# Night Visions

Newsletter of the Baton Rouge Astronomical Society

# December, 2015

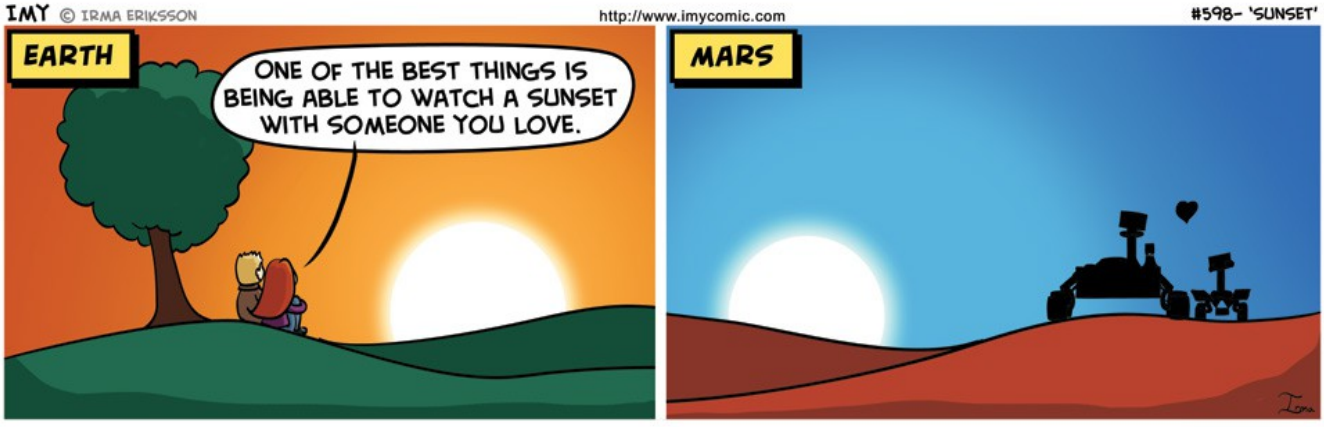
## Next Meeting: Monday, Dec. 14th at 7pm at HRPO

**The Christmas Tree Cluster, NGC 2264, also known as the Cone Nebula. Click on the image for more details.**

Image Credit: T.A. Rector (NRAO/AUI/NSF and NOAO/AURA/NSF) and B.A. Wolpa (NOAO/AURA/NSF)

# What's In This Issue?





# President's Message

This will be my last message to you during this term. Since I am term limited from serving as BRAS President next year, we will have to pick someone else to represent us. We will hold elections at our next meeting on December 14th. You may nominate anyone you believe would be good for the position, even yourself.

I thank all of you for the privilege of serving. I hope I have done a good job of representing you. Thanks also go to you for your interests, support, and dedication to astronomy and for helping others appreciate the wonders of space. After all, BRAS is all about your love of the sky.

Many of you have volunteered for outreach events but rarely receive thanks for your participation. Don't think your efforts go unnoticed. You truly are appreciated. I have often received thank you notes from groups for whom we have conducted star parties, booths and tables, presentations or other activities. Sometimes I share those notes with you but there are many you have not seen. When I look over them, I am impressed with how much you have accomplished this last year.

Our December meeting will be our traditional potluck dinner. Bring yourself, your favorite dish, and good will. Who knows, if you bought a raffle ticket, you may go home with a new telescope.

Also, don't forget, Trey will have astronomical calendars for sale, $10 each. Bring cash or a check made out to BRAS.

It's almost like the Universe is giving us a Christmas present. The bright comet Catalina will grace our December skies and should be within binocular view by the time of our meeting. Its path is well–placed for us in the Northern hemisphere. There are never guarantees with comets, but current predictions are that it may reach naked-eye visibility in mid-December.

December also brings other astronomical treats. Before dawn on December 7th, Pearl Harbor Day, Venus will be only .7 degrees away from the waning crescent Moon. The Geminid meteor shower will peak the night of our BRAS meeting and the next morning. A few days later, on the 17th, Neptune will be 3 degrees south of the waxing gibbous Moon. Two days later, on the 19th, Uranus will be a bit over 1 degree north of the Moon. You will need a telescope to both planets but the proximity of the Moon will make them easier to find. Two days before Christmas, on the 23rd, Aldebaran, the eye of Taurus the Bull and its brightest star, will be .7 degrees south of the Moon. As a special treat, the full moon will be on Christmas day! Following up, Mercury will be at greatest eastern elongation on the 28th. This means it will be at its highest point in the evening sky this orbit and easier to find. However, it will only be about 12 degrees above the horizon from Baton Rouge, so look for a low horizon. Finally to wrap up the year, Jupiter and the moon will be in conjunction 1 ½ degrees apart on New Year's Eve. What a way to say goodbye to the old year and hello to the new?

Thanks for everything! Happy holidays.

**Merrill Hess**

# Without a Trace—Almost

It was a classic case of serendipity.

While investigating how supermassive black holes formed in the early universe, UC Santa Cruz postdoctoral researcher Ke-Jung Chen stumbled on the unanticipated discovery that some primordial supermassive stars could explode without leaving *any* black hole or other stellar remnant behind.

Chen had been fascinated by supermassive black holes since grad school at the University of Minnesota. Every big galaxy has one of these voracious monsters at its center: a black hole millions or even billions of times more massive than the sun.

The big mystery long puzzling astrophysicists is: how did supermassive black holes form? The ones that exist at the centers of some very ancient galaxies that shine brightly as quasars formed when the universe was less than 800 million years old. But no ordinary-sized stellar-mass black holes could have grown that gigantic that fast.

So the conclusion seemed inescapable: supermassive black holes had to have started life already monstrous at cosmic dawn. But how?

## Monster stars

Just as ordinary black holes are the stellar remnants left by supernova explosions of stars more than 20 solar masses, supermassive black holes could have originated from supernova explosions of supermassive stars—ones having *tens of thousands* of solar masses.

Today, the highest-mass stars top out at about 100 solar masses (Eta Carinae, one of the most massive stars in our Milky Way galaxy, is about 90). But recent cosmological simulations suggest the possibility that in the early universe truly gargantuan stars could exist. So Chen began exploring this with two different computational simulations, called KEPLER and CASTRO, using resources at the National Energy Research Scientific Computing center (NERSC) at Lawrence Berkeley National Laboratory.

KEPLER is 1-dimensional (meaning it assumes that stars are spherical, so physical quantities such as temperature or density can depend only on radius). KEPLER follows how gas turns into stars and how supernovae feed back energy into surrounding gas; it also traces how convection—movement of gas inside a star—affects mixing and nuclear burning. CASTRO allows more complexity: it recreates a multidimensional section through a star, modeling internal gravitational forces and tracking the masses of specific atomic elements that are synthesized from nuclear fusion.

Most importantly, both simulations were run at high spatial resolution to explore fine details of an explosion. The supermassive star Chen modeled had a radius of about 103 million miles—about 10% larger than Earth's orbit—with a resolution of 30,000 miles, only 0.03% of the radius.

## Live fast, die young…leave no corpse

The simulations revealed that a supermassive star burns hydrogen at a furious rate for under 2 million years—a mere blink of a cosmic eye (the Sun is about 5 *billion* years old) before beginning to collapse. Then what happens internally depends critically on its mass. If it is less than 55,000 or more than 56,000 solar masses, the supermassive star explodes and leaves behind a supermassive black hole.

But if it is between those masses—say, 55,500 solar masses—special processes in the star's ultrahot low-density core trigger a general relativity instability that triggers an explosion so violent that it "completely unbinds the star and leaves no compact remnant," write Chen and his five coauthors in *Astrophysical Journal.* Indeed, the explosion "at ~9 x $10^{54}$ erg is the most energetic thermonuclear SN [super-nova] known."

Okay, that's what the simulations predict. Did such exotic primordial explosions happen in the real Universe? Future wide-field infrared telescopes in orbit—such as the proposed Wide Field InfraRed

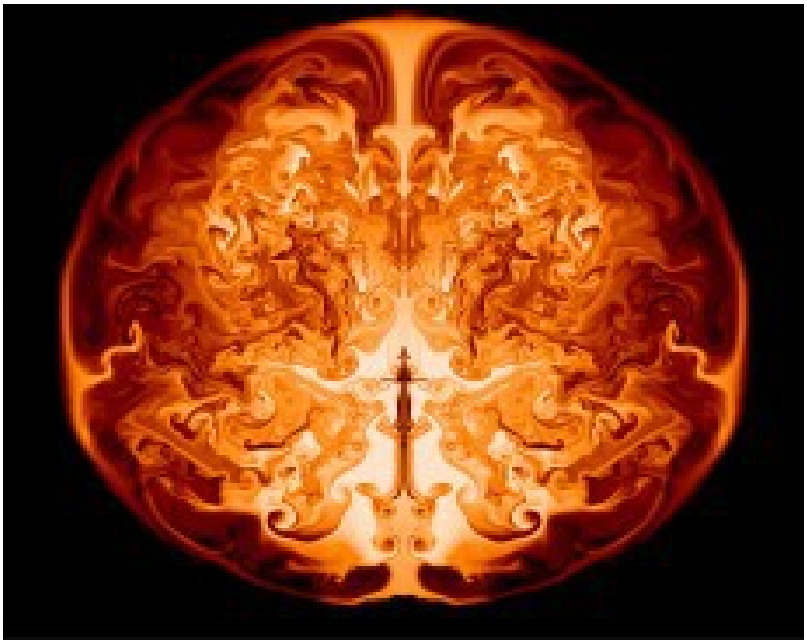
Survey Telescope (WFIRST)—might be able to directly detect such explosions at the very edge of the universe a few hundred million years after the Big Bang.

Moreover, the volume of "metals"—chemical elements heavier than helium—that a general-relativity–instability supernova explosion (GSNe) expels into space would be 100 times greater than that from a regular supernova. But it would have a different chemical composition, consisting only of lighter elements from carbon to silicon rather than heavier ones such as iron. "Traces of GSNe might therefore be found in early galaxies that are $^{56}$Fe [iron] deficient but enhanced with $^{12}$C [carbon] and $^{16}$O [oxygen]," Chen and his coauthors conclude.

Stay tuned! *–Trudy E. Bell, M.A.*

***Further reading:*** The paper "The General Relativistic Instability Supernova of a Supermassive Population III Star" in the August 1, 2014 issue of *Astrophysical Journal* by Ke-Jung Chen et al is at http://iopscience.iop.org/0004-637X/790/2/162/. See also the press release "Simulations Reveal Unusual Death for Ancient Stars" at http://www.nersc.gov/news-publications/news/science-news/2014/simulations-reveal-unusual-death-for-ancient-stars/ and http://news.ucsc.edu/2014/09/unusual-supernova.html, and the Astrobites story "A New Way to Die: What Happens to Supermassive Stars?" at http://astrobites.org/2014/03/21/a-new-way-to-die-what-happens-to-supermassive-stars/.





*This image is a slice through the interior of a supermassive star of 55,500 solar masses along the axis of symmetry. It shows the inner helium core in which nuclear burning is converting helium to oxygen, powering various fluid instabilities (swirling lines). This snapshot shows a moment one day after the onset of the explosion, when the radius of the outer circle would be slightly larger than that of the orbit of the Earth around the sun.*
*Credit: Ken Chen, UC Santa Cruz*

# Secretary's Summary of November Meeting

- Merrill opened up the meeting by holding up a signed photograph of Story Musgrave, a space shuttle astronaut who was the only one who flew on all the shuttles. He gave a brief history of the gentleman and then gave the photo to Chris for the Observatory's collection.
- Chris introduced Angelle W., a sophomore from St. Joseph's Academy, who is working on a science project this year to study the effect of light pollution on the visibility of Messier objects. She is looking for some assistance from BRAS. Members suggested several of the brightest examples for her project as well as ideas for sketches. Further suggestions can be sent to her mom through one of the BRAS officers.
- The speaker for the evening was Dr. Richard J. Oram from LIGO; the title of his lecture was "Operation of Laser Guide Stars at Large Telescopes". He gave an overview of the Gemini Observatory in Hawaii and Chile and discussed different aspects of using laser guide stars for professional astronomy.
- Ashley was recognized for bringing cupcakes to the meeting.
- There was a brief recap of the Deep South Regional Star Gaze. A few members attended, but there was only a small window of opportunity to see anything due to the weather.
- There was some discussion about upcoming events. Ben announced that on the afternoon of Dec. 7th there is going to be an occultation of Venus by the crescent moon. The raffle for the 10-in. Dobsonian telescope will take place at the next BRAS meeting in December (Dec. 14th). Elections for officers in BRAS will also take place at that meeting which will be the annual Christmas potluck. The Geminids meteor shower will peak around Dec. 13th; the Observatory will be open from 9:00 pm – 1:00 am that night for viewing. The Taurid meteor shower is currently going on with several fireballs being reported. It was announced that the star party for Rockefeller will take place the first weekend in February, 2016; the Hodges Garden Star Party is scheduled for Apr. 6 – 10, 2016.
- Someone donated a 6-in. STT telescope to the club. This came with a power pack and is self-aligning.
- Trey still has 2016 calendars available; he is also collecting dues for next year if you haven't paid yet.
- The meeting concluded with raffle of a sky map and planisphere.

**Roslyn Readinger**
**BRAS Secretary**

# HRPO

***HRPO is closed on Thursday 24 December, Friday 25 December, Saturday 26 December, and Thursday 31 December.***

FRIDAY NIGHT LECTURE SERIES

*all start at 7:30pm*

4 December: "Buying a Binocular for Skygazing" Paul Heinrich of LSU will discuss the investigation leading him and his colleagues to an actual impact crater just northeast of Baton Rouge!

12 December: "The Star of Bethlehem" Purchasing a telescope requires knowing who will use it, where it will be used and what the main celestial targets will be. Patrons will learn tips and tricks to increase the likelihood of a good buy. Patrons will also be introduced to a variety of telescopes firsthand.

SCIENCE ACADEMY

*Saturdays from 10am to 12pm*

*For ages eight to twelve. $5/$6 per child.*

5 December: "Clouds"

12 December: "Storms!"

19 December: "Expedition 3"

SOLAR VIEWING

*For all ages. Free admission.*

12 December, 12pm to 2pm

CALL FOR VOLUNTEERS

*Sunday, 13 December from 9pm to 1am. *Two volunteers in additional to regular complement.* **Geminid Meteor Shower.** Patron directing, desk duty. Easy; training provided.

*Friday, 18 December from 7pm to 10pm. *Three volunteers in additional to regular complement.* **HRPO 2016 Preview Party.** Marshmallow roast, demo tables, desk duty. Easy; training provided.

NEW HRPO HOURS

Monday to Thursday, 10am to 2pm

Friday, 5pm to 10pm

Saturday, 9am to 2pm / 6pm to 10pm

# Recent Entries in the Forum

***Below are selected recent additions to the BRAS Forum. There are also nine active polls.***

Rainy Spooky Spectrum Still Visited by Seventy-Six
Rain (Sound Familiar) Pelts Deep South Regional StarGaze
Fiftieth Anniversary of ISS Celebrated
One-Year Mission Hits 220nd Day
Undetermined Object WT1190F's Trajectory
Five Visible Passes Caught at HRPO on 18 November
Crater Posidonius and Dorsa Smirnov Viewed
Active Region 2434 Followed over Three Days
Taurid Meteor Shower Yield Several Fireballs
Paul Heinrich Visits HRPO to Discuss Brushy Creek Crater
"Dead Comet" 2015 TB145 Studied During Close Approach
Tarazed Culmination Times for Baton Rouge Posted
Algol Minima Occurs Several Times at Night This Fall
U Delphini and EU Delphini Available for a Few More Nights

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# 20/20 Vision Campaign

***GLOBE at Night: 2 December to 11 December***
***ALERT: Bring Louisiana into the "Over 100 Club".***

BRAS will speak about light pollution in January to the Federation of Great Baton Rouge Civic Associations—specifically about how homeowners can reduce light pollution on their properties. In the meantime, BRAS VP Ben Toman has pointed out the GLOBE at Night administration has the Over 100 Club for those U.S. states which turn in at least 100 reports in the same calendar year. At this time Louisiana has between seventy and eighty 2015 measurements already sent. I can probably generated twelve more during this last session. If other BRAS members can generate at least fifteen more we will stand a good chance to be Over 100 certified by GLOBE at Night!

# 2016 Amateur Astronomy Courses

*Knowledgeable BRAS Volunteers Needed.*

**Saturdays from 3pm to 7pm**
***For ages eighteen and older.***
***$15.00 per in-parish registrant. $18.00 per out-of-parish registrant.***

*These exciting one-day classes are tailor-made to instruct the patron in the use of a personal telescope or binocular, or the basics of the unaided-eye Baton Rouge sky.*

9 JANUARY: Learn Your Sky
This class is an introduction to the unaided-eye Baton Rouge sky. *This one-day course focuses specifically on the unaided-eye Baton Rouge sky.* **Limit thirty registrants. All registrants must be over eighteen; children are not allowed.**
Topics that will be covered include…
*major stars and constellations in Baton Rouge
*major lunar features and how to find them *basic skygazing terminology
*how to distinguish planets from stars
*what meteors, conjunctions and "visible passes" are, and how to see them
*major unaided-eye features of our Milky Way Galaxy
*solar viewing safety, and how to view the Sun without store-bought equipment
*how to darken the sky from your home *upcoming unaided-eye events
*benefits of belonging to an astronomy club
*actual practice identifying stars, asterisms and constellations (weather permitting)

16 JANUARY: Learn Your Telescope
This class is a hands-on introduction to the operations of your personal telescope. *This one-day course focuses specifically on telescopic views of the Baton Rouge sky.* **Limit ten households. Limit one telescope per household.**
Topics that will be covered include…
*how to set up your telescope *how to care for your telescope
*major telescopic features in the Baton Rouge sky, and how to find them
*how to darken the sky from your home *upcoming telescopic events
*actual practice aiming and focusing on celestial objects (weather permitting)

23 JANUARY: Learn Your Binocular
This class is a hands-on introduction to the operations of your personal binocular. *This one-day course focuses specifically on binocular views of the Baton Rouge sky.* **Limit twenty households. Limit one binocular per household.**
Topics that will be covered include…
*how to operate your binocular *how to care for your binocular
*major binocular features in the Baton Rouge sky, and how to find them
*how to darken the sky from your home *upcoming binocular events
*actual practice aiming and focusing on celestial objects (weather permitting)

# Cassiopeia – Queen of Ethiopia

**Position: RA 22 57 04.5897 to 03 41 14.0997, Dec. 77 69 23.447 to 48 66 32.690**

**NamedStars:**

**Schedar (Alpha Cas), "Shedir", "Breast",** mag. 2.24, 00 40 30.39 +56 32 14.7, is an orange giant star that has a widely separated (63") companion star at mag. 8.9. Two other companion stars are listed, but are just line-of-sight optical components.
**Caph (Beta Cas), "al-Sanam al- Nakah", "The Camel's Hump", "al-Kaff al-Khadib", "Palm",** mag. 2.28, 00 09 10.09 +59 09 00.8, is a yellow-white giant star and a Delta Scuti type variable star with a period of 0.104 days(2h30m11.5s).
**Ruchbah (Delta Cas), "Ksora", "knee",** mag. 2.68, 01 25 48.60 +60 14 07.5, is a blue-white Algol type eclipsing variable star with a period of 2 years and 1 month.
**Segin (Epsilon Cas),** mag. 3.35, 01 54 23.68 +63 40 12.5, is a blue-white giant star at the end of the hydrogen fusing cycle. **Segin** is notable for showing extremely weak spectral absorptions of helium.
**Achird (Eta Cas),** mag. 3.46, 00 49 05.10 +57 48 59.6, is a binary star with a period of 480 years. The primary is a yellow-hued main sequence dwarf star with the secondary being an orange-hued dwarf star of mag. 7.5 and a separation of 12.7". There are six dimmer optical components, but none are related to the **Eta Cas** system.
**Marfak (Theta Cas),** mag. 4.34, 01 11 05.93 +55 08 59.8, is a suspected variable star.
**Tycho's Star (SN1572), "Tycho's Supernova",** was a Type 1a supernova in 1572 that stayed visible into 1574.
**Tycho G,** mag. 17, 00 25 19.9 +64 08 18, is the former companion of the progenitor of **SN 1572**.

**Deep Space:**
**M 52 (NGC 7654),** mag. 6.9, 23 24.2 +61 35, 12' in size, is an open cluster that is detached, strong concentration of stars; moderate range in brightness; large. It is a rich sparkling group of at least 100 stars, with an 8.2 mag. topaz field star that is on the southwest edge all but leaps out at you. To find it, extend the Alpha-Beta line for about 6 ½° to the northwest to the 5$^{th}$ magnitude star 4 Cas. **M 52** is about 1° south and slightly west of 4 Cas. About 35' southwest of **M 52** is the "**Bubble Nebula" (NGC 7635).**
**M 103 (NGC 581),** mag. 7.4, 01 33.2 +60 42, 6' in size, is an open cluster of 25 stars; detached, no concentration of stars; moderate range of brightness; mag. of brightest star (a red giant) is 10.6; an arrow head or fan shape small group of stars. **M 103** is located ½° north and 1° east of **Delta Cas.** NGC 659 is 1½° east of **M 103;** 1¾° east and ½° north of **M 103** is **NGC 663**, and **NGC 654** is about 45' north and slightly west of **NGC 663**.
**St 2,** mag. 4.4, 02 15.0 +59 16, 60' in size, is an open cluster of about 50 stars; detached, strong concentration of stars; moderate brightness range; mag. of brightest star is 8.2.
**Cr 463,** mag. 5.7, 01 47.7 +71 46, 36' in size, is an open cluster of 40 stars; detached, no concentration of stars; moderate brightness range; mag. of brightest star is 8.5.
**NGC 457, C 13, "Owl Cluster", "E T Cluster",** mag. 6.4, 01 19.1 +58 20, 12' in size, is an open cluster of more than 100 stars; detached, strong concentration of stars; large brightness range; large, bright cluster; mag. of brightest star is 8.6. **NGC 457** resembles an owl's (or E.T. from the movie!) face or a stick figure with two very bright eyes. **Phi Cas**, a red supergiant star, mag. 4.9, 01 20 04.92 +58.13 53.8, is a foreground star on the southeast edge of the cluster. **NGC 457** is located about 4° southeast of **Gamma Cas.**
**NGC 129,** mag. 6.5, 00 29.9 +60 14, 20' in size, is an open cluster of 35 stars; not well detached from surrounding star field; moderate range in brightness; very large cluster; mag. of brightest star is 8.6.
**NGC 654,** mag. 6.5, 01 44.1 +61 53, 5' in size, is an open cluster of 60 stars; detached, weak concentration of stars; large range in brightness; mag. of brightest star is 7.4.
**NGC 1027**, mag. 6.7, 02 42.7 +61 33, 19' in size, is an open cluster of 40 stars; detached, no concentration of stars; moderate range in brightness; large; mag. of brightest star is 9.3.
**NGC 7789,"The White Rose Cluster", "Caroline's Rose", "The Magnificent Cluster",** mag. 6.7, 23 57.0 +56 44, 15' in size, is an open cluster of 300 stars; detached, weak concentration of stars; small range in brightness;

mag. of brightest star is 10.7. Discovered by Caroline Hershel in 1783, the loops of stars in it resemble the pattern of rose petals, it is located between **Rho** and **Sigma Cas.**

**NGC 225,** mag. 7.0, 00 43.4 +61 47, 12' in size, is an open cluster of 15 stars; detached, no concentration of stars; small brightness range; large cluster; involved in nebulosity; mag. of brightest star is 9.3.

**Tr 3,** mag. 7.0 (photo), 03 11.8 +63 09, 22' in size, is an open cluster of 30 stars; detached, no concentration of stars; large brightness range.

**Mrk 6,** mag. 7.1, 02 29.6 +60 39, 4.5' in size, is an open cluster of 6 stars; detached, no concentration of stars; small brightness range; mag. of brightest star is 8.4.

**NGC 663, C 10, "Letter 'S' Cluster",** mag. 7.1, 01 46.0 +61 15, 15' in size, is an open cluster of 80 stars; appears to contain a group of stars arranged in a 'S' shape; detached, no concentration of stars; large, bright; moderate range in brightness; mag. of brightest star is 8.4; located 1¾° east and ½° north of **M 103.**

**NGC 659,** mag. 7.9, 01 44.2 +60 42, 5' in size, is an open cluster of 40 stars; detached, no concentration of stars; small range in brightness; mag. of brightest star is 10.4.

**Tr 1,** mag. 8.1, 01 35.7 +61 17, 4.5' in size, is an open cluster of 20 stars; detached, strong concentration of stars; large brightness range; mag. of brightest star is 9.6.

**NGC 637,** mag. 8.2, 01 42.9 +64 00, 3.5' in size, is an open cluster of 20 stars; detached, strong concentration of stars; large range in brightness; pretty small, bright cluster; mag. of brightest star is 10.0.

**K 14,** mag. 8.5, 00 31.9 +63 10, 7' in size, is an open cluster of 20 stars; detached, no concentration of stars; small brightness range; mag. of brightest star is 11.3.

**NGC 7790,** mag. 8.5, 23 58.4 +61 13, 16' in size, is an open cluster of 40 stars; detached, no concentration of stars; moderate range in brightness; mag. of brightest star is 10.9.

**NGC 185, C 18,** mag. 9.2, 00 39.0 +48 20, 12'x10' in size, is a pretty bright, very large, and round galaxy; a dwarf galaxy of low surface brightness; very faint nucleus. It is a member of the Local Group, and satellite of the **Andromeda Galaxy (M 31).** Physically paired with galaxy **NGC 147**, located about 1°to the west-northwest. The galaxy is classified as a Type 2 Seyfert galaxy, and has an active galactic nucleus (AGN).

**NGC 147, C 17,** mag. 9.5, 00 33.2 +48 30, 12.9'x8.1' in size, is a very faint, very large galaxy; irregularly round; bright, extremely small nucleus. It is a member of the Local Group and a satellite of galaxy **M 31 (Andromeda Galaxy);** physically paired with **NGC 185,** which is about 1° to the east-southeast.

**NGC 559, C 8,** mag. 9.5, 01 29.5 +63 18, 4.4' in size, is an open cluster of 60 stars; detached, weak concentration of stars; moderate range in brightness; mag. of brightest star is 10.6.

**Cassiopeia A,** 23 21 +58 32, 4' in size, is a supernova remnant, and is notable for being the brightest astronomical radio source in the sky, and one of the first sources to be discovered in 1947.

**Cassiopeia Nebula, Sh 2-185, IC 59,** 00 56.7 +61 04, 10'x5' in size, is a pretty faint, large nebulous patch, illuminated by the bright star **Gamma Cas;** and **IC 63,** 00 59.5 +60 49, 10'x3', is a pretty faint, fan-shaped patch of nebulosity, illuminated by **Gamma Cas.**

**NGC 281, "The Pacman Nebula",** 00 52.8 +56 37, 34'x29' in size, is a pretty faint emission nebula containing a 4' clump of 4 stars; brightest star is mag. 9(photo). **NGC 281** is an H II region, containing a large amount of ionized atomic Hydrogen (H II).

**NGC 896,** 02 24.8 +61 54, 26'x12' in size, is an extremely faint and pretty large nebula; irregular shape; has a fairly prominent absorption patch in its southwest portion.

**IC 1805, "Heart Nebula",** 02 33.4 +61 26, 60' in size, is a faint, very large patch of nebulosity surrounding a large (21") open cluster of 30 stars; detached, no concentration of stars; large brightness range; total mag. of cluster is 6.5; mag. of brightest star is 7.9.

**IC 1848, "Embryo Nebula",** 02 51.3 +60 25, 60'x30' in size, is a faint and very large nebula; irregular in shape; a filamentary structure. Nebulosity is brightest in its northeast portion. Contains a 12' open cluster of 10 stars; not well detached from surrounding star field; large range in brightness; mag. of brightest star is 7.1.

**IC 1871,** 03 03.24 +60 29, 4' in size, is a faint patch of nebulosity surrounding a $10^{th}$ magnitude star.

**NGC 7635, C 11, Sh 2-162, "The Bubble Nebula",** 23 20.7 +61 12, 15'x8' in size, is a very faint, large, and luminous shell of nebulosity; illuminated by a 6.9 magnitude star.

**Sh 2-157,** 23 16.1 +60 02, 60'x50' in size, is an irregular and filamentary nebula.

**Sh 2-188,** 01 30.6 +58 22, 10'x3' in size, is a filamentary and crescent shaped nebula; the southeast portion is the most sharply defined.
**vdB – 1,** 00 11.0 +58 46, 5' in size, is three stars involved in nebulosity.
**vdB -8,** 02 51.6 +67 52, 4'x1' in size, is an 8.6 magnitude star involved in nebulosity; extending northwest-southeast.
**There are six deep sky objects beyond mag. 10 – as usual, see me for them.**

**Other Stars:**
**Gamma Cas,** mag. 2.15, 00 56 42.50 +60 43 00.3, is the central star in the constellation, and is a class B eruptive variable star (prototype). It exhibits irregular variations in brightness, which ranges between 2.20 magnitude and 3.4 magnitude. **Gamma Cas** is a spectroscopic binary star, an optical double with a mag. 11 companion about 2 arc seconds away, with an orbital period of roughly 204 days. The star is a known X-ray source. The amount of X-ray radiation that it emits is 10 times higher than that of other B or Be class of stars. **Gamma Cas** was the first Be star known ("e" for "emission").
**Zeta Cas,** mag. 3.69, 00 36 58.27 +53 53 49.0, is a blue-white sub-giant star, and a SPB variable star (Slow Pulsing B Star), the first one of its kind discovered to have a magnetic field.
**Iota Cas,** mag. 4.46, 02 29 03.99 +67 24 08.6, is a triple star. The primary is a white hued star at mag. 4.5; the secondary is a yellow hued star at mag. 6.9; and the tertiary star is at mag. 8.4. AB separation is 2.5", AC separation is 7.3".
**Rho Cas,** mag. 4.51, 23 54 23.04 +57 29 57.8, is a yellow hyper-giant star, and a semi-regular pulsating variable star. It has a minimum magnitude of 6.2 and a maximum magnitude of 4.1. It has a period of approximately 320 days. There are only seven known yellow hyper-giant stars in the Milky Way Galaxy.
**Psi Cas,** mag. 4.72, 01 25 55.90 +68 07 47.8, is a triple star. The primary is an orange hued giant star, and the secondary is a close pair of stars that appears to be of mag. 9.0, with a separation of 20" from the primary.
**R Cas,** mag. 4.80, 23 58 24.80 +51 23 19.0, is a Mira type red giant variable star with a period of 430.46 days, ranging in magnitude from 4.80 to 13.5.
**Sigma Cas,** mag. 4.88, 25 59 00.53 +55 45 17.8, is a binary star with a green hued primary star at mag. 5.0, and a blue hued secondary star at mag. 7.3. They have a separation of 3".
**Phi Cas,** mag. 4.95, 01 20 04.92 +58 13 53.8, is a multiple star system that lies on the edge of **NGC 457**. Binary has magnitudes of 5 and 12, third star is mag. 7. Separation of AB is 48.6", and C has a separation of 134" from AB.
**V 509 Cas,** mag. 5.10, 23 00 05.10 +56 56 43.4, is a yellow-white G-type hyper-giant star classified as a semi-regular variable star with its luminosity varying between mag. 4.75 and 5.5.
**HR 8832,** mag. 5.57, 23 13 14.74 +57 10 03.5, is a suspected variable star with four planets in orbit around it.
**HD 2952,** mag. 5.93, 00 33 10.32 +54 53 42.3, has one planet in orbit.
**AO Cas,** mag. 6.11, 00 17 43.07 +51 25 59.1, is a rotating ellipsoidal variable star (a binary). Both stars are giant O-type stars revolving almost in contact with each other, in a period of 3.52355 days. The computed separation is 15 million miles, which means that their surfaces must be nearly touching.
**RZ Cas,** mag. 6.26, 02 48 55.51 +69 38 03.1, is an eclipsing variable star. It takes two hours to fade to mag. 7.8, and two hours to rise to its normal magnitude of 6.26. The systems period is 1 day 4 hours 41 minutes.
**HD 22074,** mag. 6.39, 23 20 14.37 +61 58 12.5, is a suspected variable star with one planet in orbit.
**HD 7924,** mag. 7.19, 01 21 59.12 +76 42 37.0, has one planet in orbit.
**HD 108,** mag. 7.40, 00 06 03.39 +63 40 46.8, is a binary runaway star with a variable spectrum.
**HD 13908,** mag. 7.51, 02 18 15.0 +65 35 40, has two planets in orbit.
**HD 17156,** mag. 8.17, 02 49 44.49 +71 45 11.6, has a transiting planet.
**HD 240237,** mag. 8.17, 23 15 42.22 +58 02 35.7, has one planet in orbit.
**HD 240210,** mag. 8.33, 23 10 29.23 +57 01 46.0, has one planet in orbit.
**BD+60 2522,** mag. 8.7, 23 20 44.52 +61 11 40.6, is the source of nebula **NGC 7635.**
**HD 219415,** mag. 8.94, 23 14 54.0 +56 43 49, has one planet in orbit.
**IGR J00291+5934,** 00 29 13.06 +59 34 19.0, is an X-ray pulsar with a millisecond pulsar.

**IE 2259+586,** 23 01 08.14 +58 52 44.5, is a magnetar.
**PSR B2319+60,** 23 21 55.21 +60 24 30.7, is a pulsar.
**PSR B2334+61,** 23 37 05.78 +61 51 01.7, is a pulsar.
**PSR J02054+6449,** 02 05 37.92 +64 49 42.8, is the central pulsar of **3C58.**
**W3 IRS 5,** 02 25 40.54 +62 05 51.4, is a proto-star; possibly similar to a proto-trapezium.
**IRAS 00338+6312,** 009 36 47.5 +63 29 02, is a proto-star.
**There are 8 more other stars beyond mag. 10 – as usual, see me.**

# Sky Happenings for December:

**Dec. 2nd –** Morning – Look for Regulus, the brightest star in Leo, about 4° left or above the Moon.

**Dec. 3rd –** Last Quarter Moon occurs at 11:40 AM CST.

**Dec. 4th –** The Moon passes 1.8° south of Jupiter at 12:00 midnight CST.

**Dec. 5th –** Venus rises about 3½ hours before the Sun, anchoring a chain that stretches past Spica to connect Mars, the crescent Moon, Beta Virginis, Jupiter, and finally Regulus.

The Moon is at apogee (251,531 miles from Earth) at 8:56 AM CST

The Moon passes 0.1° south of Mars at 9 PM CST.

**Dec. 7th –** The Moon occults Venus at 11 AM CST.

**Dec. 9th –** Asteroid Psyche is at opposition at 8 AM CST.

**Dec. 11th –** New Moon occurs at 4:29 AM CST.

**Dec. 13th/14th –** All Night – The Geminid Meteor Shower peaks on Dec. 13th at 12:00 noon CST. Viewing should be strong on the 13th/14th.

**Dec. 17th –** The Moon passes 3° north of Neptune at 2 AM CST.

**Dec. 18th –** First Quarter Moon occurs at 9:14 AM CST.

**Dec. 19th –** The Moon passes 1.2° south of Uranus at 7 PM CST.

**Dec. 21st –** The Moon is at perigee (228,924 miles from Earth) at 3:00 AM CST.

Mars passes 4° north of Spica at 6:00 PM CST at 5:00, with a globe shrinking from about 17.5" to 14.5" in diameter, while its gibbous phase increases from about ⅔ to ¾ sunlit.

Winter Solstice occurs at 10:48 PM CST.

**Dec. 23rd –** At midnight on the morning of the 23rd, Mars will rise about 3° to the upper left of Spica

The Moon passes 0.7 north of Alderbaran at 2:00 PM CST

As twilight deepens, look for Alderbaran about 3° to the right or upper right of the waxing gibbous Moon

Asteroid Euterpe is at opposition at 11:00 PM CST.

**Dec. 25th –** Full Moon occurs at 5:11 AM CST.

**Dec. 26th –** Uranus is stationary at 5:00 AM CST.

**Dec. 28th –** Mercury is at greatest eastern elongation (20°) at 9:00 PM CST.

**Dec. 30th -** The Moon rises before midnight with Jupiter trailing behind to the lower left. The duo accompanies the hind foot of Leo across the sky through the early morning hours.

**Dec. 31st –** The Moon passes 1.5° south of Jupiter at 12:00 noon CST.

**Mercury –** Mercury sets too soon after the Sun to glimpse until mid-month. Mercury will appear above the southwest horizon starting about 30 minutes after sunset. On Dec. 15th, Mercury lies only 4° high but should show up because it shines so brightly at mag. -0.6. Mercury will stay at mag. -0.6 to -0.7 all month, climbing higher each night. By the time Mercury reaches greatest elongation of 20° east from the Sun on Dec. 28th

standing 9° high, it will set about an hour and a half after the Sun. In late Dec., a telescope view shows a disk that measures 7" across and appears to be half lit.

**Venus –** Venus rises about an hour after Mars on Dec. 1st and appears conspicuous in the eastern sky by 4:00 AM local time. At mag. -4.2, it is 5 full magnitudes (a factor of 100) brighter than its companion, Spica, which stands just 4° away. Venus crosses into Libra on Dec. 11th. Look for the double star Zubenelgenubi, mag. 2.8, (Alpha Librae) 2° south of Venus on the 17th. On Dec. 7th, the Moon occults Venus after sunrise, at about 11:12 to 11:18 AM CST. Venus drops from less than 30° high to less than 20° high an hour before sunrise during Dec. During Dec., Venus dims a bit to mag. -4.0, with a globe shrinking from about 17.5" to 14.5" in diameter, while its gibbous phase increases from about ⅔ to ¾ sunlit.

**Mars –** Mars rises in the east at around 1:00 AM in early Dec., and only about a half hour earlier at the end of the month, coming up almost two hours after Jupiter. On Dec. 1st, Mars shines at mag. 1.5 and stands 1.5° due south of mag. 2.8 Gamma Virginis (the double star Porrima). Mars brushes past 4th magnitude Theta Virginis on Dec. 12th and 13th. Mars passes 4° north of Spica on the 21st. Mars brightens from mag. +1.5 to +1.3 during Dec. Mars shows a disk of only 5" wide, and stays on the far side of the solar system from Earth.

**Jupiter –** Jupiter starts Dec. rising around 12:30 AM local time and around 10:30 PM by the end of the month. Jupiter brightens from mag. -2.0 to -2.2 during Dec. against the background stars in southeast Leo. Jupiter's disk grows from 36" to 39" wide in Dec. Jupiter reaches quadrature (90° west of the Sun) on Dec. 14th. The angle of the Sun shining on Jupiter diverges noticeably from our line of sight during Dec. On Dec. 8th, Callisto's shadow falls on Jupiter's northern hemisphere starting at 3:17 AM CST, when the Moon itself is still 1.6' east of the planet. Early on the mornings of Christmas Eve and New Years Eve, Europa will cast a shadow that will cross the Jovian disk about 2.5 hours before the moon itself.

**Saturn –** Saturn was in conjunction with the Sun on Nov. 30th and becomes plainly visible around mid Dec. when it rises in the southeast more than an hour before sunup. Saturn, at mag. +0.5, is just over 6° north (upper left) of the slightly dimmer Antares on Dec. 21. Saturn and Venus will close the gap between them in the final days of the year, having an extremely close conjunction on the morning of Jan. 9, 2016.

**Uranus –** Uranus resides among the faint stars of Pisces the Fish. Uranus appears slightly more than half way to the zenith in the southeast as darkness falls and remains in view all evening. It doesn't set until around 1:00 AM local time, even as the month comes to a close. Uranus glows at mag. 5.8, and remains 2° due south of mag. 4.3 Epsilon Piscium. Uranus has a blue-green disk that spans 3.6'. On Dec. 19th, the gibbous Moon will be about 1.5° due south of Uranus.

**Neptune –** Neptune lies in central Aquarius. At mid-month, Neptune sets after 10:00 PM local time. To find Neptune, locate mag. 3.8 Lambda Aqr, then Sigma Aqr. (mag. 4.8) lying 6° southwest of Lambda. On Dec. 1st, Neptune resides 1.5° northeast of Sigma Aqr. The gap grows to 2.0° by month's end. Neptune glows at mag. 7.9, and shows a disk that measures 2.3" across and sports a blue-grey color.

**Pluto –** Pluto is in Sagittarius, north of the teapot asterism, at RA 19 01.3, Dec. -21 04, and is at mag. 14.2 and shows a diameter of 0.1".

**Sun –** The Sun arrives at the Dec. solstice at 10:48 PM CST on Dec. 21st, marking the start of winter in the Northern Hemisphere.

**Moon –** The waning Moon shines near Regulus on the morning of Dec. 2nd, and near Jupiter on Dec. 3rd and 4th. On Dec. 6th, it is about equal distant from Mars and Spica. The waning lunar crescent is quite near Venus on the American dawn of Dec. 7th, and during the daytime, the Moon will occult Venus. Late on New Year's Eve, Dec. 31st, the waning gibbous Moon rises with Jupiter not far below.

**Asteroids –** On Dec. 9th and 10th, asteroid 39Laetitia poses as a 10th magnitude star on the fringe of **M 77. M 77** is the founding member of Carl Seyfert's class of active galaxies, with a super-massive black hole at its core that is hidden from view by gas, dust, and dense swarms of stars. Laetitia and **M 77** lies less than 1° east-southeast of 4th magnitude Delta Ceti.

**Comets –** Comet C/2013 US10 (Catalina) will share an 8° field with Venus and a thin crescent Moon on the morning of the 7th. Catalina should be a steady mag. 5, although there are some expectations that it will be at mag. 4. After Dec. 8th, there will be two weeks of Moon free skies, allowing one to get detailed views of the comet. On New Year's morning, comet Catalina will be about ½° from Arcturus.

**Meteor Showers –** The Geminid Meteor Shower peaks on Dec. 14th, just 3 days after a New Moon. The radiant is from a point near Castor in Gemini. The International Meteor Organization (IMO) predicts that the Geminids should reach an impressive zenithal hourly rate (ZHR) of 120 this year. The peak should be centered on roughly 18h Universal Time (12:00 noon CST) on Dec. 14th. For North America, that splits the difference between late nights of Dec. 13-14 and 14-15. The performance on both of these nights is likely to be similar.

### When to View the Planets:

| **Evening Sky** | **Midnight** | **Morning Sky** |
|---|---|---|
| Mercury (southwest) | Jupiter (east) | Venus (southeast) |
| Uranus (southeast) | Uranus (west) | Mars (southeast) |
| Neptune (south) | | Jupiter (south) |
| | | Saturn (southeast) |

## Dark Sky Viewing: Primary – Dec. 12th, Secondary – Dec. 19th

## Cassiopeia – Queen of Ethiopia

Cassiopeia was the vain and boastful wife of King Cepheus of Ethiopeia, who is next to her in the sky. They are the only husband and wife couple among the constellations. Classical authors spell her name Cassiepeia, but Cassiopeia is the form used by astronomers.

While combing her long locks one day, Cassiopeia dared to claim that she was more beautiful than the sea nymphs, called the Nerieds. There were 50 Nerieds, daughters of Nereus, the so-called Old Man of the Sea. One of the Nerieds, Amphitrite, was married to Poseidon, the sea god. The Nerieds appealed to Poseidon to punish Cassiopeia for her vanity, and the sea god sent a monster to ravage the coast of King Cepheus's country. This monster is commemorated in the constellation Cetus. To appease the monster, Cepheus and Cassiopeia chained their daughter, Andromeda, to a rock as a sacrifice, but Andromeda was saved from the monster's jaws by the Hero Perseus in one of the most famous rescue stories in history.

As an added punishment, Cassiopeia was condemned to circle the celestial pole forever, sometimes hanging upside down in undignified posture. In the sky, Cassiopeia is depicted sitting on her throne, still fussing with her hair.

Almost all the characters in the most famous rescue story in history have been placed in the sky: Cepheus – King of Ethiopeia; Cassiopeia – Queen of Ethiopeia; Andromeda – Daughter of Cepheus and Cassiopeia; Perseus – The Hero; Cetus – the Sea Monster; Pegasus – the Winged Horse that was Perseus's mount; and the only character not having a constellation is Medusa – Perseus is holding her severed head in his left hand.