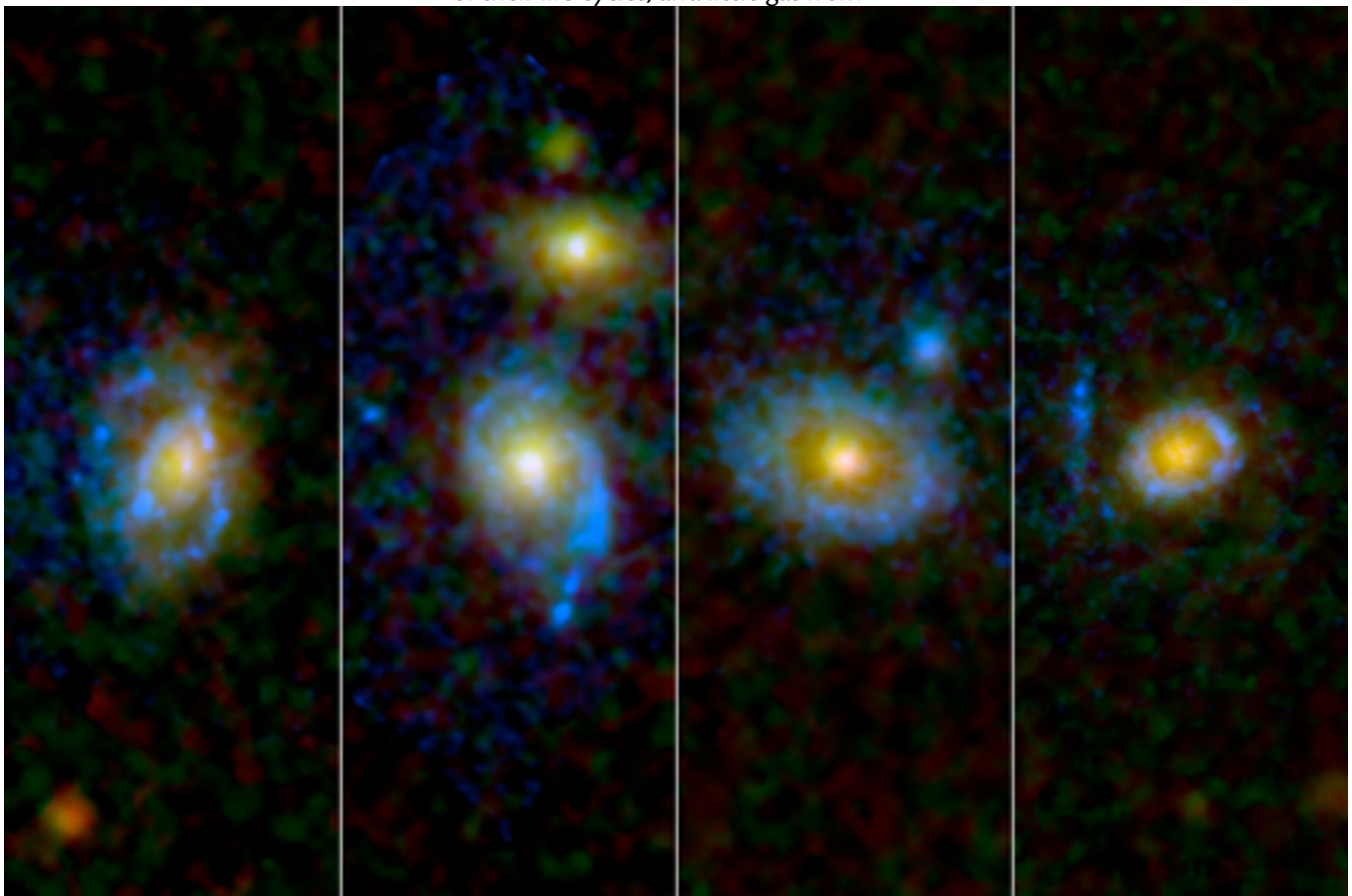
astronomers observing at visible wavelengths saw that galaxies looked either ‘red and dead’ or ‘blue and new,’” explained Salim. Reddish galaxies were featureless, shaped mostly like balls or lentils; bluish ones were magnificent spirals or irregular galaxies.

Elliptical galaxies looked red, astronomers reasoned, because they had mostly old red giant stars near the end of their life cycles, and little gas from

which new stars could form. Spiral and irregular galaxies looked blue, however, because they were rich in gas and dust that were active nurseries birthing hot, massive, bluish stars.

At least, that’s how galaxies appear in visible light.

As early as the 1970s, though, the first space-borne telescopes sensitive to ultraviolet radiation (UV) revealed



*The Galaxy Evolution Explorer UV space telescope helped to identify red elliptical galaxies that also emitted the strongest UV. These are detailed, long-exposure Hubble Space Telescope images of four of these galaxies that capture the UV-emitting rings and arcs indicative of new star formation.*

something mysterious: a few red elliptical galaxies emitted “a surprising ultraviolet excess,” said Rich. The observations suggested that some old red galaxies might not be as “dead” as previously supposed.

To investigate, Salim and Rich used NASA’s Galaxy Evolution Explorer satellite to identify 30 red elliptical galaxies that also emitted the strongest UV. Then they captured a long, detailed picture of each galaxy using the Hubble Space Telescope.

“Hubble revealed the answer,” says Salim. The UV radiation was emitted by enormous, flat bluish rings that completely surrounded each reddish galaxy, reminiscent of the rings of Saturn. In some cases, the bluish rings even showed a faint spiral structure!

Because the bluish UV rings looked like star-forming spiral arms and lay mostly beyond the red stars at the centers of

the elliptical galaxies “we concluded that the bluish rings must be made of hot young stars,” Salim continued. “But if new stars are still being formed, that means the red-and-dead galaxies must have acquired some new gas to make them.”

How does a galaxy “acquire some gas?” Salim speculates that it was an act of theft. Sometimes galaxies have close encounters. If a gas-rich irregular galaxy passed close to a gas-poor elliptical galaxy, the gravity of the elliptical galaxy could steal some gas.

Further studies by Galaxy Evolution Explorer, Hubble and other telescopes are expected to reveal more about the process. One thing is certain, says Rich: “The evolution of galaxies is even more surprising and beautiful than we imagined.”

The press release is available at <http://www.galex.caltech.edu/newsroom/>

[glx2010-03f.html](http://www.galex.caltech.edu/newsroom/glx2010-03f.html). The full published article is “Star Formation Signatures in Optically Quiescent Early-Type Galaxies” by Samir Salim and R. Michael Rich, *The Astrophysical Journal Letters* 714: L290–L294, 2010 May 10.

Point the kids to the Photon Pile-up Game at <http://spaceplace.nasa.gov/en/kids/galex/photon>, where they can have fun learning about the particle nature of light.

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

### Starry, Starry Night

#### **Alhena**

Paul Kohlmiller

The star Alhena lies at the “foot” of Pollux in Gemini. It is the third brightest star in that constellation after Castor and Pollux. Hence its Bayer designation is Gamma Geminorum. Its magnitude is 1.9. The name Alhena has to do with a brand or mark on the neck of a camel. This is a class A star with a surface temperature of 9200 Kelvin (Sol is 5800 Kelvin). It is 105 light years away and its absolute magnitude is -0.64 meaning its intrinsic brightness exceeds the twins themselves. Alhena has a companion which was discovered using a technique similar to the wobble method that Geoff Marcy and colleagues use to detect planets. The companion star has the size of our Sun and it orbits Alhena once every 12.6 years. The semi-major axis of the elliptical orbit is 8.5 AU but the distance between the two stars varies from 1 to 20 AU. It seems unlikely that any planets could be present in that configuration.

Alhena is the brightest star ever used to study an occultation of an asteroid. This was done in 1991 with the asteroid 381 Myrrha and this gave an estimated diameter of 140 kilometers. These observations confirmed that Alhena’s companion star is a class G star (like Sol).

Alhena crosses the meridian around midnight by the end of December. It is near the moon on the winter solstice.

## *Holiday Party - 12/18/2010*

**Bring your favorite dessert or appetizer to share. Contributions of food or drink are appreciated but not necessary. No alcohol, please.**

### **Directions to Houge Park**

Houge (rhymes with “Yogi”) Park is in San Jose, near Campbell and Los Gatos. From Hwy. 17, take the Camden Avenue exit. Go east 0.4 miles, and turn right at the light, onto Bascom Avenue. At the next light, turn left onto Woodard Road. At the first stop sign, turn right onto Twilight Drive. Go three blocks, cross Sunrise Drive, then turn left into the park.

From Hwy. 85, take the Bascom Avenue exit. Go north, and turn right at the first traffic light, onto White Oaks Road. At the first stop sign, turn left onto Twilight Drive. You will now be passing the park. Turn right at the first driveway, into the parking lot.

---

## The Last Month In Astronomy

07-NOV-2010 **Eris shrinkage** Dear Pluto, First, on behalf of the planet or at least the astronomers or maybe just on behalf of amateur astronomers on my block, sorry for belittling you lately. Yes, we always understood that it is us not you. You didn't change. We demoted, no, make that, modified your status to that of "dwarf planet". As Neil deGrasse Tyson says, if you were in orbit around 1 AU then you would have a cometary tail and "that's no way for a planet to behave". But Dr. Tyson, on a recent episode of "The Big Bang Theory" claimed he didn't stick it to you, the International Astronomy Union did. Yet, his preeminence dwarfs other astronomers. Oops, used the "d" word again. We did have good intentions. We knew that there are a lot of objects like you out there 40 AU or more away from Sol. And we figured someday we would find an object even larger than you and we either let everybody be a planet or we get pedantic about it. This would not have felt so unseemly except that it makes scientists look like they don't know anything. If you can't get the definition of a planet correct how much faith can we put into cosmology? And it's not like astronomers were going to go back and fix the misnamings that have accumulated over centuries: planetary nebulae (nothing to do with planets), Alpha Orionis (Betelgeuse is not brighter than Rigel), quarter moon (when it looks half lit), novae (not "new" stars, dying stars). But righteous indignation was rampant when Eris was discovered and it was bigger than you. Oops, again. Turns out Eris is probably smaller than you. Some occultation measurements performed by telescopes in Chile made that determination. Alas, this doesn't mean we are going to restore your previous planetary status anytime soon. If ever. For all the reasons why please see Mike Brown the original discoverer of Eris. He says that this must mean that you are less dense than Eris. And if that is true then you might not be related at all. Now what? <http://www.skyandtelescope.com/news/106861063.html>

05-NOV-2010 **Hartley Studied** The Deep Impact mission has completed part 2 of its mission. It came within 435 miles of Comet Hartley. This mission is officially called EPOXI - a combination of two instruments. Hartley 2 is the fifth comet nucleus to be imaged and the first time two comets were studied with the same hardware. <http://www.jpl.nasa.gov/news/news.cfm?release=2010-375&rn=news.xml&rst=2807>

29-OCT-2010 **Mars Gullies from CO2** Researchers have tracked changes in gullies and tracked them to CO2 frost. This is because the changes appear during Martian winter, a time when liquid water is unlikely. Instead, it appears that the carbon dioxide frost accumulates at the top of a dune that eventually gets thick enough to cause a small avalanche. <http://www.jpl.nasa.gov/news/news.cfm?release=2010-359&rn=news.xml&rst=2792>

28-OCT-2010 **Largest Neutron Star** A neutron star has been found that is twice the mass of the sun. The pulsar is PSR J1614-2230 which rotates 317 times per second. The mass measurement works best when a companion star is present and in this case the companion orbits once per 9 days. In addition, the companion is in an orbit that is nearly edge-on from Earth. This causes radio waves to undergo a delay called the Shapiro Delay. This discovery makes some theories more likely and others less so. Winners are that short-duration gamma ray bursts can come from neutron stars and that they can be used to study gravitational waves. Losers are that free quarks can be found in a neutron star core and that they might contain other subatomic particles. <http://www.astron.nl/about-astron/press-public/news/astronomers-discover-most-massive-neutron-star-yet-known>

28-OCT-2010 **How Many Earths** Sometimes the statistics tell a story that arrives before the rest of the evidence. For example, we know that the odds are you are more likely to die from an asteroid hitting Earth than you are from a terrorist act. This is true despite the fact that no human (that we know of) has ever been killed by an asteroid. Here's another one. 23% of all Sun-like stars should have Earth mass planets. But we haven't found any yet. That new statistic comes from Geoff Marcy and Andrew Howard from UC Berkeley. Their reasoning goes something like this: for every 100 sun-like stars, we detect 1-2 Jupiters, maybe 6 Neptunes, and about a dozen super-Earths (3-10 Earth masses). At that rate, you should end up with 23 planets in the range of .5 to 2.0 Earth masses. Compare this to some estimates of the factors in the Drake Equation. One factor is the number of stars that have planets and another factor is the number of those planets that can support life. Some put each factor at one over ten so those two factors come out to 1%. Can it really be 23% instead? Okay, not quite an apples-to-apples comparison but wow! [http://www.berkeley.edu/news/media/releases/2010/10/28\\_sun\\_earth\\_solar\\_system.shtml](http://www.berkeley.edu/news/media/releases/2010/10/28_sun_earth_solar_system.shtml)

27-OCT-2010 **THEMIS becomes ARTEMIS** Two spacecraft have been given new assignments. The two THEMIS spacecraft were supposed to study that solar wind as it moves past the Earth. The problem is that the spacecraft, intended to be in the Earth shadow only 3 hours at a time, found themselves in shadow 8 hours during some orbits and the electronics suffered. So the instruments were moved to the Lagrangian points 1 and 2 and they have been renamed ARTEMIS. [http://science.nasa.gov/science-news/science-at-nasa/2010/27oct\\_artemis/](http://science.nasa.gov/science-news/science-at-nasa/2010/27oct_artemis/)

# It Must Be Astronomical ...

## Loaners

The loaner program offers members a means to try scopes of various sizes and technologies before you buy. For more information please see the loaner program web page: <http://www.sjaa.net/loaners>

## Dues Change

Effective January 1, 2011, the SJAA membership dues will be changed. The regular dues will remain at \$20 but only for members choosing the electronic version of this newsletter. Those who want to continue with the print version will find that their dues are \$30.

## Kids Links

A new game on the NOAA/NASA Scijinks website puts you in the position of an airline Flight Controller whose job is to safely steer planes around such hazards as air turbulence, lightning storms, and near-invisible volcanic ash. You have maps with information from the GOES-R satellite so you can easily see where trouble lurks. Check it out at <http://scijinks.gov/aviation-game>.

## School Star Parties

### Completed Events

	Total Sched.	Good Sky	Partial Success	Cloudy Fail	Cancel at noon
Jul	1	1			
Aug	4	4			
Sep	0				
Oct	5	5			
<b>Total</b>	<b>10</b>	<b>10</b>	<b>0</b>	<b>0</b>	<b>0</b>

### Scheduled Events

	Total	Firm	Workin'		
Oct	2	2	0		
Nov	14	12	2		
Dec	7	5	2		
Jan	2	1	1		
Feb	2	2	0		
Mar	5	3	2		
<b>Total</b>	<b>32</b>	<b>25</b>	<b>7</b>		

As of mid-October

*“Science is a way of thinking much more than it is a body of knowledge.” - Carl Sagan*

### Officers and Board of Directors

**Pres** Rich Neuschaefer  
**VP** Greg Claytor  
**Sec** Mark Wagner  
**Tres** Robert Armstrong  
**Dir** Lee Hoglan  
**Dir** Gordon Reade  
**Dir** Rod Norden  
**Dir** Kevin Roberts  
**Dir** Rob Jaworski

### Ephemeris Staff

**Editors** Paul & Mary Kohlmler  
**Circulation** Gordon Reade  
**Printing** Accuprint (408) 287-7200

### School Star Party Chairman

Jim Van Nuland (408) 371-1307

### SJAA Email Addresses

Board of Directors [sjaa-board@sjaa.net](mailto:sjaa-board@sjaa.net)  
 Announce [announce-sjaa@sjaa.net](mailto:announce-sjaa@sjaa.net)  
 School Star Parties [schools@sjaa.net](mailto:schools@sjaa.net)  
 Ephemeris [ephemeris@sjaa.net](mailto: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>

### Publication Statement

SJAA *Ephemeris*, newsletter of the San Jose Astronomical Association, is published monthly.

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

The SJAA *Ephemeris* is published in three formats: hardcopy, Adobe Acrobat PDF, and HTML. The PDF and HTML versions are found at <http://ephemeris.sjaa.net>.

Articles for publication should be submitted by the 10<sup>th</sup> of the previous month. The PDF version is generally available by the 24<sup>th</sup> of the previous month and the HTML version by the last day of the previous month.

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

Nonprofit Organization  
U.S. Postage Paid  
San Jose, California  
Permit No. 5381

**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. The newsletter is always available online at <http://ephemeris.sjaa.net>**

Questions?

Send e-mail to [membership@sjaa.net](mailto: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/SJAAmembership.html>

**Name:** \_\_\_\_\_

**Address:** \_\_\_\_\_

**City/ST/Zip:** \_\_\_\_\_

**Phone:** \_\_\_\_\_

**E-mail address:** \_\_\_\_\_