Volume 28 Issue 1

January 2014

The Observer

East Valley Astronomy Club

Jupiter at Oppostion 2014 - Christopher Go

Upcoming Events:

Deep Sky Star Party - January 4

Public Star Party - January 10

Evac Monthly Meeting - January 17

Local Star Party - January 25

Check out all of the upcoming club events in the Calendars on page 11

Inside this Issue:

Welcome to the New Year

by Claude Haynes

Welcome to a new year. 2013 was billed as the "Year of the Comet", but ISON proved to be more like Icarus and melted with waxen wings. That may apply not just to comets. Burn out is an issue sometimes. We have many loyal members who faithfully volunteer at the Observatory and school star parties. Unfortunately I often see the same faces at each event, and over time that can wear an individual down.

I want to commend Dave Coshow, Lynn Young and David Shiel in organizing these activities that provide so much benefit to our community. I also want to congratulate the volunteers who provide hours of time and share their zeal for observing. They are providing a key experience in science education. If you are not an active participant in one of our events, I would encourage you to join us. It is fun and very gratifying.

I also want to encourage members to participate in our personal observing events. The Evac website has been updated with the 2014 Local and Deep Sky Start Party dates. Getting together at Picket Post is a great way to improve our own skills, and share our knowledge and experience with each other. We have a strong and

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Welcome to the New Year

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active club and I look forward to 2014. Together we can advance the hobby of astronomy, and renew our passion for observing and education.

Keep Looking Up!

If It's Clear…

by Fulton Wright, Jr.

January 2014

Celestial events (from Sky & Telescope magazine, Astronomy magazine, and anywhere else I can find information) customized for Prescott, Arizona. Remember, the Moon is 1/2 degree or 30 arc-minutes in diameter. All times are Mountain Standard Time.

ISON Rest In Peace.

Convenient times to catch Algol at its minimum are Jan 2 @ 9:35 PM, Jan 5 @ 6:24 PM, and Jan 25 @ 8:09 PM.

At the end of the month, about 6:45 PM, look low in the west for Mercury (magnitude -0.7). Also at the end of the month, about 6:45 AM look low in the east for Venus (magnitude -4.5).

On the night of Wednesday, January 1, notice that 2 of Jupiter's moons, Io and Europa, are paired up about 11:15 PM and Ganymede and Callisto are paired up about 2:15 AM (Thursday). This is also the date of the new Moon so you have all night to hunt for faint fuzzies.

On Friday, January 3, starting about 1:45 AM, Io and its shadow enter Jupiter, pass over the Red Spot, and about 4:00 AM exit the planet. The next night (still Friday) from 11:15 PM to 2:25 AM (Saturday), Ganymede and its shadow do the same thing (except no Red Spot this time).

Also on Friday, January 3, before dawn, dedicated meteor watchers might want to look for the Quadrantids coming from a spot in northern Bootes. Do I expect a nice warm night where you can observe in you shirt sleeves? Ummm...no.

On the night of Saturday, January 4, at 8:13 PM, Io and its shadow enter Jupiter. This time, because Jupiter is so close to opposition, Io's shadow is almost completely covered by the satellite itself. See if you can see the shadow at all. The satellite exits at 10:28 PM. At 3:39 AM (Sunday), Europa pulls the same trick, exiting at 6:21 AM right on top of the Red Spot. Europa's shadow will be even harder to see.

On Tuesday, January 7, at 8:40 PM, the Moon is at first quarter phase. It should look exactly half illuminated. At 9:27 PM the Moon occults the magnitude 4.3 star, Epsilon Piscium. The star reappears from behind the bright limb of the Moon at 10:30 PM. Finally, at 12:56 AM (Wednesday) the Moon sets.

On Wednesday, January 15, at 5:42 PM (1 minute before sunset) the full Moon rises spoiling any chance of hunting faint fuzzies for the night. Since libration is tipping the north pole of the Moon toward us at this time, why not check out that area tonight.

On the night of Wednesday, January 22, at 9:17, Europa moves in front of Jupiter. At 10:09 PM its shadow falls on Jupiter. At 11:57 PM the satellite leaves, followed by the shadow at 12:50 AM (Thursday). The interesting thing is that the satellite enters on top of the Red Spot (but doesn't stay there) and the shadow spends most of its time on the Red Spot.

On the night of Thursday, January 23, at 1:07 AM (Friday), the third quarter Moon rises. Although the early morning hours are not the most convenient, around this date, libration is tilting the planetary west (celestial east) limb toward us so it would be a good time to look for Mare Orientale.

On Thursday, January 30, we get our 2nd new Moon of the month. That means a dedicated deep-sky-er could pull 2 all-night-ers this month.

The Milky Way's SMBH and G2

by Henry De Jonge IV

Introduction

Many of you may have seen the science show in June of this year called "Swallowed by a BH" about the discovery of a huge gas cloud observed traveling directly towards the SMBH in the center of our Milky Way. We will look at this exciting development and discuss some of the findings, implications, and many questions it is generating. This is a very unique SMBH and galactic event in our fairly recent and modern timeframe of observing. A golden opportunity to witness a spectacular event and learn a great deal.

Our SMBH and Galactic Center

It has now been determined that almost all sizable galaxies contain one or more SMBHs at their centers and that there exists some definite, (and not yet fully known) relationships between these giants and the host galaxy. The SMBH at the center of our galaxy is called Sagittarius A*, (Sgr A*) and it is usually very quiet as these things go. It emits few X-rays and gamma rays which would make it an actively feeding SMBH. In fact it is currently classified as inactive and has only shown irregular small active events in the known past. We do know that it is still surrounded by a hot atmosphere of x-ray emitting gas and many other objects such as stars and smaller BHs as well as other dense objects. One estimate asserts that our galaxy has about 20,000 BHs and a similar number of neutron stars within the central volume of one parsec radius.

The last major active feeding period for Sgr A* is thought to have occurred between 1-10 Myr ago and at that time there formed about 100 massive, young, hot, O and WR stars that currently surround our SMBH within 0.1 pc. One interesting question is why we do not see a large, well formed, left over accretion disk around the SMBH from all this past activity. The average rate of mass accretion over the last few hundred years is estimated to be about 1 billionth to 1/10 millionth solar masses each year. Its current mass has been recently and more accurately revised to 4.3 million solar masses. A large but not super large SMBH as these things go.

Recently it has been shown by the Chandra X-ray satellite that more than 99% of the gas that passes by our BH never gets too close and becomes stimulated in an accretion disk and then absorbed by the BH. It is thought that this is because the gas is too hot, (or physically in high motion) and thus spreads out making it too difficult for the BH to absorb. Apparently cooler or less active gas is a better candidate for absorption. However, sometimes these gas clouds can lose angular momentum and this can occur via gas cloud collisions, sending some gas clouds into the capture range of the SMBH. We are aware of other gas clouds in the galactic center some of which are very large and may have had clumps accreted onto the SMBH in the past. BHs are creative in how they can obtain a meal it seems.

We know that most galaxies now contain a SMBH in their center, however only a small amount are seen to be active at any one time thus limiting our knowledge of when and exactly how these SMBHs are active.

A drawing of Sgr A with an accretion disk and the G2 cloud*

Possible origins of the gas cloud

The origin and predicted properties of G2 depend greatly upon its orbital parameters and current properties. By working the models of the trajectory of G2 backwards and based upon its current structure and known evolution there are several possible origins of this gas cloud. Unfortunately we do not have solid details about its past structure before 2003, and our first detailed observations were made in 2004. Thus we have only about 10 years of orbital data to help us understand the dynamics of how it formed, where it came from, and where it is exactly going.

G2 is a relatively cold, dusty, ionized, gas cloud with a gas temperature of 10,000K and a dust temperature of 550K. It is thought to contain about 3 earth masses of material, however this estimate is subject to some uncertainty and may be much larger or smaller. It is on a highly eccentric orbit and was first detected in 1995. As for the origins of the gas cloud there are two main theories with many variants but basically assuming it is either a compact source or a diffuse cloud source.

The Milky Way's SMBH and G2

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The compact source, (or compact cloud) theory says that the cloud came from a dense, unseen object in the galactic center that is releasing gas as in an outflowing envelope such as from a hidden star. This is thought to have occurred in about 1995 and at a distance of about 7.6 x 1016 cm away. This theory has recently become more favorable as a hidden star would allow the cloud to remain in its somewhat more compact form for a longer period of time as is observed. If this model proves correct then the gas cloud has also been in existence for much longer than thought and may even survive its close passage to the SMBH. Variants of this theory include such compact origin objects as a compact planetary nebula, a protostellar disk attached to a low mass star, a brown dwarf, a TTauri star, an evaporating low mass star, or a Jupiter sized planet. Still another version purports it may be a protoplanetary disk surrounding a young star. Currently we do not know of any star that is close to its predicted origin spot at this time. This theory as any other is still not fully understood or complete.

The diffuse cloud, (or spherical shell) theory says that it may have come from the remains of expanding clouds of material from hot massive stars in the galactic center. This is thought to have occurred in a 1920s timeframe. These clouds may have interacted in the past and become relatively cool over time thus facilitating their eventual demise. Some other variants propose sources such as small nova or leftover remains from a star long ago absorbed into Sgr A*.

Some models of the origin of G2 indicate that the total mass of the cloud is considerably less than 3 earth masses- some down to only about 0.1 earth masses and thus may completely disappear when it gets close to the BH. Let's hope this doesn't happen.

These theories will be validated or not after observing its passage around the SMBH for some time and seeing what happens, if it survives or not and how it changes. Its great distance from us, the sheer number and density of close objects, and the general noise of the central region make all observations difficult and predictions even more so.

Drawing of the path of G2 some orbiting stars close to Sgr A*

Possible scenarios and outcomes

The mass of the G2 cloud may be just sufficient enough to be able to withstand decomposition and evaporation on its way into the SMBH. It is currently being absorbed into the hot, dense, and magnetized accretion flow about our SMBH. It was originally expected that in late 2013 we would see G2 pass by the SMBH, (at the pericenter or closest point of passing) and break into a string of droplets over the next 30 years. Eventually it will approach about 2000-3000 times the event horizon radius at pericenter. Recall that the Schwarzschild radius of our SMBH is about 1.3 trillion cm or 13 billion meters. This interaction with the surrounding gas and dust will then stimulate bursts of activity from our SMBH, (like an AGN). However currently new models predict that G2 will reach pericenter in March 2014. Remember it is difficult to tell exactly when such an extended object reaches a particular point but these are best estimates. Time will tell.

In the meantime a small fraction of the emission from G2 detected in early 2013 is already blue shifted indicating that part of the cloud has already circled the BH and is coming back towards us as it completes an orbit. This orbital period is estimated to be about 140-198 years currently. We have also noted that from about 2004 to present the gradient velocity of the cloud has been increasing steadily indicating the tidal shear induced by the curvature of space time near the BH is

The Milky Way's SMBH and G2

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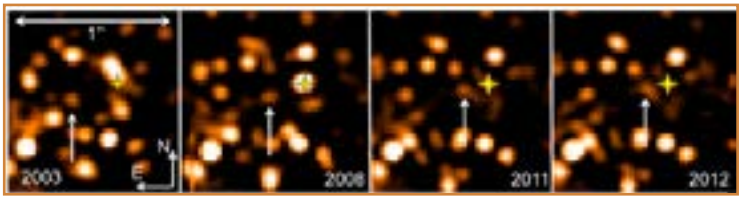
taking effect. The fastest components of G2 as of early 2013 are receding from us at over 3,000 km/sec while the blue shift is also on the order of about 3,000 km/sec towards us.

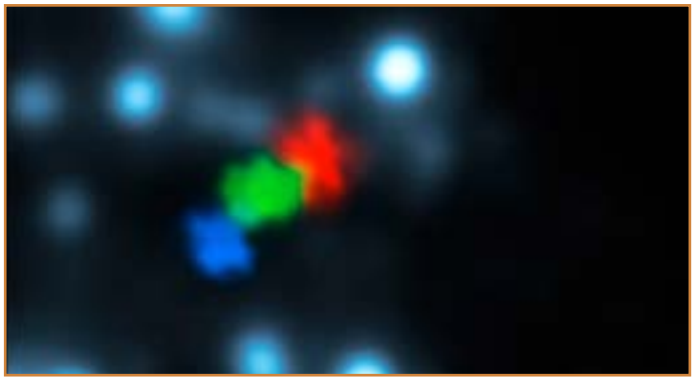
There are still many unknowns about how this scenario will play out. G2 will interact with the galactic center medium in a variety of ways and be subject to such influences as magnetic fields, rotation, convection, thermal winds, other gravitational influences, heating and cooling processes, ram pressure, and thermal conduction. Many of these processes are non linear in effect. G2 is thought to be not large enough for self-gravity to play a critical role in its future behavior with respect to the SMBH.

As G2 supersonically approaches the hot SMBH accretion disk it will form a bow shock front that should cause particles like electrons to accelerate relativistically and emit synchrotron radiation that should be detectable via radio telescopes. The predicted total bolometric magnitude is about 100 times that of the sun and it should be easily visible in the IR.

There is also a possibility that G2 could interact with a small emission jet from Sgr A* that has been tentatively detected in 2012. However this remains largely speculative due to the unknown exact location and structure of the jets at this time but this event would be detectable by x-rays and radio waves. This would be distinctly different from the simpler SMBH interaction predicted, yet would also be extremely valuable in shedding light on such phenomena.



The path of G2 from 2003-2012 marked by the arrow, the yellow cross is Sgr A*



A composite image showing the path of G2 towards Sgr A*, with blue in 2006, green in 2010, and red in 2013.

What this can tell us

This gas cloud heading for Sgr A* is acting like a probe, (test particle) for our SMBH and could test some theoretical predictions of GR. It will examine the accretion disk surrounding our BH and its properties. The large tidal gravitational forces of our SMBH should, (and apparently has already) stretch out the gas cloud and compress it vertically while thinning it out as nears the BH and thus cause increased heating and friction resulting in outbursts of radiation that we can detect. The differences in radiation and their timing will tell us how the cloud morphs during it voyage into the accretion disk and the SMBH-for example whether the vertical compression velocity is stronger or weaker than the horizontal velocity. This in turn will tell us more about the gas clouds structure and the hydrodynamical models regarding BH accretion disks. This will also tell us about the gas structure and composition in the SMBH vicinity at the center of our galaxy. We may also learn more about BH spin like the rate of spin or the frame dragging effects from this encounter as the cloud passes around and possibly into the BH.

As we have mentioned it is thought that most galactic centers have a dense concentration of neutron stars, as well as small, (stellar sized) to mid-sized BHs at their center. These remnants are brought to the center by dynamical friction and stellar mass segregation in the galaxy over time. By studying the G2 cloud and our SMBH we may gain some insights into this collection of interesting objects within our own galactic center especially if it encounters any of these other objects. This would be

The Milky Way's SMBH and G2

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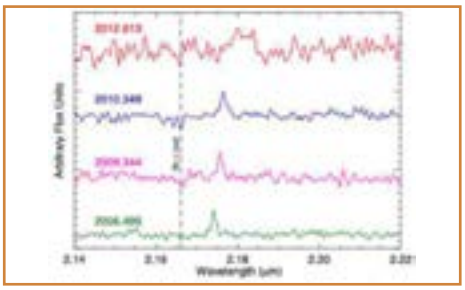
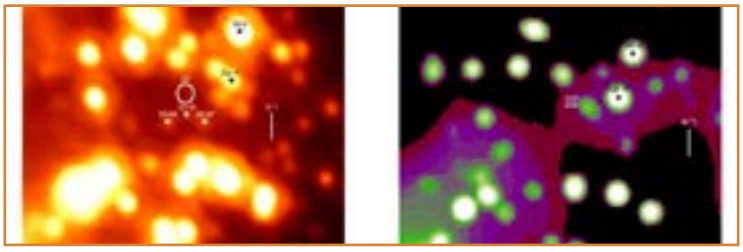
detected via the emitted radiation, (x-ray and gamma rays) or any sudden and non-predicted deviations from its projected orbital path.

The expected data should be forthcoming in late 2013 and thereafter, and astronomers are excited. We do not yet see any other objects that are expected to interface with Sgr A* in the near future so this is a highly anticipated and once in a lifetime event.



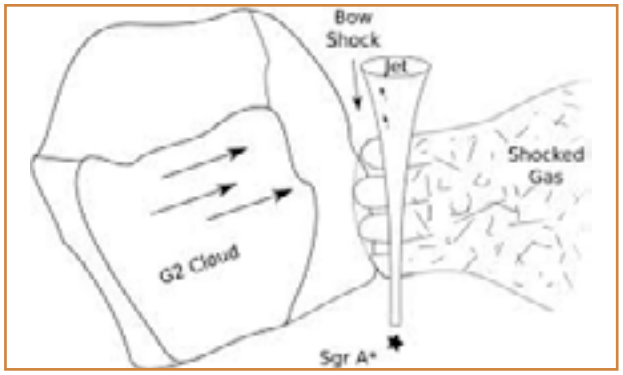
The spectra of G2 over time, notice the shifting of the high peak to longer wavelengths as it is redshifted.



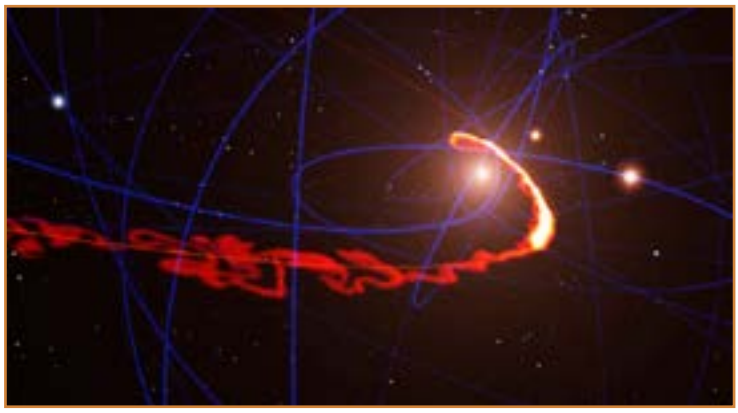
NIR Keck images of G2 approaching Sgr A* from 2010 on the left to 2012 on the right.

Conclusions

This is the first advanced known and predicted interaction of our SMBH with matter and we are in a position to study it very well. While the origin of G2 is still under debate we may be able to gain much information and understanding about SMBHs and accretion disks by watching the gas cloud G2 come close and possibly fall into Sgr* A. The understanding of in falling matter into a BH is still highly theoretical and this is an excellent opportunity to test the models. This accretion activity may continue for decades. G2 may also help us to understand the density of other compact and exotic objects in the central portion, (bulge) of our galaxy that are expected to reside therein. This may lead to better galactic formation and BH accretion models. It may also shed light on jets emitted from SMBHs if there is such an encounter with G2. Again another test of SMBH astrophysics.



A schematic of Sgr A* and G2 showing one of the jets.



Another drawing of G2 approaching Sgr A* and the crowded galactic center.

Whatever happens we are prepared to observe this passage in many wavelengths and over time to test our theories and gain better understanding. With all the attention that this event has stimulated it is exciting to learn new things, (especially features like the jets) about our galactic center and SMBH as more instruments and scientists study the situation. This alone is worth the effort in my opinion regardless of the outcome. The final results over time of the radiation detected, the pattern, the energy distribution, the timing, and the magnitude will all help pinpoint the origins of G2 as well. However we must also remember that whatever occurs has already happened about 27,000 years ago, (8.33 kpc away).

New Moon on January 1 at 6:14

First Quarter Moon on January 7 at 22:39

*Full Moon on January 15 at 23:52

Last Quarter Moon on January 24 at 00:19

New Moon on January 30 at 16:39

Looking for that perfect weekend activity?

Why not resolve to getting involved?

Contact Dave Coshow to join the staff at GRCO

Email: grco@evaconline.org

Help Wanted EVAC Officers: Treasurer

Email:Claude Haynes - president@evaconline.org

Classified Ads

Upcoming Meetings

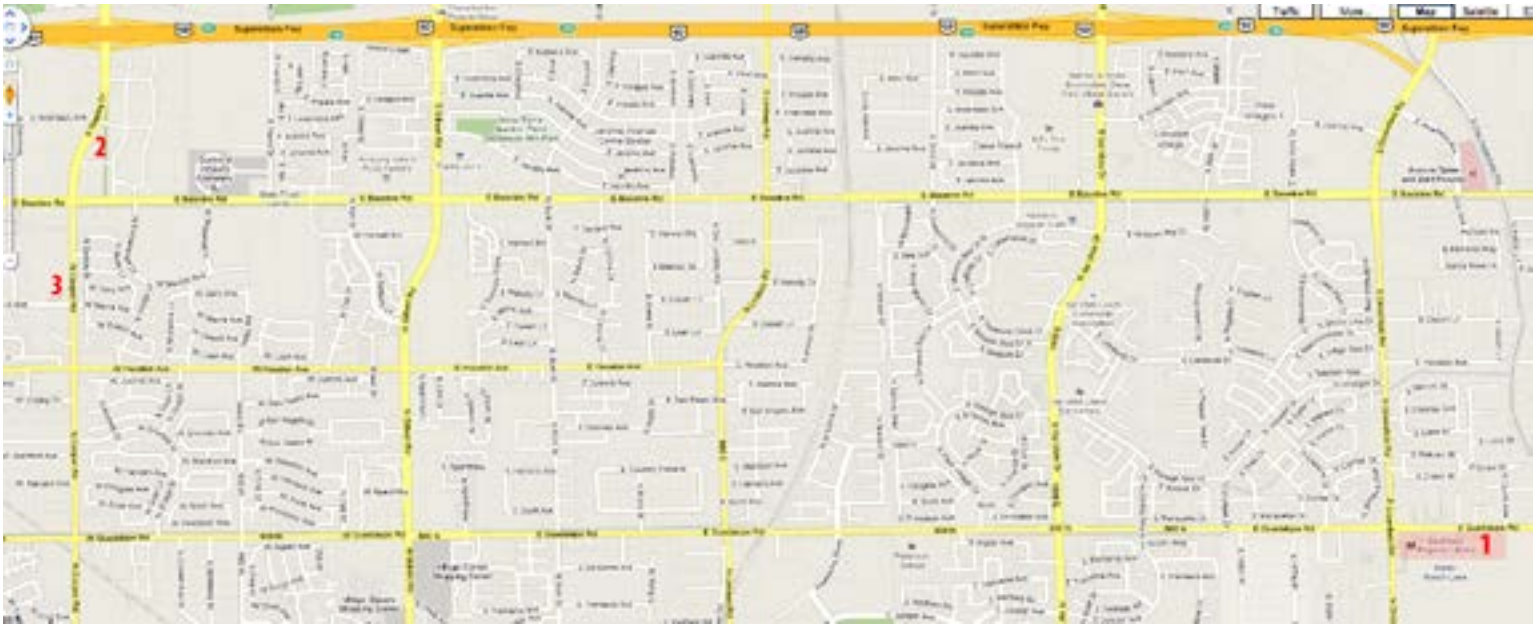
December 20
Holiday Party
January 17
February 21
March 21
April 18
May 16

The monthly general meeting is your chance to find out what other club members are up to, learn about upcoming club events and listen to presentations by professional and well-known amateur astronomers.

Our meetings are held on the third Friday of each month at the Southeast Regional Library in Gilbert. The library is located at 775 N. Greenfield Road; on the southeast corner of Greenfield and Guadalupe Roads. Meetings begin at 7:30 pm.

All are welcome to attend the pre-meeting dinner at 5:30 pm. We meet at Old Country Buffet, located at 1855 S. Stapley Drive in Mesa. The restaurant is in the plaza on the northeast corner of Stapley and Baseline Roads, just south of US60.

Visitors are always welcome!



2 Old Country Buffet
1855 S. Stapley Drive
Mesa, Az. 85204

1 Southeast Regional Library
775 N. Greenfield Road
Gilbert, Az. 85234

January 2014

Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
			1	2	3	4
5	6	7	8	9	**10**	11
12	13	14	**15**	**16**	**17**	18
19	20	**21**	22	**23**	24	25
26	27	**28**	**29**	**30**	**31**	

January 10 - Public Star Party & Skywatch at Riparian Preserve

January 15 - Basha Elementary School

January 16 - Charlotte Patterson Elementary

January 17 - General Meeting at SE Library

January 21 - Avalon Elementary School

January 23 - San Marcose Elementary School

January 28 - Concordia Charter School

January 29 - Payne Junior High

January 30 - Fry Elementary School

January 31 - Fuller Elementary School

February 2014

Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
						1
2	3	**4**	5	6	7	8
9	10	11	12	**13**	**14**	**15**
16	17	18	**19**	**20**	**21**	22
23	24	**25**	26	**27**	28	

February 4 - Basis Mesa Charter School

February 13 - Navarrete Elementary

February 14 - Riparian Public Star Party and Skywatch

February 15 - City of Chandler

February 19 - Arcadia Learning Center

February 20 - Sirrine Elementary

February 21 - General Meeting at SE Library

February 25 - Red Mountain Elementary

February 27 - Sousa Elementary School

East Valley Astronomy Club -- 2013 Membership Form

Please complete this form and return it to the club Treasurer at the next meeting or mail it to EVAC, PO Box 2202, Mesa, Az, 85214-2202. Please include a check or money order made payable to EVAC for the appropriate amount.

IMPORTANT: All memberships expire on December 31 of each year.

Select one of the following:

☐ New Member ☐ Renewal ☐ Change of Address

New Member Dues (dues are prorated, select according to the month you are joining the club):

☐ **$30.00 Individual** January through March

☐ **$35.00 Family** January through March

☐ **$22.50 Individual** April through June

☐ **$26.25 Family** April through June

☐ **$15.00 Individual** July through September

☐ **$17.50 Family** July through September

☐ **$37.50 Individual** October through December

☐ **$43.75 Family** October through December

Includes dues for the following year

Renewal (current members only):

☐ **$30.00 Individual** ☐ **$35.00 Family**

Name Badges:

☐ **$10.00** Each (including postage) Quantity: _____

Name to imprint: _____

Total amount enclosed: ☐

Please make check or money order payable to EVAC

☐ Payment was remitted separately using PayPal ☐ Payment was remitted separately using my financial institution's online bill payment feature

Name: ☐ Phone: ☐

Address: ☐ Email: ☐

☐ Publish email address on website

City, State, Zip: ☐ URL: ☐

How would you like to receive your monthly newsletter? (choose one option):

☐ Electronic delivery (PDF) *Included with membership* ☐ US Mail **Please add $10 to the total payment**

Areas of Interest (check all that apply):

☐ General Observing ☐ Cosmology

☐ Lunar Observing ☐ Telescope Making

☐ Planetary Observing ☐ Astrophotography

☐ Deep Sky Observing ☐ Other

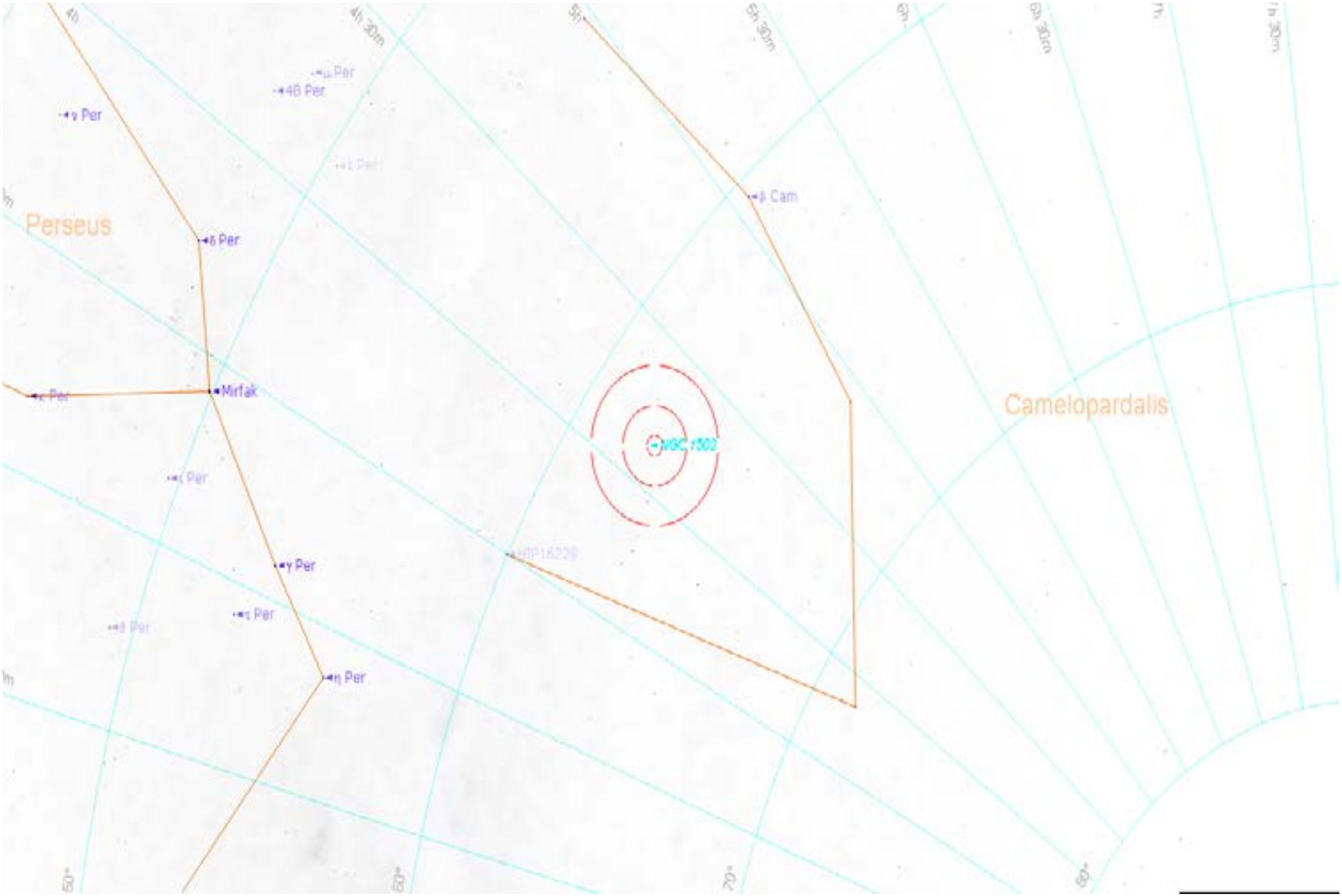
Please describe your astronomy equipment:

Would you be interested in attending a beginner's workshop? ☐ Yes ☐ No

How did you discover East Valley Astronomy Club? ☐

PO Box 2202
Mesa, AZ 85214-2202
www.evaconline.org

All members are required to have a liability release form (waiver) on file. Please complete one and forward to the Treasurer with your membership application or renewal.



NGC 1502 (Collinder 45) Open Cluster in Camelopardalis

RA 04h 07m 50.0s DEC +62° 19' 54" Magnitude: 4.1 Size: 8.0'

The Observer is the official publication of the East Valley Astronomy Club. It is published monthly and made available electronically as an Adobe PDF document the first week of the month. Printed copies are available at the monthly meeting. Mailed copies are available to members for a slight surcharge to offset printing and mailing expenses.

Please send your contributions, tips, suggestions and comments to the Editor at: news@evaconline.org Contributions may be edited. The views and opinions expressed in this newsletter do not necessarily represent those of the East Valley Astronomy Club, the publisher or editor.

The East Valley Astronomy Club is a 501(c)(3) nonprofit charitable organization.

www.evaconline.org

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