



# SJAA EPHEMERIS

## SJAA Activities Calendar

Jim Van Nuland

late May

- 25 Houge Park star party. Sunset 8:17 p.m., 72% moon sets 2:52 a.m. Star party hours: 9:00 to midnight.
- 26 **General meeting at Houge Park.** 8 p.m. Dr. Jeffrey Cuzzi of NASA/Ames will tell us of the rings of Saturn.

June

- 2 Mirror-making workshop at Houge Park. 7:30 p.m.
- 7 Mirror-making workshop at Houge Park. 7:30 p.m.
- 8 Astronomy Class at Houge Park. 7:30 p.m.
- 8 Houge Park star party. Sunset 8:27 p.m., 40% moon rise 1:51 a.m. Star party hours: 9:30 to midnight.
- 9 Coyote Lake Park star party. Sunset 8:27 p.m., 29% moon rise 2:17 a.m. Star party starts at 9:30.
- 16 Dark sky weekend. Sunset 8:30 p.m., 6% moon sets 10:32 p.m.
- 22 Houge Park star party. Sunset 8:32 p.m., 57% moon sets 1:17 a.m. Star party hours: 9:30 to midnight.
- 23 Mirror-making workshop at Houge Park. 7:30 p.m.
- 30 **General meeting at Houge Park.** 8 p.m. John Dillon, science historian, will tell us of the search for the first telescope.

July

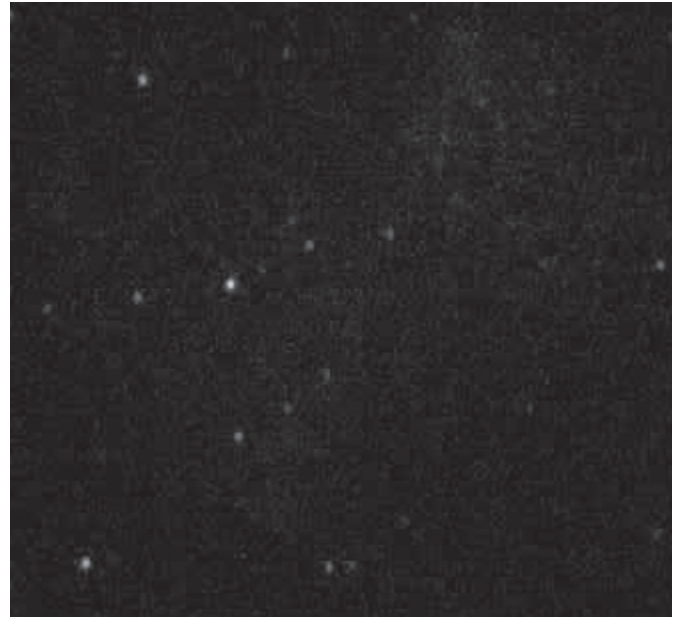
- 5 Mirror-making workshop at Houge Park. 7:30 p.m.
- 6 Astronomy Class at Houge Park. 7:30 p.m.
- 6 Houge Park star party. Sunset 8:31 p.m., 55% moon rise 0:20 a.m. Star party hours: 9:30 to midnight.
- 7 Dark sky weekend. Sunset 8:31 p.m., 44% moon rise 0:48 a.m.
- 14 Dark sky weekend. Sunset 8:28 p.m., 1% moon sets 9:07 p.m.
- 20 Houge Park star party. Sunset 8:24 p.m., 33% moon sets 11:41 p.m. Star party hours: 9:30 to midnight.
- 21 Coyote Lake Park star party. Sunset 8:23 p.m., 49% moon sets 12:04 a.m. Star party starts at 9:30.
- 21 Mirror-making workshop at Houge Park. 7:30 p.m.
- 30 **General meeting at Houge Park.** 8 p.m. Bryant Grigsby, staff astronomer at Lick Observatory, will tell of Developing Adaptive Optics for Lick Observatory.
- The Board of Directors meets at 6:00 p.m. preceding each general meeting. All are welcome.*

**24 hour news and information hotline:**

**(408) 559-1221**

## The Dark Sky Advantage

Paul Kohlmler



*This is just a simple demonstration of the importance of a dark sky site. Both pictures of M27 were taken with the same equipment (10 inch LX200, SBIG ST-7XE CCD imager), the same 10 second exposure, and processed identically. The one above is from my backyard in Gilroy last July 30. The one below is from Fremont Peak on August 26. The picture above shows almost nothing. The picture below at least shows some of the nebula and many more stars. A filter would have improved the light-polluted photo but only with a longer exposure or several stacked images combined.*



# DEEP SKY OBSERVING

by Mark Wagner

June 2007 third quarter to new moon observing list The list begins in the north and moves southward. Objects are within roughly a two hour section of right ascension that is at a comfortable elevation to the east at astronomical dark. This list is just a sampling of the full list which is at <http://www.resource-intl.com/Deep.Sky.Jun.07.html>.

TARGET	TYPE	SIZE	MAG.	R.A.	DEC.
N6340	Globular Cluster	3.2'x2.9'	11.9	17h 10m 24s	72° 18' 16"
NGC 6543	Planetary Nebula	1.0'x0.4'	8.8	17h 58m 15s	66° 38' 05"
Paired with dim IC4677					
NGC 6229	Globular Cluster	4.5'	9.4	16h 46m 58s	47° 31' 40"
M92	Globular Cluster	14.0'	6.5	17h 17m 07s	43° 08' 11"
NGC 6207	Galaxy	3.3'x1.7'	11.9	16h 43m 04s	36° 49' 56"
Next to M13 and IC4617					
M13	Globular Cluster	20'	5.8	16h 41m 41s	36° 27' 37"
with NGC 6207 and IC4617					
NGC 6426	Globular Cluster	4.2'	10.9	17h 44m 54s	03° 10' 13"
M12	Globular Cluster	16'	6.1	16h 47m 14s	-01° 56' 52"
M10	Globular Cluster	20'	6.6	16h 57m 09s	-04° 05' 58"
M14	Globular Cluster	11.0'	7.6	17h 37m 36s	-03° 14' 45"
NGC 6517	Globular Cluster	4.0'	10.1	18h 01m 50s	-08° 57' 32"
M107	Globular Cluster	13.0'	13	16h 32m 31s	-13° 03' 13"
NGC 6356	Globular Cluster	8.2'	10	17h 23m 35s	-17° 48' 47"
M9	Globular Cluster	12.0'	7.8	17h 19m 11s	-18° 30' 59"
NGC 6342	Globular Cluster	4.4'	9.5	17h 21m 10s	-19° 35' 14"
NGC 6440	Globular Cluster	4.4'	9.3	17h 48m 52s	-20° 21' 34"
Paired with Globular 6445					
NGC 6235	Globular Cluster	5.0'	8.9	16h 53m 25s	-22° 10' 38"

Note: Source catalogs are Messier, Arp, Abell Planetary, Abell Galaxy Cluster (AGC), Hickson Compact Galaxy (HCG), Herschel 400-I, Herschel 400-II. Herschel 400-I are identified as NGCXXXX, Herschel 400-II as NXXXX.

## Jupiter Season Opens

Akkana Peck

This June marks the official beginning of Jupiter Season. The gas giant passes opposition on the 5th, when it rises around 8pm and transits at 1am.

Unfortunately it stays low: even when it transits it's only 30 degrees up. Still, there's plenty to see on Jupiter even when it's down in the atmospheric murk, so aim the telescope low and take a look!

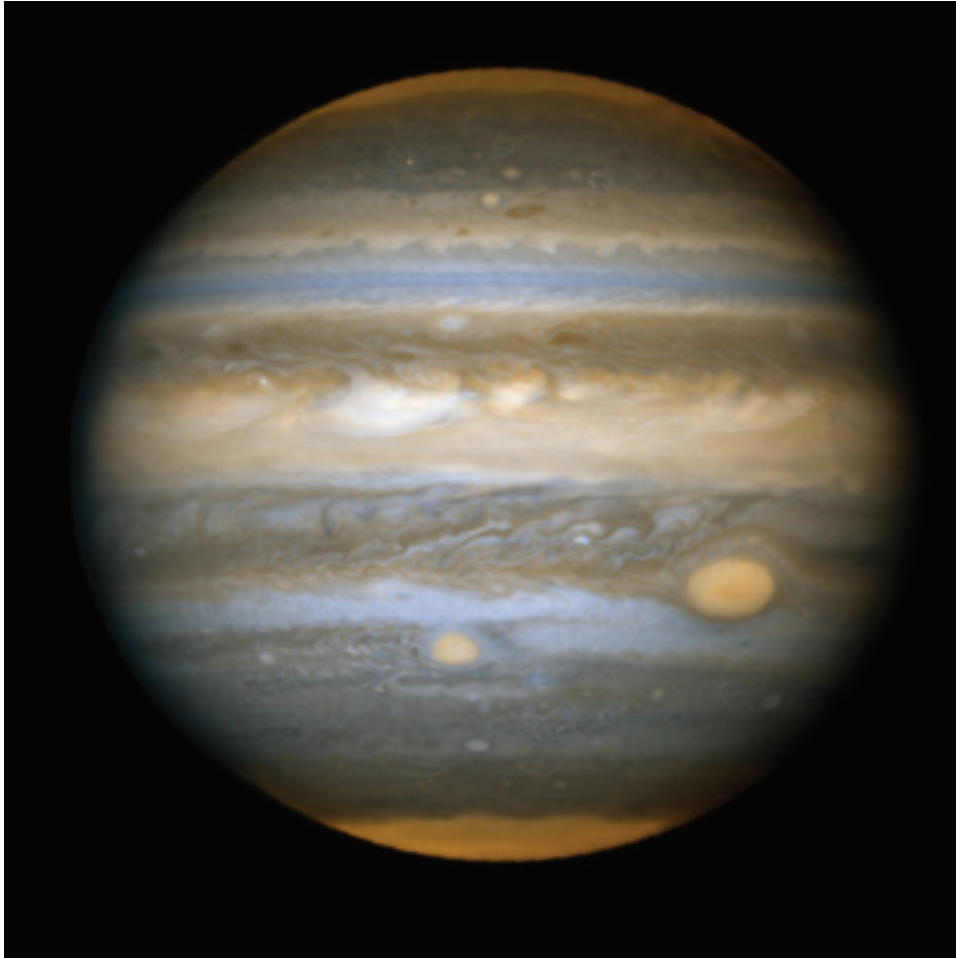
Venus continues its long-running and beautiful evening show. It reaches greatest elongation (greatest distance from the sun) on the 9th, when it

will be a hefty 35 degrees up at sunset. A few days later, on the 12th and 13th, Venus passes near the Beehive cluster (M44).

Saturn hovers a bit above the much brighter Venus the evening sky. It's too low to see much detail, but you can still catch a view of the rings (and amaze your friends) before it disappears behind the sun.

Mercury, too, is visible in the evening skies. It's an easy target at the beginning of June, but by month's end its crescent wanes to a snippet and it draws so close to the sun that it will be difficult to find.

Watch it day to day as it sinks toward the sun, and see how its crescent gets slimmer and larger every day.



Pluto is at opposition on the 19th. It's at the southeast corner of Ophiuchus – well, actually it's technically in the northwest corner of Sagittarius, but you'll find it most easily by starting from Sabik (Eta Ophiuchus), hopping to Xi Serpens then swinging three and a quarter degrees east-southeast. Of course, you'll want better directions than that to identify the tiny magnitude 13.9 speck, especially in this crowded star field. Use a reliable chart, like the one from the RASC Observer's Handbook, or a good planetarium program.

If you have more than one planetarium

program, try them all. Pluto's orbit is surprisingly complicated, and a lot of planetarium programs don't get it right.

If you can find two that show it in exactly the same place, that's a good start.

Neptune rises around midnight, and Uranus a bit over an hour or so later. That makes them not very well suited to observing this month, unless you're already up observing into the wee hours.

But there's something brighter to see than Neptune. Ever wanted to see an asteroid, but felt like the hunt would be too difficult? The brightest asteroid, 4 Vesta, was at opposition last month, and this month it remains barely within reach of the naked eye ... if that eye belongs to a sharp observer at a dark site. It's a hair brighter

than 6th magnitude all month, and you'll find it in northern Scorpius. Use a planetarium program or online chart to find it: it begins June a little over a degree south of the globular M107, then skims westward. At mid-month it makes a triangle for a few days with a couple of other 6th magnitude stars before bending southwest into emptier skies.

Mars is barely visible at the break of dawn. It's still far away, though, and you won't be able to see much detail on it yet, so keep waiting ... you'll get a better chance at the red planet later this year.

During the summer and fall of 2006, U.S. Coast Guard planes flew over the North Pacific in search of illegal, unlicensed, and unregulated fishing boats. It was a tricky operation—in part because low clouds often block the pilots' view of anything floating on the ocean surface below.

To assist in these efforts, they got a little help from the stars.

Actually, it was a satellite—CloudSat, an experimental NASA mission to study Earth's clouds in an entirely new way. While ordinary weather satellites see only the tops of clouds, CloudSat's radar penetrates clouds from top to bottom, measuring their vertical structure and extent. By tapping into CloudSat data processed at the Naval Research Laboratory (NRL) in Monterey, CA, Coast Guard pilots were better able to contend with low-lying clouds that might have otherwise hindered their search for illegal fishing activity.

In the past, Coast Guard pilots would fly out over the ocean not knowing what visibility to expect. Now they can find out quickly. Data from research satellites usually takes days to weeks to process into a usable form, but NASA makes CloudSat's data publicly available on its QuickLook website and to users such as NRL in only a matter of hours—

making the data useful for practical applications.

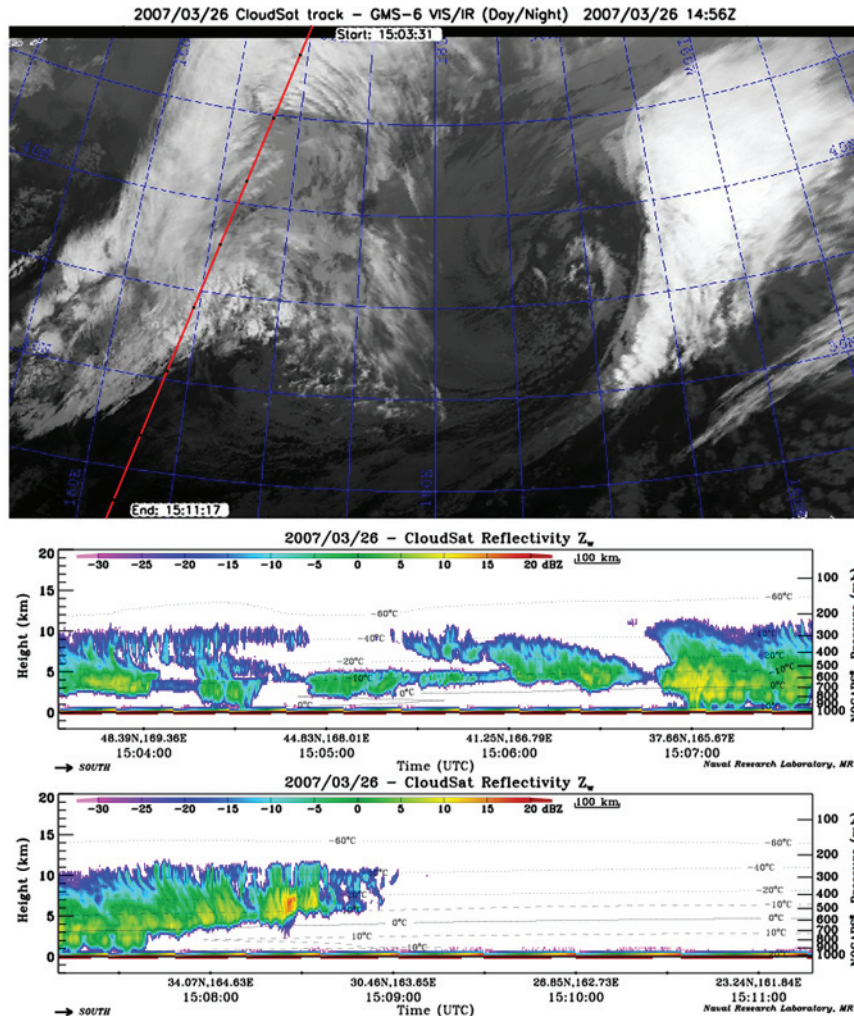
not only for scientific research, but also to operational users such as Coast Guard patrol aircraft and Navy and commercial ships at sea.

"Especially when it's dark, there's limited information about storms at sea," says Vane. "With CloudSat, we can sort out towering thunderclouds from blankets of calmer clouds. And we have the ability to distinguish between light rain and rain that is falling from severe storms." CloudSat's radar is much more sensitive to cloud structure than are radar systems operating at airports, and from its vantage point in space, Cloudsat builds up a view of almost the entire planet, not just one local area. "That gives you weather information that you don't have in any other way."

There is an archive of all data collected since the start of the

mission in May 2006 on the CloudSat QuickLook website at [cloudsat.atmos.colostate.edu](http://cloudsat.atmos.colostate.edu). And to introduce kids to the fun of observing the clouds, go to [http://spaceplace.nasa.gov/en/kids/cloudsat\\_puz.shtml](http://spaceplace.nasa.gov/en/kids/cloudsat_puz.shtml).

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



*A view of the clouds from space gives only 2-D information. CloudSat, on the other hand, gives a 3-D profile of the clouds, including water content. A CloudSat ground track appears as a diagonal line overlaid upon a GMS-6 (a Japanese weather satellite) infrared image. CloudSat is crossing the north-central Pacific Ocean on a descending orbit (from upper-right to lower-left) near a storm front. The radar data corresponding to this ground track (beginning in the center panel and continuing into the lower panel) is output in color and shows a vertical cloud profile far more complex than the two-dimensional GMS-6 imagery would suggest.*

"Before CloudSat, there was no way to measure cloud base from space worldwide," says Deborah Vane, project manager for CloudSat at NASA's Jet Propulsion Laboratory.

CloudSat's primary purpose is to better understand the critical role that clouds play in Earth's climate. But knowledge about the structure of clouds is useful

## Gold Creation

Paul Kohlmeier

One of my favorite astronomy-themed t-shirts says "You are star dust". It makes the point that we are all made from long dead stars. Of course, everything around us is also made of star stuff. This even includes rare elements such as gold. This paper discusses the process of gold formation.

Most main sequence stars are in the business of making helium from hydrogen. Other elements can be created through fusion. However, this only works for elements as heavy as iron or less. That's because creation of elements heavier than iron requires additional energy rather than producing energy.

There are two main processes involved in creating the heavier elements. These are called the *s*-process and the *r*-process. These are not exotic names – *s*-process simply means the slow process and *r*-process means (you guessed it) the rapid process. These processes were largely demonstrated in a seminal paper by Margaret and Geoffrey Burbidge, William Fowler and Fred Hoyle in 1957. This paper is so famous it is often referred to simply as B<sup>2</sup>FH – the last initials of the authors. Fowler would win the Nobel Prize in 1983 for his work in this area.

You already know that atoms are made up of electrons, neutrons and protons. Any addition or subtraction of an electron that results in a non-neutral atom is called ionization. Any addition or subtraction of a neutron results in a new isotope of an atom. Any addition or subtraction of a proton creates a different element. The process of building up an atom's nucleus (protons and neutrons) is called nucleosynthesis.

Since protons all have the same charge, it is difficult for an atom to add a proton to an atom's nucleus because the it has the same kind of charge as the protons

already in the nucleus. But a neutron has no charge so adding a neutron is much easier. This is called neutron capture. As we saw above, adding a neutron results in a new isotope of an atom. But the extra neutron is not likely to remain for long. Instead, a process called beta decay results in the neutron turning into a proton (and some other stuff that we will ignore for now).

So the creation of heavy elements requires a supply of neutrons and a lot of energy to shove them into already existing atoms. The *s*-process can produce some of the heavier elements but *s*-process elements tend to be much lighter than gold. The *s*-process can occur during a star's carbon burning phase. The *r*-process takes something quite a bit stronger – a supernova. In other words, a star has to be blown to smithereens in order to create gold and other heavy elements. Our solar system has been the benefactor of the *r*-process. Many rare earths including gold show that to be the case. The evidence is that our solar system was metal enriched by more than one supernova.

But we still don't know the exact mechanism involved. Here are some possibilities. Each of these has some evidence to support it but also has some reasons for doubt.

### **MHD Jets**

A tightly focused jet of neutrons might create *r*-process elements. Calculations based on magnetohydrodynamic jets were done for a star having 13 solar masses. In this scenario a supernova explosion does not create a simple spherical outward shock wave but instead a magnetically focused jet passes through oxygen rich layers which kicks off the *r*-process. The simulations agree with the abundance of *r*-process elements. But it is not at all clear that there are enough neutrons in this

scenario to make it all work.

### **Quark–Nova**

The remnant star from a supernova can be a neutron star. The stellar wind from the new neutron star can increase the likelihood of a successful *r*-process. The idea that a neutron star is a good place for the *r*-process makes sense. If we are going to capture a neutron, it has to be easier when a lot of neutrons are available.

Normally we think of neutron stars as the end result of a supernova. But another kind of nova, called a quark-nova, could create the greatest explosions in the universe. It's possible that quark-novae are the source of gamma-ray bursts.

For *r*-process elements, the key point about a quark-nova is that there is a transition in the core of a neutron star where matter becomes some kind of strange quark matter. This process is quite violent. It ejects a lot of neutrons at the surface of the neutron star. This matter decompresses creating a neutrino-driven wind. The resulting wave increases the likelihood of *r*-process nucleosynthesis. But this scenario requires an improbably heavy neutron star and the winds may not be sufficient for the heavier *r*-process elements such as gold. Also, neutrino-driven winds actually have an inhibitory effect on the *r*-process.

### **Neutron Star Mergers**

A pair of neutron stars will merge about once per 100,000 years in the Milky Way galaxy. The effects of this rare occurrence are not completely known. The production of *r*-process elements might be most efficiently done during a neutron star merger. Two nearby stars have to both go supernova without one star gaining enough mass from the

*Continued on page 6*

other to form a black hole. Then the neutron stars revolve around a common center close enough that they eventually merge. The result might yet create a black hole but a lot of neutrons are available for capture. As in the Proto Neutron Star scenario, the ejecta from the neutron star material and the expected abundances match what we see in the galaxy. However, the rarity of these mergers makes this scenario doubtful.

### **Collapsar**

Another way to synthesize r-process elements is when a black hole is created in a collapsar – a star that collapses. Heavy elements can be synthesized in collapsars. A collapsar is formed when a black hole is formed in a specific way. The original massive star is rotating when it explodes but the explosion is incomplete. Collapsars (like the quark-novae described above) are a leading candidate for gamma-ray bursts. The total amount of heavy elements created in a collapsar can be 1% of a solar mass. Some heavy elements are created in a collapsar much more easily than in a supernova. But the collapsar scenario is a new idea and hasn't had enough time to be attacked. Previous studies showed that collapsars with slower rotations would not produce the heaviest r-process elements.

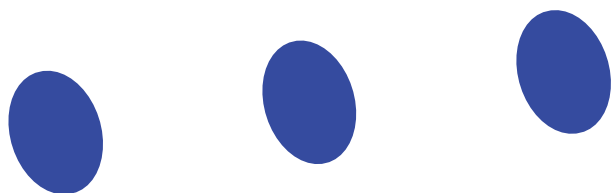
### **Supernova Itself**

The energies unleashed in such an explosion are sufficient but there is some doubt that supernovae can account for the abundances of r-process elements.

All of the above involve the aftermath of a supernova. So the simplest answer to "How is gold made?" is still supernovae. It has been reported that the dominant source of the r-process elements are Type II Supernovae with progenitor masses between 20 and 40 solar masses. But it is not certain if one or more of the above processes are necessary or if the supernova itself creates the r-process elements.

There are a couple of specific supernovae scenarios that can create r-process elements. One case involves a star with about 10 solar masses at the time of the supernova. Such a supernova gets two chances to create r-process elements: in the prompt supernova explosion or in a neutrino-driven wind that follows.

(Another version of this article is available with references. See <http://ephemeris.sjaa.net/0706/GoldCreation.doc>)



The news seen between Apr. 13 and May 13, 2007.

APR-23-2007 **STEREO sees Soundly** The STEREO spacecraft was launched in October of 2006. But these twin observatories took about half of a year to be far enough apart to realize the mission's goals - taking three dimensional pictures of the sun. Now the first 3D images are available. [http://www.nasa.gov/mission\\_pages/stereo/main/index.html](http://www.nasa.gov/mission_pages/stereo/main/index.html)

APR-24-2007 **Potentially Habitable Planet** A planet, named Gliese 581c, is the first exoplanet discovered that appears to be habitable. A few facts about the planet are contained in the name. The Gliese stars are red dwarfs so it cannot be far away. In fact, Gliese 581 is one of the 100 closest known stars (actually less than 21 light years distant). The letter c indicates that at least one other planet has already been found around this star. And the habitable zone around a red dwarf must be much closer to the star than Earth is to the sun. Indeed, this planet has a "year" that lasts 13 days. <http://www.washingtonpost.com/wp-dyn/content/article/2007/04/24/AR2007042401470.html>

MAY-03-2007 **Mercury's Liquid Inner Shell** When Mariner 10 zoomed by Mercury in 1974-75 it discovered a magnetic field. This was unexpected because one of the prerequisites for a planetary magnetic field is a molten core. Mercury's core was thought to be solid simply because it is too small to have not cooled off by now. Recent radar observations show that at least the outer core, a shell around the solid core, is still molten. This in turn may indicate the presence of sulfur in this part of Mercury - a kind of antifreeze that lowers the freezing point of iron. <http://www.nasa.gov/vision/universe/solarsystem/mercury-20070503.html>

MAY-07-2007 **Brightest Supernova** The largest supernova ever detected was found in 2006. SN 2006gy is 100 times more energetic than a typical supernova. But for some reason NASA chose May 7 to announce this discovery which has been reported in various journals earlier. [http://www.nasa.gov/vision/universe/features/chandra\\_bright\\_supernova.html](http://www.nasa.gov/vision/universe/features/chandra_bright_supernova.html)

MAY-08-2007 **Phoenix at the Cape** The Phoenix spacecraft is now at Cape Canaveral undergoing final testing before the August 3 launch. The Phoenix will actually go digging for water on a Martian arctic plain. [http://www.nasa.gov/mission\\_pages/mars/news/phoenix-20070508.html](http://www.nasa.gov/mission_pages/mars/news/phoenix-20070508.html)

MAY-09-2007 **Hot Jupiter Temperature Mapped** A total of 250,000 data points from HD 189733b were mapped by the infrared telescope Spitzer. This planets completes an orbit in 2.2 days and is the closest planet found thus far. The temperature readings range from 1,200 degrees Fahrenheit (on the dark side) to 1,700 degrees (on the sunlit side). [http://www.nasa.gov/mission\\_pages/spitzer/news/spitzer-20070509.html](http://www.nasa.gov/mission_pages/spitzer/news/spitzer-20070509.html)

## Officers and Board of Directors

**Pres** Rob Hawley (408) 997-6526  
**VP** Rich Neuschaefer  
**Sec** Craig Scull (408) 292-9317  
**Tres** Gary Mitchell (408) 265-2336  
**Dir** David Smith (408) 978-5503  
**Dir** Mike Koop (408) 446-0310  
**Dir** Lee Hogle  
**Dir** Gordon Reade  
**Dir** Steven Nelson (650) 968-4733

### Ephemeris Staff

**Editors** Paul & Mary Kohlmler  
(408) 848-9701

### Circulation

(Volunteers needed.)

**Printing** Accuprint (408) 287-7200

### School Star Party Chairman

Jim Van Nuland (408) 371-1307

### Telescope Loaner Program

Mike Koop (408) 446-0310

### Web Page

Paul Kohlmler pkohlml@best.com

### SJAA Email Addresses

Board of Directors board@sjaa.net  
Membership ?'s membership@sjaa.net  
Chat List chat@sjaa.net  
Ephemeris ephemeris@sjaa.net  
Circulation circulation@sjaa.net  
Telescope Loaners loaner@sjaa.net  
Members Email Lists:

<http://www.sjaa.net/mailman/listinfo>

### 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

### Submit

Submit articles for publication in the SJAA *Ephemeris*. Send articles to the editors via e-mail to [ephemeris@sjaa.net](mailto:ephemeris@sjaa.net). **Deadline, 10th of previous month.**

## SJAA loaner scope status

All scopes are available to any SJAA member; contact Mike Koop by email ([koopm@best.com](mailto:koopm@best.com)) or by phone at work (408) 473-6315 or home (408) 446-0310 (Please leave message, phone screened).

### Available scopes

These are scopes that are available for immediate loan, stored at other SJAA members homes. If you are interested in borrowing one of these scopes, please contact Mike Koop for a scope pick up at any of the listed SJAA events.

# Scope	Description	Stored by
1	4.5" Tasco Newt/ EQ Mount	Annette Reyes
3	4" f/15 Quantum S/C	Hsin I. Huang
6	8" f/10 Celestron S/C	Karthik Ramamurthy
7	12.5" f/7 Dobson	Craig Scull
8	14" f/5 Truss Dobson	Charles Santori
11	f/8 Orion XT6 Dob	West Valley College
13	f/8 Orion XT6 Dob	Rajiv Vora
14	8" f/8.5 Dob	Bill Kerns
15	8" f/9 Dobson	Mike Koop
19	6" f/8 Meade Newt/P Mount	Daryn Baker
23	6" f/8 Edmund Newt/EQ Mount	Wei Cheng
24	60mm f/15 Meade Refractor	Al Kestler
26	11" f/4 Dobson	Vivek Kumar
27	13" f/4.5 Dobson	Steve Houlihan
28	13" f/4.5 Dobson	Craig Scull
32	5.5" f/7.6 Dobson	Sandy Mohan
33	10" Deep Space Explorer	Art Kalb
34	8" f/10 Dynamax S/C	Yuan-Tung Chin
38	4.5" f/8.5 Meade Digital Newt	Tej Kohli
39	17" f/4.5 Truss Dobson	Steve Nelson
40	Super C8+	Srinath Krishnan
41	18" Sky Designs Dob	Kevin Roberts
42	11x80 Binoculars	Ritesh Vishwakarma
44	4.5" f/8 Orion Skyview	Mantle Yu

### Scope loans

These are scopes that have been recently loaned out. If you are interested in borrowing one of these scopes, you will be placed on the waiting list until the scope becomes available after the due date.

# Scope	Description	Borrower	Due Date
12	8" f/6 Orion XT Dob	John Schulein	3/7/07
35	8" f/6 Meade Newt/EQ Mount	Lee Barford	4/25/07
36	Celestron 8" f/6 Skyhopper	Steve Quigley	4/12/07
43	4.5" f/8 Orion XT Dob	John Walker	4/6/07

### Extended scope loans

These are scopes that have had their loan period extended. If you are interested in borrowing one of these scopes, we will contact the current borrower and try to work out a reasonable transfer time for both parties.

# Scope	Description	Borrower	Due Date
2	6" f/9 Dob	John Paul De Silva	?
9	C-11 f/10 Compustar	Bill Maney	Indefinite
10	Star Spectroscope	Greg Bradburn	3/15/07
16	60mm H-Alpha Solar Scope	Mike Koop	Repair
21	10" Dobson	Michael Dajewski	Repair
29	8" Celestron S/C Astrophoto	Rodney Moorehead	2/18/07
37	4" Celestron Fluorite Refractor	David Smith	5/4/07

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

## San Jose Astronomical Association Membership Form

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

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

**I'll get the Ephemeris newsletter online**

<http://ephemeris.sjaa.net> Questions?

Send e-mail to [membership@sjaa.net](mailto:membership@sjaa.net)

### Membership Type:

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

Bring this form to any SJAA Meeting  
or send to the club address (above).

Please make checks payable to "SJAA".

Subscribing to Sky & Telescope magazine through the SJAA  
saves you \$10 off the regular rate. (S&T will not accept multi-year  
subscriptions through the club program. Allow 2 months lead time.)

You can join or renew online:

<http://www.sjaa.net/SJAAmembership.html>

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

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

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

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

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