



Desert Sky Observer

Volume 36

Antelope Valley Astronomy Club Newsletter

December 2016

Up-Coming Events

December 3: Christmas Party

* Monthly meetings are held at the S.A.G.E. Planetarium in Palmdale, the second Friday of each month. The meeting location is at the northeast corner of Avenue R and 20th Street East. Meetings start at 7 p.m. and are open to the public. *Please note that food and drink are not allowed in the planetarium*



President

Frank Moore

There are strange and mysterious sounds
When the winds of winter blow,
The long nights are crystal clear and cold,
And the fields and meadows are covered with snow.
The stars are frosty against the sky,
And the wind's whistle is shrill,
As the snow blows against the house
And drifts against the hill.
Yet, I like to see during the winter
A white carpet on the ground,
To plod aimlessly in the deep snow,
where deer tracks abound.
I like to feel the stillness
Of a crisp winter's night,
Watching a full moon rise over the horizon,
Exposing a winter wonderland beautiful and bright.

Winter Wonderland - Poem by Joseph T. Renaldi

Season's greetings members. This poem by Joseph T. Renaldi has always expressed my feelings towards winter, which is really my favorite time of year. As an amateur astronomer I find it really expresses the dichotomy of how it affects our hobby.

On the one hand, "the long nights are crystal clear" which is conducive to wonderful observing, but they're also COLD. "The stars are frosty against the sky," but, as all of us in the Antelope Valley and up here in Tehachapi can relate, "the wind's whistle is shrill."

Thus, while the night sky may be crystal clear, were often forced to take a pause from our observing due to the inclement weather. Such was the case on the weekend of November 26 when I canceled our monthly Dark Sky Star Party when weather shut down all of our regular observing sites. The desert sites were rendered inhospitable by high winds and rain, and the mountain sites were closed due to cold weather and snow. In fact, on the night of what might have been our star party, it was 14 degrees at the Chuchupate

observing site and Lockwood Valley Road was closed from Frazier Mountain Park Road to Highway 33. Even if we'd gotten in, we might not have been able to get out till the snow melted.

The weekend before that, on Saturday November 19, we had what was among the best viewing conditions I can remember for the Moon Walks at Prime Desert Woodland but it was cold and much of the public, chilled after the walk, left without even stopping at the telescopes. Still, for those that remained, the clear and moonless night made for some a real treat and exceptional views. Members with telescopes included Darrell Bennett, Rod and Donna Girard, Tom Hames and Rose and Frank Moore.

On Saturday December 3 we had our annual Christmas Party at Domingo's Mexican Restaurant in Lancaster. As I mentioned in a separate email, "It was crowded, it was hectic, it was a bit loud but I can't remember having a better time at our annual holiday gathering."

Our apologies that the seating got a little tight and that the venue ran out of their ever popular "Fried Ice Cream". We had 47 members at the party which is the most we have ever had since Rose and I began serving on the board. I think the cost to members and to the club, which was less than half of what we spent at prior venues, put the event within the reach of more members and contributed to the great turnout. Each time we try a new venue, we learn about details to which we will have to pay attention if we use that venue again and this was no exception.

As is our custom, Rose distributed certificates for participation in various outreach events and we announced the recipients of our annual Keith Lawson and Holland Fountain awards.

The Holland Fountain Award, which is awarded for "Infectious enthusiasm in astronomy and related sciences", was awarded to Ellen Mahler. As I noted at the banquet, Ellen is always anxious to go to any event to which she can arrange a ride. This includes both public outreach events and star parties. She's always well prepared, in fact certainly more prepared than me, with her planned observing list and information about the objects she hopes to find. Because she does not drive, Ellen has to go to the extra effort of arranging transportation and my thanks go out to those who help her in that regard. Congratulations Ellen and THANK YOU.

This year the Keith Lawson Award, which is awarded, "In recognition of outstanding contributions to the Antelope Valley Astronomy Club and the exceptional pursuit of amateur astronomical knowledge", was awarded to Tom Hames.

Tom's contributions to the club over the last few years have taken many forms. As the owner of [High Desert Telescopes](#), he is constantly promoting the club to customers who come into the store in search of astronomy equipment and information. Tom comes to most of our public outreach events and often brings a telescope, for public viewing, to our monthly meetings at the SAGE Planetarium. Tom has been a speaker at our meetings, has assisted Jeremy Amarant with astronomy related education for youth including lessons in his "space art", and has offered the same for AVAC members at several meetings. Some of Tom's work can be seen on his [Instruments of Light](#) website. With a long history with the Antelope Valley Astronomy Club, and with astronomy related organizations in southern California, Tom is a veritable treasure trove of astronomical knowledge and especially on the history and development of amateur equipment. Finally, Tom has been more than generous in providing telescopes and other equipment for door prizes and raffles at our events. Congratulations Tom and THANK YOU.

As the new year approaches, the board will be looking at the dates of various regional astronomy related events, dates for our own Dark Sky Star Parties, and for our own local outreach and readying our calendar for 2017.

May you all have a blessed Christmas and a Happy New Year.



Secretary

Rose Moore

Thank you to all the members and their guests that attended the Christmas Party on Dec. 3rd. We had 47 attendees at the party, the largest group that I'm aware of at this time. When we were looking at different venues for the party, we certainly didn't think we would have this many attend! Thank you to all that donated prizes! Special thanks to those that helped out, and a special big thank you to Rod Girard, our new Treasurer, for handling the raffle tickets, auction sheets, and cash during the party! He has now been initiated as our new Treasurer! We were especially thankful to have several members attending who have been ill recently.

Don Bryden will be leaving the area to join his family in South Carolina at the end of the month. He is leaving his job as an air traffic controller in just a few weeks and beginning retirement! Don has been the past AVAC president, and a huge asset to the club. His knowledge of astronomy, his expertise, and telescope making skills, will be very missed by the members. We will miss him at our club's star parties and public outreach! Good luck Don, and keep in touch!

Our trip to SOFIA will be on Friday, Feb. 3rd. Right now our list is full, but if you would like to go on a standby list, please let me know. I need to know if you are a US citizen or a Resident Alien. **I need your driver's license number if you have not given it to me! I will be contacting those within the next 2 weeks that have not sent me the complete information. I must have your full name as it appears on your driver's license: first name, middle name, last name. They will not accept middle initials or nicknames. Guys, if married, your wife's name as it appears on the license is what they need. If she still uses her maiden name as her legal name, that is what they want. Another email with other trip information will be coming in a week or two. We do not know where we are meeting at this time.

I would like to thank all those that have come out this year to participate in AVAC events and our meetings! We need your support!

Questions, suggestions, comments? Please email me! Merry Christmas and Happy New Year! Happy Holidays!

Space Place

Dimming stars, erupting plasma, and beautiful nebulae

By Marcus Woo

Boasting intricate patterns and translucent colors, planetary nebulae are among the most beautiful sights in the universe. How they got their shapes is complicated, but astronomers think they've solved part of the mystery—with giant blobs of plasma shooting through space at half a million miles per hour.

Planetary nebulae are shells of gas and dust blown off from a dying, giant star. Most nebulae aren't spherical, but can have multiple lobes extending from opposite sides—possibly generated by powerful jets erupting from the star.

Using the Hubble Space Telescope, astronomers discovered blobs of plasma that could form some of these lobes. "We're quite excited about this," says Raghvendra Sahai, an astronomer at NASA's Jet

Propulsion Laboratory. "Nobody has really been able to come up with a good argument for why we have multipolar nebulae."

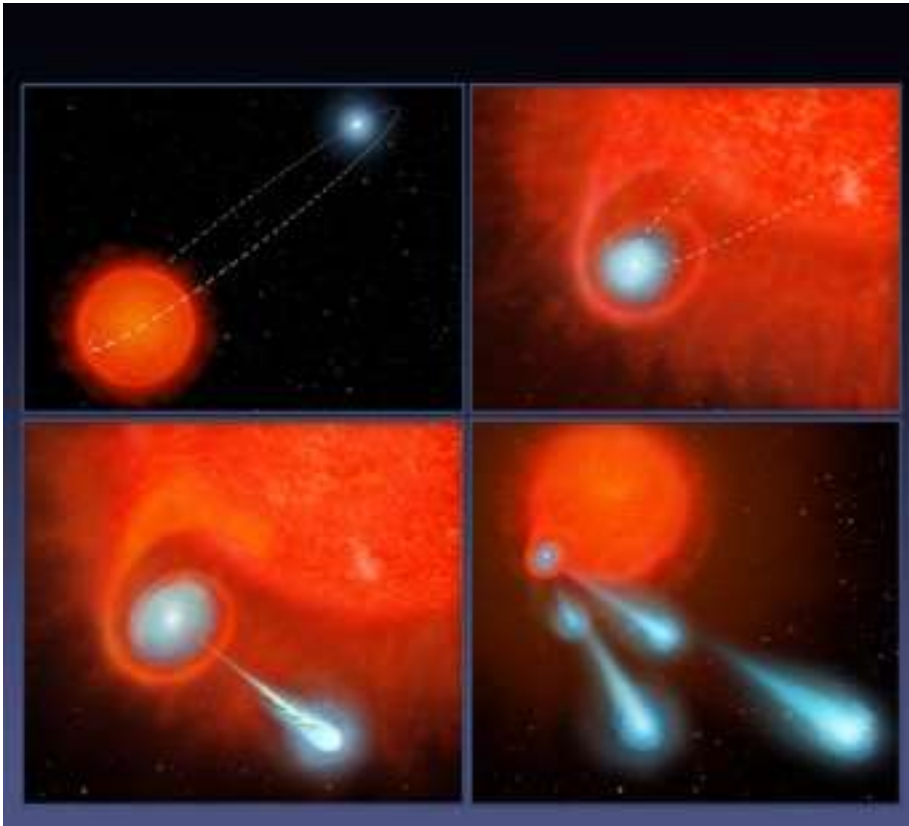
Sahai and his team discovered blobs launching from a red giant star 1,200 light years away, called V Hydrae. The plasma is 17,000 degrees Fahrenheit and spans 40 astronomical units—roughly the distance between the sun and Pluto. The blobs don't erupt continuously, but once every 8.5 years.

The launching pad of these blobs, the researchers propose, is a smaller, unseen star orbiting V Hydrae. The highly elliptical orbit brings the companion star through the outer layers of the red giant at closest approach. The companion's gravity pulls plasma from the red giant. The material settles into a disk as it spirals into the companion star, whose magnetic field channels the plasma out from its poles, hurling it into space. This happens once per orbit—every 8.5 years—at closest approach.

When the red giant exhausts its fuel, it will shrink and get very hot, producing ultraviolet radiation that will excite the shell of gas blown off from it in the past. This shell, with cavities carved in it by the cannonballs that continue to be launched every 8.5 years, will thus become visible as a beautiful bipolar or multipolar planetary nebula.

The astronomers also discovered that the companion's disk appears to wobble, flinging the cannonballs in one direction during one orbit, and a slightly different one in the next. As a result, every other orbit, the flying blobs block starlight from the red giant, which explains why V Hydrae dims every 17 years. For decades, amateur astronomers have been monitoring this variability, making V Hydrae one of the most well-studied stars.

Because the star fires plasma in the same few directions repeatedly, the blobs would create multiple lobes in the nebula—and a pretty sight for future astronomers.



This four-panel graphic illustrates how the binary-star system V Hydrae is launching balls of plasma into space. Image credit: NASA/ESA/STScI

News Headlines

The Latest News From Spaceweather.com

The latest news on sunspots, coronal holes, solar winds, near earth asteroids, solar flares, CMEs, aurora, and other constantly evolving information about the Sun-Earth environment can be found here.

<http://spaceweather.com/>

Ring in the new orbits! Cassini Makes First Ring-Grazing Plunge

NASA's Saturn-orbiting Cassini spacecraft has made its first close dive past the outer edges of Saturn's rings since beginning its [penultimate mission phase](#) on Nov. 30. Cassini crossed through the plane of Saturn's rings on Dec. 4 at 5:09 a.m. PST (8:09 a.m. EST) at a distance of approximately 57,000 miles (91,000 kilometers) above Saturn's cloud tops. This is the approximate location of a faint, dusty ring produced by the planet's small moons Janus and Epimetheus, and just 6,800 miles (11,000 kilometers) from the center of Saturn's F ring.

<http://www.jpl.nasa.gov/news/news.php?feature=6690>

Neutron starlight gets QED-fueled polarization boost

May have confirmed Heisenberg and Euler's 80-year-old proposal. The detection of highly polarized light from a nearby neutron star is likely the first observation of a quantum effect predicted 80 years ago. Using the Very Large Telescope in Chile, a team led by Roberto Mignani from the National Institute for Astrophysics in Milan, Italy, and the University of Zielona Góra in Poland claims to have detected the signature of vacuum birefringence in optical photons from a neutron star.

<https://goo.gl/BNM3Vu>

DigitalGlobe releases first stunning earth photo from WorldView-4. DigitalGlobe has released the first picture from its latest high resolution commercial imaging satellite. The latest satellite provides breathing room for DigitalGlobe to provide coveted 30-centimeter imagery to commercial customers. Built by Lockheed Martin, WorldView-4 orbits the Earth every 90 minutes, documenting up to 680,000 square kilometers per day of the planet's surface

<https://goo.gl/tJVuky>

Mars Ice Deposit Holds as Much Water as Lake Superior

Frozen beneath a region of cracked and pitted plains on Mars lies about as much water as what's in Lake Superior, largest of the Great Lakes, researchers using NASA's Mars Reconnaissance Orbiter have determined.

<http://www.jpl.nasa.gov/news/news.php?feature=6680>

December Sky Data

First Qtr Dec 7	Full Dec 13	Last Qtr Dec 20	New Dec 28
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**Best time for deep sky observing this month:
December 18 through December 30**



Mercury reaches its greatest elongation east on the 10th of December and may be spotted low in the southwest for the first two weeks of the month. Its angular size increases from 5.5 arc seconds at the start of the month to 7 arc seconds by the 10th while its gibbous phase falls from 68% to 56% illuminated. Mercury reaches magnitude 0.0 on the 17th but will be lost in the Sun's glare by the 19th or so as it moves to inferior conjunction on the 28th.

Venus is now visible in the southwest after sunset and sets about 3 hours after sunset at the start of December increasing to ~4 hours by months end. Moving rapidly eastwards, it brightens from magnitude -4.2 to -4.3 during the month while its angular diameter increases from 17 to 22 arc seconds.

Mars will be seen low in south after sunset. It dims from magnitude +0.6 to +0.9 during the month. Its disk is now only 6 arc seconds wide so no details will be seen on its disk.

Jupiter rises at ~02:30 at the start of December but at ~01:00 by its end. During the month its magnitude increase slightly from -1.8 to -2.0 magnitude while its angular size increases from 31 to 35 arc seconds. By the end of the month it will reach the meridian by dawn at an elevation of ~35 degrees.

Saturn passes behind the Sun on the 10th of December so cannot be seen for much of the month. However by Christmas day it will rise an hour before the Sun and may just be seen in the brightening dawn at a magnitude of +0.5. Binoculars may well be needed to spot Saturn lying low in the southeast to the left of Antares in Scorpius.

The Geminids **meteor shower** is expected to peak on the night of December 13 and early morning hours of December 14. A Full Moon may make viewing conditions difficult. The best time to view the shower, which is considered to be one of the most prolific meteor showers of the year, is after dark on December 14.

Sun and Moon Rise and Set

Date	Moonrise	Moonset	Sunrise	Sunset
12/1/2016	08:19	18:48	06:41	16:40
12/5/2016	11:14	22:30	06:44	16:40
12/10/2016	14:26	02:46	06:48	16:41
12/15/2016	19:00	08:18	06:51	16:42
12/20/2016	-----	11:50	06:54	16:44
12/25/2016	03:37	14:35	06:57	16:47
12/31/2016	08:35	19:27	06:58	16:51

Planet Data

	Dec 1			
	Rise	Transit	Set	Mag
Mercury	08:11	13:01	17:52	-0.5
Venus	09:51	14:49	19:48	-4.2
Mars	11:05	16:25	21:45	0.6
Jupiter	02:17	08:08	14:03	-1.8
Saturn	07:06	12:14	17:19	0.5

	Dec 15			
	Rise	Transit	Set	Mag
Mercury	08:14	13:13	18:11	-0.1
Venus	09:51	15:02	20:13	-4.2
Mars	10:40	16:11	21:41	0.8
Jupiter	01:32	07:21	13:14	-1.9
Saturn	06:19	11:23	16:31	0.4

	Dec 31			
	Rise	Transit	Set	Mag
Mercury	06:07	11:15	16:31	2.8
Venus	09:38	15:09	20:38	-4.3
Mars	10:09	15:54	21:37	0.9
Jupiter	00:38	06:26	12:17	-2.0
Saturn	05:24	10:28	15:35	0.5

Planet, Sun, and Moon data calculated for local time at Lancaster, CA

Suggested Observing List

There is no AVAC Star Party this month so the list and star chart are for Saturday, December 31 in case anyone will be observing instead of celebrating. The list is sorted by the best time to observe the object. The difficulty column describes how difficult it is to observe the object from the current location on a perfect night in a 6 inch Newtonian telescope.

ID	Cls	Con	RA 2000	Dec 2000	Mag	Begin	Best	End	Difficulty
NGC 55	Gal	Scl	00h15m08.4s	-39°13'13"	8.5	18:09	18:21	18:50	challenging
NGC 6910	Open	Cyg	20h23m12.0s	+40°46'42"	7.3	18:04	18:23	18:45	easy
M 29	Open	Cyg	20h23m57.0s	+38°30'30"	7.5	18:06	18:23	18:41	easy
M 15	Glob	Peg	21h29m58.0s	+12°10'00"	6.3	18:08	18:24	18:46	easy
M 39	Open	Cyg	21h31m48.0s	+48°26'00"	5.3	18:03	18:27	20:09	easy
IC 5146	Neb	Cyg	21h53m24.0s	+47°16'00"	10.0	18:03	18:27	20:28	challenging
NGC 7160	Open	Cep	21h53m40.0s	+62°36'12"	6.4	17:59	18:28	21:06	obvious
IC 1396	Neb	Cep	21h39m06.0s	+57°30'00"		18:02	18:28	20:38	challenging
NGC 7243	Open	Lac	22h15m08.0s	+49°53'54"	6.7	18:06	18:28	20:29	detectable
NGC 253	Gal	Scl	00h47m33.1s	-25°17'20"	7.9	18:07	18:30	20:16	detectable
NGC 288	Glob	Scl	00h52m45.0s	-26°35'00"	8.1	18:11	18:31	19:41	challenging
M 52	Open	Cas	23h24m48.0s	+61°35'36"	8.2	18:08	18:31	21:09	detectable
NGC 7790	Open	Cas	23h58m24.0s	+61°12'30"	7.2	17:59	18:32	23:07	easy
NGC 7789	Open	Cas	23h57m24.0s	+56°42'30"	7.5	18:07	18:32	21:22	detectable
M 110	Gal	And	00h40m22.3s	+41°41'09"	8.9	18:06	18:33	21:47	detectable
M 32	Gal	And	00h42m41.8s	+40°51'58"	8.9	18:03	18:34	22:35	easy
M 31	Gal	And	00h42m44.3s	+41°16'07"	4.3	18:03	18:34	22:32	easy
NGC 457	Open	Cas	01h19m35.0s	+58°17'12"	5.1	18:01	18:41	00:19	obvious
NGC 559	Open	Cas	01h29m31.0s	+63°18'24"	7.4	18:00	18:44	00:43	easy
M 103	Open	Cas	01h33m23.0s	+60°39'00"	6.9	18:00	18:46	00:41	obvious
M 33	Gal	Tri	01h33m50.9s	+30°39'36"	6.4	18:05	18:46	22:35	detectable
NGC 637	Open	Cas	01h43m04.0s	+64°02'24"	7.3	17:58	19:31	01:00	obvious
NGC 663	Open	Cas	01h46m09.0s	+61°14'06"	6.4	18:02	19:31	00:54	easy
NGC 884	Open	Per	02h22m18.0s	+57°08'12"	4.4	17:58	19:31	01:21	obvious
NGC 869	Open	Per	02h19m00.0s	+57°07'42"	4.3	17:58	19:31	01:17	obvious
M 76	PNe	Per	01h42m19.9s	+51°34'31"	10.1	18:06	19:31	23:15	detectable
NGC 752	Open	And	01h57m41.0s	+37°47'06"	6.6	18:13	19:31	21:34	challenging
Heart Neb	Neb	Cas	02h33m52.0s	+61°26'50"	6.5	18:15	19:42	22:45	challenging
NGC 957	Open	Per	02h33m21.0s	+57°33'36"	7.2	18:02	19:42	01:26	easy
M 34	Open	Per	02h42m05.0s	+42°45'42"	5.8	18:04	19:50	00:27	easy
M 77	Gal	Cet	02h42m40.8s	-00°00'48"	9.7	18:06	19:50	23:01	detectable
NGC 1027	Open	Cas	02h42m40.0s	+61°35'42"	7.4	18:07	19:51	00:50	detectable
NGC 1245	Open	Per	03h14m42.0s	+47°14'12"	7.7	18:22	20:23	22:47	challenging
NGC 1342	Open	Per	03h31m38.0s	+37°22'36"	7.2	18:06	20:40	01:07	detectable
M 45	Open	Tau	03h47m00.0s	+24°07'00"	1.5	18:01	20:55	01:31	obvious
NGC 1444	Open	Per	03h49m25.0s	+52°39'30"	6.4	17:59	20:58	02:36	obvious
NGC 1502	Open	Cam	04h07m50.0s	+62°19'54"	4.1	17:57	21:17	03:19	obvious

ID	Cls	Con	RA 2000	Dec 2000	Mag	Begin	Best	End	Difficulty
NGC 1528	Open	Per	04h15m23.0s	+51°12'54"	6.4	18:04	21:23	02:47	easy
Hyades	Open	Tau	04h26m54.0s	+15°52'00"	0.8	18:06	21:35	01:51	obvious
NGC 1647	Open	Tau	04h45m55.0s	+19°06'54"	6.2	18:34	21:54	01:29	detectable
NGC 1664	Open	Aur	04h51m06.0s	+43°40'30"	7.2	18:06	21:59	03:09	easy
NGC 1746	Open	Tau	05h03m50.0s	+23°46'12"	6.1	18:45	22:12	01:54	detectable
NGC 1851	Glob	Col	05h14m06.0s	-40°02'48"	7.1	21:06	22:22	23:38	difficult
M 43	Neb	Ori	05h35m30.0s	-05°16'00"	9.0	20:33	22:43	01:06	difficult
M 42	Neb	Ori	05h35m18.0s	-05°23'00"	4.0	19:33	22:43	01:53	easy
IC 434	Neb	Ori	05h41m00.0s	-02°27'00"	11.0	19:27	22:49	02:10	challenging
M 38	Open	Aur	05h28m40.0s	+35°50'54"	6.8	18:25	00:00	03:01	detectable
M 36	Open	Aur	05h36m18.0s	+34°08'24"	6.5	18:11	00:00	03:43	easy
M 37	Open	Aur	05h52m18.0s	+32°33'12"	6.2	18:23	00:00	03:48	easy
M 35	Open	Gem	06h09m00.0s	+24°21'00"	5.6	19:01	00:00	03:40	easy
NGC 2175	Open	Ori	06h09m39.0s	+20°29'12"	6.8	19:39	00:00	03:05	detectable
NGC 2264	Open	Mon	06h40m58.0s	+09°53'42"	4.1	19:48	00:00	03:50	easy
NGC 2301	Open	Mon	06h51m45.0s	+00°27'36"	6.3	20:27	00:00	03:31	easy
NGC 2129	Open	Gem	06h01m07.0s	+23°19'20"	7.0	18:35	00:00	03:43	obvious
M 1	Neb	Tau	05h34m30.0s	+22°01'00"	8.4	20:03	00:00	01:39	difficult
NGC 2169	Open	Ori	06h08m24.0s	+13°57'54"	7.0	19:05	00:00	03:28	obvious
M 78	Neb	Ori	05h46m48.0s	+00°05'00"	8.0	20:46	00:00	01:18	difficult
M 41	Open	CMa	06h46m01.0s	-20°45'24"	5.0	22:16	00:00	01:31	easy
NGC 2237	Neb	Mon	06h32m02.0s	+04°59'10"	5.5	22:00	00:01	01:43	challenging
M 50	Open	Mon	07h02m42.0s	-08°23'00"	7.2	21:16	00:10	03:07	detectable
NGC 2353	Open	Mon	07h14m30.0s	-10°16'00"	5.2	21:34	00:22	03:10	easy
NGC 2355	Open	Gem	07h16m59.0s	+13°45'00"	9.7	21:53	00:24	03:12	difficult
NGC 2360	Open	CMa	07h17m43.0s	-15°38'30"	9.1	23:14	00:25	01:56	challenging
NGC 2392	PNe	Gem	07h29m10.8s	+20°54'42"	8.6	20:08	00:37	05:06	obvious
NGC 2393	Gal	Gem	07h30m04.6s	+34°01'40"	14.6	19:44	00:38	05:31	not visible
NGC 2423	Open	Pup	07h37m06.0s	-13°52'18"	7.0	22:15	00:45	03:14	easy
M 47	Open	Pup	07h36m35.0s	-14°29'00"	4.3	22:19	00:44	03:10	obvious
NGC 2439	Open	Pup	07h40m45.0s	-31°41'36"	7.1	22:38	00:48	03:00	detectable
M 46	Open	Pup	07h41m46.0s	-14°48'36"	6.6	22:26	00:49	03:13	detectable
NGC 2440	PNe	Pup	07h41m55.4s	-18°12'31"	11.5	22:50	00:49	02:48	detectable
M 93	Open	Pup	07h44m30.0s	-23°51'24"	6.5	23:54	00:52	01:49	easy
NGC 2451	Open	Pup	07h45m23.0s	-37°57'21"	3.7	22:57	00:52	02:51	easy
NGC 2477	Open	Pup	07h52m10.0s	-38°31'48"	5.7	23:10	00:59	02:51	easy
NGC 2506	Open	Mon	08h00m01.0s	-10°46'12"	8.9	23:21	01:07	03:08	difficult
NGC 2546	Open	Pup	08h12m15.0s	-37°35'42"	5.2	00:05	01:20	02:34	difficult
NGC 2571	Open	Pup	08h18m56.0s	-29°45'00"	7.4	23:12	01:26	03:44	detectable
M 44	Open	Cnc	08h40m24.0s	+19°40'00"	3.9	21:51	01:48	05:37	easy
M 67	Open	Cnc	08h51m18.0s	+11°48'00"	7.4	23:11	01:58	04:59	detectable
M 82	Gal	UMa	09h55m52.4s	+69°40'47"	9.0	21:04	03:03	05:46	detectable
M 81	Gal	UMa	09h55m33.1s	+69°03'56"	7.8	21:25	03:03	05:44	detectable
NGC 3227	Gal	Leo	10h23m30.6s	+19°51'54"	11.5	00:21	03:31	05:39	difficult
M 97	PNe	UMa	11h14m47.7s	+55°01'09"	9.7	00:01	04:22	05:44	detectable

A.V.A.C. Information

Membership in the Antelope Valley Astronomy Club is open to any individual or family.

The Club has three categories of membership.

- Family membership at \$30.00 per year.
- Individual membership at \$25.00 per year.
- Junior membership at \$15.00 per year.

Membership entitles you to...

- Desert Sky Observer—monthly newsletter.
- The Reflector – the publication of the Astronomical League.
- The A.V.A.C. Membership Manual.
- To borrow club equipment, books, videos and other items.

AVAC

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The Antelope Valley Astronomy Club, Inc. is a 501(c)(3) Non-Profit Corporation.

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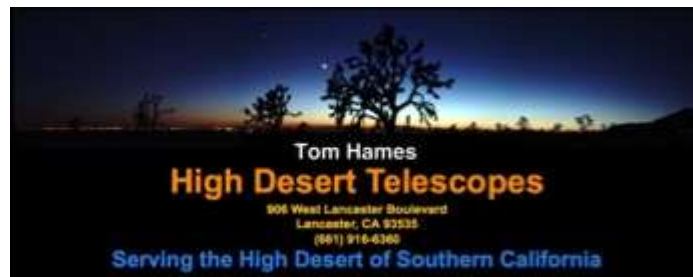


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