SkyWAAtch

On the Edge

Courtesy of Olivier Prache is this image of the edge of the Andromeda galaxy. The result of 3 nights of exposures the image highlights some the galaxy's star-forming H-II regions as well as M32, a satellite galaxy.

Imaging info: nine-1/2 hours using a Hyperion 12.5" astrograph and an ML16803 camera.

In This Issue . . .

WAA October Lecture

"The Planck Mission"
Friday October 2nd, 7:30pm
Miller Lecture Hall,
Pace University, Pleasantville

Dr. Charles Lawrence will speak on the European Space Agency's Planck Mission to map the Cosmic Microwave Background. Dr. Lawrence is a fellow at NASA's Jet Propulsion Laboratory. He received his Ph.D from M.I.T. Free and open to the public. Directions and Map.

Upcoming Lectures

Pace University, Pleasantville, NY

Our speaker for November 6th will be science educator Charles Fulco. His topic will be light pollution, in particular how it impacts Westchester. On December 4th, Andy Poineros will be presenting on the New Horizons Mission.

Starway to Heaven

Saturday October 10th, Dusk
Ward Pound Ridge Reservation,
Cross River, NY

This is our scheduled Starway to Heaven observing date for October, weather permitting. Free and open to the public. The rain/cloud date is October 17th. **Note**: By attending our star parties you are subject to our rules and expectations as described here. Directions.

New Members. . .

Eileen Fanfarillo - Irvington

Renewing Members. . .

Doug Baum - Pound Ridge
Kristina Newland - White Plains
Satya Nitta - Cross River
Linda Boland - Hyde Park
George & Susan Lewis - Mamaroneck
Josh & Mary Ann Knight - Mohegan Lake
Cathleen Walker – Greenwich
Mark Girvin - Larchmont

Call: 1-877-456-5778 (toll free) for announcements, weather cancellations, or questions. Also, don't forget to periodically visit the WAA website.

Astrophotography Exhibition October 3rd to October 29th 2015

The Somers Library will be exhibiting the astrophotography of Scott Nammacher, a Westchester based amateur astrophotographer. The exhibit is entitled "Treasures of the Northern and Southern Night Skies." Mr. Nammacher will show his photographs, taken from two remotely operated observatories (one in Australia and the other in New Mexico) and from his up-state observatory, Starmere Observatory. He has been photographing nebulas, galaxies, along with cloud and gas regions, and more local solar system targets since the early 2000s.

Somers Library Address: Route 139 & Reis Park, Somers, NY 10589

Library Website: www.somerslibrary.org

Artist Website: starmere.smugmug.com

Artist Email: snammacher@msn.com

WAA SkyWAAtch Newsletter editor Tom Boustead settling in at Ward Pound Ridge for the Perseid meteor shower on August 12th

Westchester Amateur Astronomers

Almanac

For October 2015 by Bob Kelly

Oct 4 Oct 12 Oct 20 Oct 27

If you've said it would take an act of Congress to get you out of bed in the morning to stargaze, this month is for you! An alignment of planets and legislation makes morning viewing exciting and accessible in October. The Energy Policy Act of 2005, section 110, http://aa.usno.navy.mil/faq/docs/daylight_time.php is the legislation providing for 'Daylight Time.' It does not compel you to rise and shine before sunrise, but it makes our sunrises as late as 7:25am local time, occurring with the appearance of bright planets in our dawn skies for you to see.

A celestial line dance occurs, starting with the ever-so-bright appearance of Venus last month, followed by Jupiter arriving these past few days. Perhaps it's more of a linear square dance with Venus, the star Regulus, Mars and Jupiter, from top to bottom in their starting positions. Then Venus and Regulus do a do-si-do in the first full week of October, with the Moon swinging through on the 8^{th}. Jupiter and Mars partner around the 15^{th}; then Venus, Jupiter and Mars make a threesome starting on the 17^{th}. The grand finale is Jupiter and Venus' close dance on the 25^{th} and 26^{th}, with Mars lingering just below waiting for Venus to fall into his arms at the end of the month. Mercury tries, but once again is too shy to join the dance, doing the celestial equivalent of running the coat check room, bright, but low on the eastern horizon for the last three weeks of October.

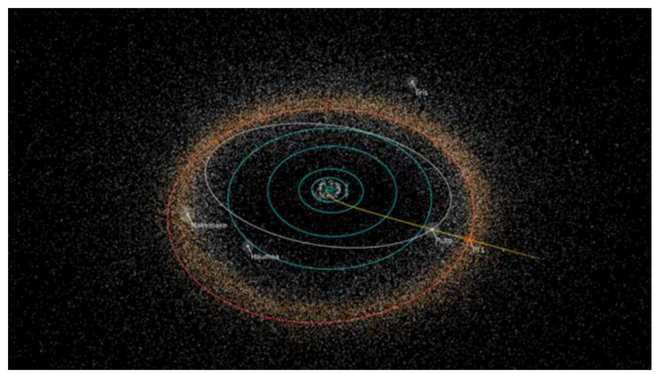
If you get up when it's still dark, you may see a few Orionid meteors in moderate numbers before dawn, especially around the 22^{nd}.

For your morning stargazing, bring out whatever optical aid is easiest to carry to a clear vantage point toward the east. Hold good binoculars steady to see Venus as a widening crescent, but shrinking in overall size. Jupiter's moons are fascinating as well but are easier to see, at this distance across the solar system, in a telescope. Try to get some photos of the alignments. Take a bunch of photos with different settings, see what looks best and try again!

Saturn lingers in the evening, sitting in the smog and setting early. A good telescope might show Cassini's Division in the rings as they are tipped open toward us. And Titan stands nearby.

Uranus and Neptune are well placed in prime time, later in the evening. Try star hopping to them. While the constellations they are passing through are faint, it's worth the trip to see them as tiny bluish dots, not like the pinpoint twinkly stars around them. Uranus is at opposition, at magnitude +5.7 this month.

While you are hopping, Vesta is good at mag +6.2 in Cetus, not as obvious as Uranus or Neptune due to its small size. Can you find Ceres (mag. +9), the latest home of the Dawn spacecraft, in Sagittarius? Pallas is south of Hercules (mag. +10). While we still can view the Teapot, it's fun to point out the Teaspoon to its northeast, where Pluto hides at magnitude +14 and somewhere in that area, New Horizons streaks onward to its next Kupier belt object arrival on January 1^{st}, 2019.



New Horizon's path into the Kuiper Belt.

See: http://pluto.jhuapl.edu/News-Center/News-Article.php?page=20150828

Aldebaran is occulted by the moon during daylight mid-morning on the 2^{nd} . Even the gibbous moon will be hard to find. The glare from the bright limb of the moon makes the disappearance of Aldebaran hard to see, but spotting them in the daytime sky near each other would still be a treat and possible in binoculars when you know which way to point them, about 10 to 15 degrees above the western horizon.

The International Space Station soars in the evening twilight over us for much of October.

Binocular Power

Mike Cefola

I happened to wake up around 3:20 a.m. at our place in Vermont and took a quick glance out the sliding door to one of the decks to see if the stars were out. Our location is on latitude with the Great Lakes, so partially cloudy to cloudy conditions are not uncommon. Also, I've had nights that are wonderfully dark for naked eye or binocular viewing but an atmosphere too unsteady for telescopes. Taking this into account, the stars were so bright and beautiful that I had to get out there. Throwing on some clothes, I ran out to the larger deck, which provides a wider vantage point for observing.

I opted for my Canon 12x36 stabilizer binoculars. Keep in mind I have an eighteen-inch Dob that can be rolled out of the garage and a large tube Celestron SG on a permanent pier in the Smokehouse (the name is another story) Observatory atop my garage roof which can be rolled open. However, with dawn not far away, expediency ruled. I chose the 12x36 model, after trying the larger 50mm Canon version on wide field views of the Milky Way and its many star clouds. Still, the 12x allows for nice detail on deep sky objects. The weight of the smaller pair also played a part in my decision. Even though they are stabilized binocs, the larger ones still can be hefty when focusing on an object for a longer time.

The sky was one of the most magnificent I've encountered in years of observing at the house: extremely dark with no light pollution and amazingly steady. I started with some easy stuff to get my bearings. Schedar, in Cassiopeia, the brightest star in the constellation, is a stunning gold. I happen to love this star for another reason; it is a double star with a faint companion that, when viewed in a telescope eyepiece under decent power, shows up purple or deep violet. My eyes clearly see it as purple and Bill Newell can confirm that he sees it the same way. The combination of the brilliant gold and purple stars is one of the great telescope sights. I proceeded to Castor and Pollux, stars that make up the heads of the twins in Gemini, my birth sign (yes, I dare mention astrology but I use a small "a" as opposed to "A"stronomy). Finally, I viewed two of Orion's fabulous stars, Rigel and Bellatrix. The big O, rising above the pine trees in the east, always gives me chills the first time I view it each fall.

Turning to serious deep sky objects, I wanted to see what these 12x36 stabilizers could do. I started with a fall favorite, the double cluster in Perseus. With the stabilization engaged, the binocs displayed a beautiful array of stars in both clusters with varied colors and sizes. This is truly one of those objects better suited to binoculars as viewing both clusters in the same FOV is a magnificent sight. A fast, wide-field scope is another route to go with this pair. While here, make sure you view one of the best asterisms in the sky, Stock 2, or "the Stickman." I first saw this asterism at Stellafane years ago through an 80mm Televue refractor. It takes a bit of concentrating to see it, but when the apparition finally hits your FOV, it is a kick. It looks just like those stickman figures we artistically challenged kids drew in primary school to represent an adult. To find the asterism, look for a line of stars that curve away from the upper cluster NGC 869 and when they end, you're at the Stickman. I believe your best shot is low power binoculars in the 7-10 by 50mm range. I next moved to M52, the open cluster in Cassiopeia. In the open cluster mindset, I found the ever-entertaining trio of Messier open clusters in Auriga, M36, 37, and 38. All three are in a line where you need do nothing more than start at M37 and move straight up to 36 and 38 respectively. While at M38, be sure to observe its fainter companion, NGC 1907, which was in the Canon's same FOV. Since I was in the M30s, I went to M35 in Gemini, one of the most beautiful open clusters in the northern sky. A multitude of stars make up this large cloud in the eyepiece. The added bonus is the easily visible companion open cluster in the same FOV, NGC 2158.

Moving on to Taurus, I focused on the stunning Hyades or bull's head. The brilliant stars of this cluster make it one of the most thrilling binocular objects to observe. While viewing the Hyades, be sure to find another asterism brought to my attention by Phil Harrington, author of numerous books and articles on binocular observing. "The House," placed right in the heart of it, looks like yet another classic drawing I did to represent a real house—using the same level of artistic ability for those stickman figures. Don't leave Taurus without looking at NGC 1647 and 1746, two commonly overlooked open clusters worthy of your time. The final open cluster I viewed was the Pleiades, which need no description, as we all know the sheer beauty of these stars. Being in Taurus, I had to give a shot at M1, the Crab Nebula, which came in clear as could be with stabilization turned on. Don't get me wrong, it didn't look like the incredible photos of it furiously expanding into space, but still a thrill to know what I was looking at in 12x binoculars.

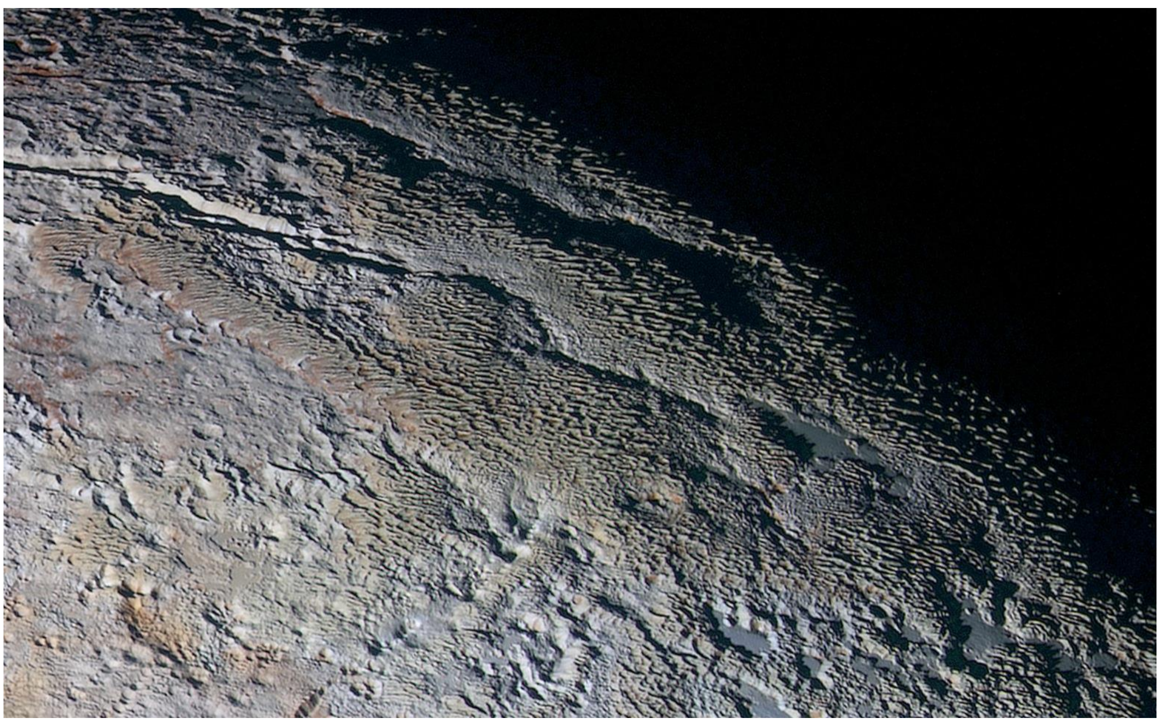
With dawn around the corner, I decided to go for two prominent galaxies high above. M31, the Andromeda Galaxy, was almost at zenith and spectacular. The binocs' wide FOV let me trace the spiral arms in all their glory beyond the actual field. Easily visible were its companion galaxies, M32 and M110. I then moved to M33, the classic spiral galaxy in Triangulum, equally stunning with easily recognizable arms surrounding the core. I had read this galaxy was visible under the right conditions to the naked eye, so I boldly tried to see it that way. After relaxing my eyes, there it was—a faint gray blob against the blackness of the sky. As great as all our astro-viewing gizmos are, this by far was the viewing highlight of the night.

Before I got ready to drag myself inside to log what I had viewed, I went for one last favorite asterism, also in Triangulum, "the Golf Club": a grouping of stars that go straight down in a line and then curve left to make the club. The best part is the little compact cluster at the end of the curving stars, NGC 752, which makes the perfect ball about to be lofted into the fairway of space.

So that's my sell on the power of binoculars, whether stabilized or not, big or small. Don't forget, in daytime these same observing tools bring joy by allowing me to view birds and some gliders from the nearby airport.

Borrowing the close from Phil Harrington's monthly binocular *Astronomy* column, I will end with "Remember, two eyes are better than one"!

* *



An image of the surface of Pluto taken by New Horizons.

Image Credit: NASA, Johns Hopkins Univ./APL, Southwest Research Institute

Planetary Nebulas

Larry Faltz

One of the highlights of a summer or fall evening's viewing is the Ring Nebula, Messier 57, in the constellation Lyra. Visible in almost any telescope, it's an ethereal smoke ring hanging improbably in the night sky. It's easy to find, located not far from bright Vega and halfway between β and γ Lyrae, both conspicuous 3rd magnitude stars. The sight of this planetary nebula always brings out oohs and aahs in first-time viewers when they finally pick it out from the background. Then, of course, you're asked to explain what the heck it is and things get complicated. "Exploding star" is usually sufficient for newbies at a star party but it's not really accurate. The science is interesting and we'll get to it after bit of history.

Dumbbell Nebula (M27). 28-second Mallincam video camera image using 8" SCT from Ward Pound Reservation (LF)

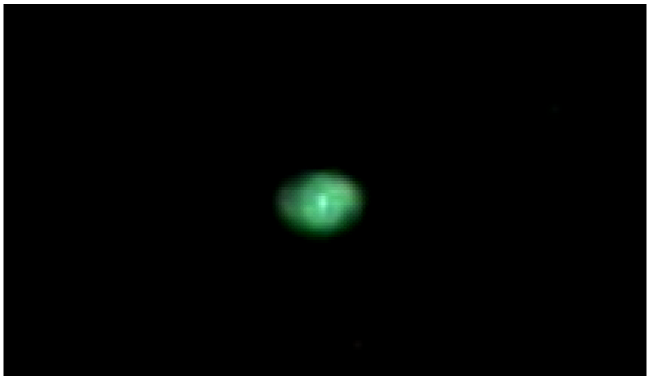
2014 marked the 250th anniversary of the discovery of planetary nebulas (we'll use the English "s" rather than the Latin "e" for the plural, but either is correct). On the night of July 12, 1764, Charles Messier (1730-1817) came across a fuzzy spot along the lower edge of the Summer Triangle in the constellation Vulpecula, noting that it is "oval shaped and does not contain any stars." We now know this object as M27, the Dumbbell Nebula. Antoine Darquier de Pellepoix (1718-1802) discovered the Ring in the constellation Lyra in January 1779, just a few days before Messier saw it. Eventually Messier's catalog of 109 objects, published on May 11, 1781, included 4 nebulas we now know are planetary nebulas: M27, M57, M76, the so-called "Little Dumbbell" in Perseus, and M97, the faint Owl Nebula in Ursa Major.

The term "planetary nebula" is ascribed to William Herschel. Messier had observed Uranus shortly after Herschel's discovery of the planet was announced on April 26, 1781, and they exchanged correspondence. It was Messier's catalog that stimulated Herschel to start systematically observing deep sky objects. His skill as a telescope maker, sharp eyesight, incredible patience, ability to get money out of King George III and the invaluable assistance of his sister Caroline allowed him to catalog over 2,500 objects in the next two decades. He described the object we now know as the Saturn Nebula as "a curious nebula, or what else to call it I do not know." He considered it "a planet of the starry kind" and that's how the "planetary" came to be. Herschel included 36 planetary nebulas in his catalog, of which only M76 is also on Messier's list.

Messier & Caldwell Planetary Nebulas

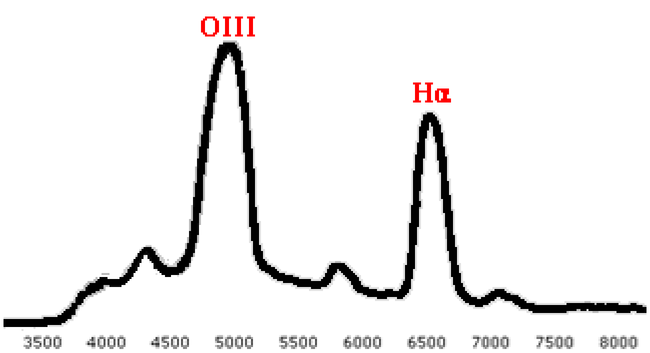
Cat #	NGC	Mag	Con	View	Name
M27	6853	7.5	Vul	Sum	Dumbbell
M57	6720	8.8	Lyr	Sum	Ring
M76	650	10.1	Per	Aut	Little Dumbbell
M97	3587	9.9	Uma	Spr	Owl
C2	40	11.6	Cep	Aut	Bow-Tie
C6	6543	8.8	Dra	Sum	Cat's Eye
C15	6826	9.8	Cyg	Sum	Blinking Planetary
C22	7662	9.2	And	Aut	Blue Snowball
C39	2392	9.9	Gem	Win	Eskimo or Clown
C55	7009	8.3	Aqr	Aut	Saturn
C56	246	8	Cet	Aut	Skull
C59	3242	8.6	Hya	Spr	Ghost of Jupiter
C63	7293	6.5	Aqr	Aut	Helix
C69	6302	12.8	Sco	Sum	Bug
C74	3132	8.2	Vel	Spr	Eight Burst
C90	2867	9.7	Car	Spr	
C109	3195	11.6	Cha	Spr	

There are 13 planetaries in the Caldwell catalog, Patrick Moore's 1995 extension of the Messier list to the next-best 109 celestial objects. These range from magnitude 6.5 to 12.8. Eleven of them are visible from our latitude. C90 and C109 are too far south to be seen from Westchester.



Cat's Eye Nebula from Ward Pound. 8" SCT at f/10, Mallincam, 2x digital zoom, 2 second image (LF)

There are 137 planetaries in the NGC and IC catalogs, first published in 1888 and 1895, respectively (now always displayed together.) These include all the Messier and Caldwell objects. Most of the other planetaries are small and/or faint, but a few are tempting objects for larger amateur telescopes. The first serious catalog devoted solely to planetaries was the Perek-Kohoutek (PK) catalog, published in 1957, listing 1,510 objects. The PK designation is often seen in observing lists, astronomical programs and planetarium software. More accessible is the on-line 1992 Strasbourg-ESO Galactic Planetary Nebulae Catalog, with a smaller number (1,143) of confirmed planetaries, more accurately characterized. You can access this catalog through Aladin, the professional on-line sky atlas. The Saguaro Astronomy Club of Phoenix, Arizona publishes an extensive database of 10,342 deep sky objects in its latest version, listing 743 planetaries from NGC, IC and PK; the faintest is magnitude 20.1. With a large-enough telescope from Ward Pound Ridge Reservation, on a good night one might have no trouble seeing deep sky objects down to magnitude 12.0 if their surface brightness is high enough, which is usually the case with planetaries (as compared to many galaxies); Saguaro lists 84 planetaries brighter than this. Of these, 63 are larger than 10 arc-seconds, about 3 times the size of Uranus. Many of these are visible from our latitude, but it takes some planning to figure out which and when. Planetarium or planning software can make that easy. Check out the observing guides on Alvin Huey's www.faintfuzzies.com. His planetary nebula handbook (among several useful deep sky guides) lists over 300 objects, with detailed finder charts and images.



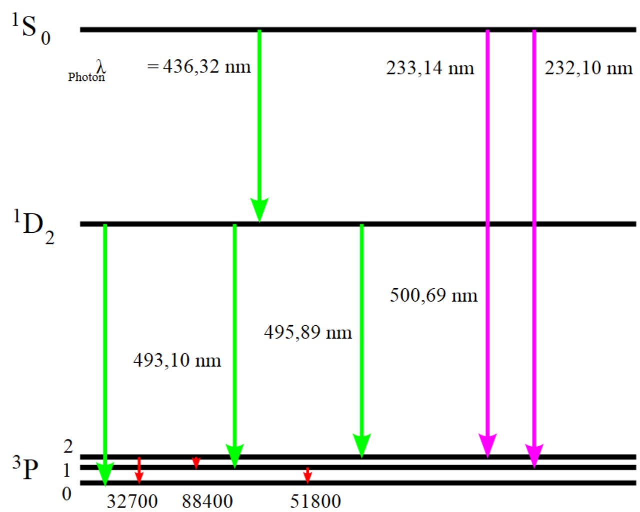
Low resolution spectrum of the Cat's Eye Nebula, NGC6543

The development of spectroscopy in the mid-19th century was the key to elucidating the unique nature of planetary nebulas. English astronomer William Huggins (1824-1910) had established that the spectra of stars and galaxies consisted of a continuum of wavelengths with superimposed dark lines, which we now know to be caused by absorption of specific wavelengths by atoms in the stellar atmosphere. In 1864, Huggins visually observed the Cat's Eye Nebula (NGC6543) with a spectroscope and noted that it consisted of a few bright lines without an underlying continuum. He wrote "I looked into the spectroscope. No spectrum such as I expected! A single bright line only! At first I suspected some internal displacement of the prism. Then the true interpretation flashed upon me. The light of the nebula was monochromatic. The riddle of the nebulae *(sic)* was solved. The answer, which had come to us in the light itself, reads: not an aggregation of stars, but a luminous gas." The strong spectral line at 500.7 nanometers (5007 Ångstroms) was unknown to science and so it was thought to be evidence of a new element, named "nebulium."

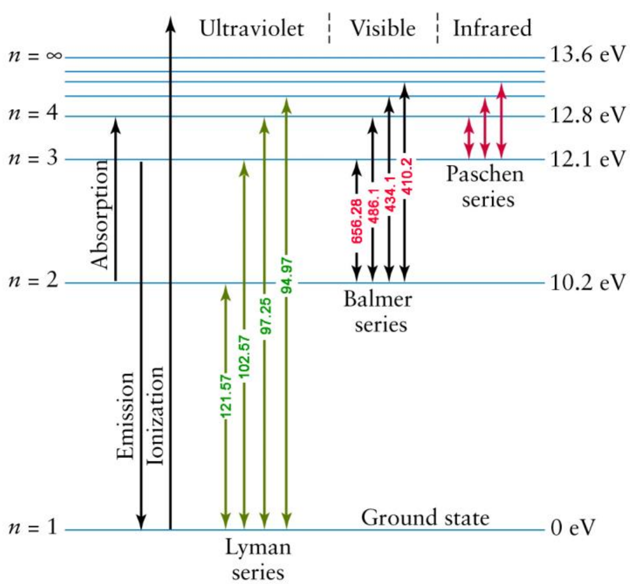
M76, the Little Dumbbell. 8" SCT and Mallincam, 28 seconds, from Ward Pound (LF)

In the Bohr model of the atom, electrons occupy distinct "orbitals" with different, but discrete, energies. The "ground state" is the lowest energy level. An electron can, for an almost infinitesimal time, occupy a higher energy orbital by absorbing a photon. If the incoming photon's energy is high enough, the electron is kicked out of the atom completely, and the atom is ionized. Emission lines in the spectrum arise when the electron drops from the temporary higher energy level to a lower one (but not necessarily all the way to the ground state), emitting a photon of wavelength $\lambda = hc/\Delta E$, where c is the speed of light, h is Planck's constant, 6.626×10^{-34} Joule-seconds and ΔE is the energy difference between the two orbitals. Shorter wavelength photons have higher energies.

It was only in the 1920's that the mysterious 500.7 nm spectral line was correctly explained. In very rarefied gases, with densities much lower than could be achieved in the laboratory at that time, excited electrons can occupy "metastable" energy levels that at higher densities would be immediately de-excited by atomic collisions. These energy levels give rise to the previously unknown spectral lines, called "forbidden" in the sense that they can't be made in the laboratory. The 500.7 nanometer line was eventually shown to be due to excited states of the remaining electrons doubly ionized oxygen (O^{+2}), known as OIII. A variety of OIII filters are available for planetary nebula observers. They enhance visual contrast by reducing the transmission of other wavelengths, emphasizing the greenish-blue 500 nanometer region. Every planetary nebula observer should have one.



The spectrum diagram of doubly-ionized oxygen (O^{+2}). The "forbidden" transitions are in green.



The hydrogen electron transition spectrum. There are no forbidden lines for this element.

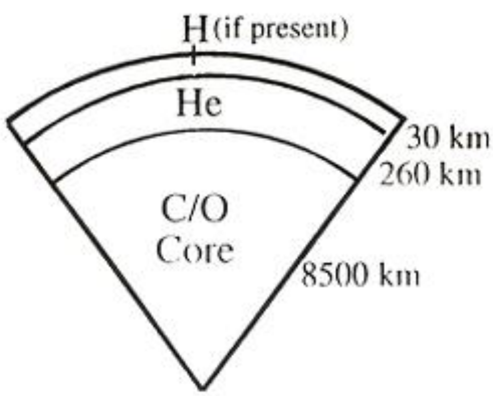
There are a good number of hydrogen atoms in the nebula as well. We see the red Balmer series hydrogen alpha line at 656.28 nanometers. The blue hydrogen beta line at 486.1 nanometers may also be detected. H-α and H-β filters can enhance emission nebulas and some planetaries. The more energetic Lyman series photons are in the ultraviolet range. Emission lines in the visual spectrum also arise from helium, carbon, nitrogen and neon, but OIII predominates and in the eyepiece the brighter planetaries appear blue-green.

While planetary nebulas look like dense patches of gas, that's only an illusion. Their density is only about 10^4 atoms per cubic centimeter (air at sea level has about $2*10^{19}$ atoms per cc), which is what we would experience if the Earth's atmosphere was removed and the air in one modest-sized house (not a McMansion!) was allowed to spread over the whole Earth to a height of one kilometer. That's still much denser than interstellar space, which is estimated to have less than 1 atom per cc. In this rarified environment, the atoms can remain in their metastable states long enough for subsequent transitions to lower energy states to be evident.

M97, the Owl Nebula, 8" SCT & Mallincam, 56 seconds, from Ward Pound. (LF)

Planetary nebulas decorate the demise of elderly stars. Over 90% of stellar death involves a planetary nebula phase. As stars age, they consume the hydrogen in their cores (recall that only at the deep center of the star does fusion actually take place). Eventually they need to fuse helium in a hotter core, surrounded by an expanding shell of cooler hydrogen. The star becomes a red giant, the brightest examples of which are Aldebaran, Arcturus, Antares and Betelgeuse. Helium burning results in a core of relatively inert carbon and oxygen. The bloated star's atmosphere is vented into space at a velocity of 20-40 km/sec. The star becomes progressively smaller, bluer and hotter. The hot helium fusion reactions, taking place at core temperatures of 100 million degrees K, emit energetic ultraviolet photons that ionize the vented gas and excite some of the remaining electrons. These re-emit lower-energy photons that make the expanding cloud visible. With time, the fuel is gone and the core collapses into a white dwarf.

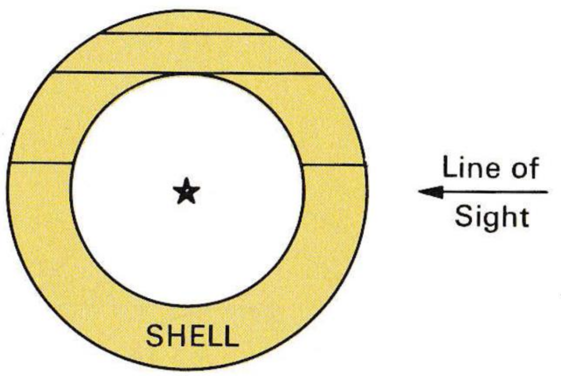
White dwarfs are not powered by fusion. They resist further gravitational collapse because of "electron degeneracy pressure." Their atoms are densely packed together in a plasma of nuclei and electrons. Since the Pauli Exclusion Principle requires that no two half-integer spin particles such as electrons occupy the same state, further contraction is resisted on a quantum-mechanical rather than thermal basis as in regular stars. White dwarfs emit some thermal radiation, decreasing over time as they cool, but not the ultraviolet wavelengths necessary to power the ionization of a planetary shell. The planetary nebula will ultimately cease to be visible. As a result, planetaries are relatively short-lived, their lifetimes measured in only tens of thousands of years, a micro-instant in astronomical terms. It is possible that some stars will emit new shells over time as they undergo repeated bursts of mass ejection on their way to the white dwarf stage, but the odds are good that astronomers of the far future will see completely different planetaries than the ones we observe today.



Cross section of a white dwarf

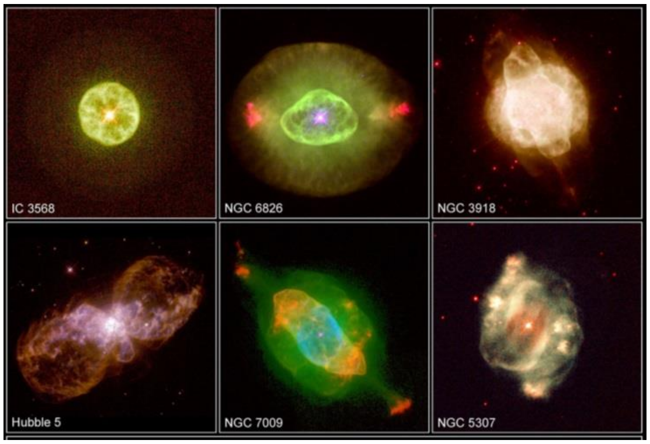
If the gas is a spherical shell, why is the Ring Nebula a ring? The answer has to do with our line of sight through the object. We are looking through more gas along the edges of the shell than through the middle. Medical students learn about this when they study the anatomy of the cervical spine. The first cervical vertebra is a ring, called the "Atlas" because it holds up the skull. When it is x-rayed, it appears as two separated bones because the x-ray beam encounters more mass along the front and back edges on a lateral image or left and right sides on an anterior-posterior image, and we don't see the middle part of the ring in either projection. Were it a sphere, it would look like the Ring Nebula on an x-ray, but of course it wouldn't be able to function properly in that case, and your head would fall off!

M57, Ring Nebula, 105mm refractor and Mallincam, 14 seconds, from Springfield, Vermont. (LF)



Why the sphere-shaped Ring looks like a ring, or the ring-shaped Atlas looks like 2 separated bones.

New planetary nebulas are being found all the time as deeper and deeper telescopic surveys are done with large instruments, sensitive detectors and automated detection software. In 2014, the IPHAS Hα survey, using the 2.54-meter Isaac Newton Telescope on La Palma in the Canary Islands, found 159 new ones in the northern galactic plane. A complimentary southern survey is underway. Over 750 planetaries have been detected in the Andromeda galaxy (M31), and at least 715 have been detected in the Large Magellanic Cloud. They have also been detected in more distant galaxies, including M81 (Bode's Nebula in Ursa Major), NGC6822 (Barnard's Galaxy in Sagittarius) and NGC4651 (the Umbrella Galaxy in Coma Berenices.) In NGC4651, at least 10 planetaries of the 32 found in that object are in a stream tracing a disrupted dwarf galaxy that recently passed through NGC4651's disk.

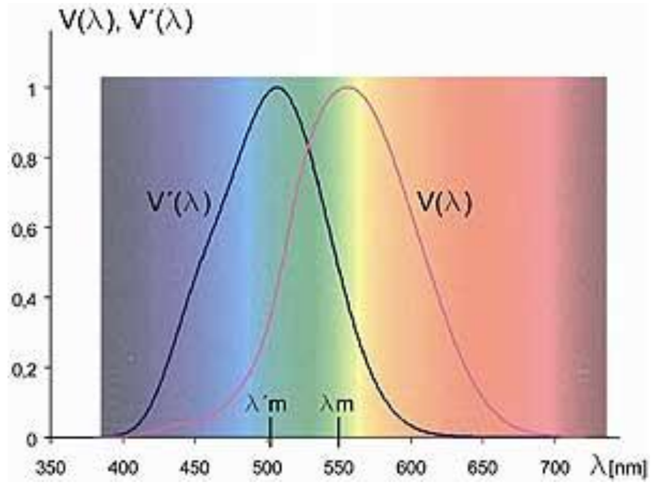


Hubble images of some planetary nebulas

Our appreciation of planetary nebulas has been enhanced by a series of remarkable Hubble Space Telescope images, revealing them to be among the most beautiful and surprising objects in the cosmos. These views confirm that a central star powers a shell of surrounding gas with ultraviolet radiation, but we are challenged to find explanations for each object's complex and seemingly unique structure.

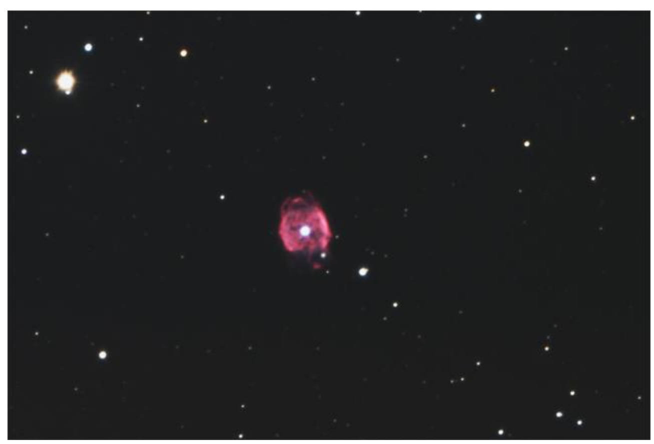
The shape of a planetary nebula is influenced by the local stellar environment and details of the central star's composition. A star's mass, thermal behavior, magnetic environment and perhaps acoustic currents in its outer layers may alter the symmetry and intensity of mass ejection in the red giant phase. Hydrodynamics in the stellar atmosphere no doubt influence the shape and evolution of the expanding gas cloud. A major factor is the interaction of the star's wind of ejected charged particles with the existing cloud itself. Many stars, if not most, are binary, so the non-senescent component of the pair can influence the distribution of ejected gas through gravity, stellar wind, local dust, and its own radiation at energetic wavelengths. The ejected gas interacts with the local interstellar medium that has its own magnetic, hydrodynamic and radiation properties.

All of this churning makes for a vast variety of unexpected structures. Fortunately for us visual astronomers, the dark-adapted human eye (scotopic vision) is most sensitive to light at 500 nanometers, exactly the wavelength of OIII. With the use of averted vision, with or without a filter, many of the Messier and Caldwell planetaries are observable even in 100 mm (4") telescopes from Ward Pound on a good night. A few of them are worth highlighting and should be must-sees on your observing list.



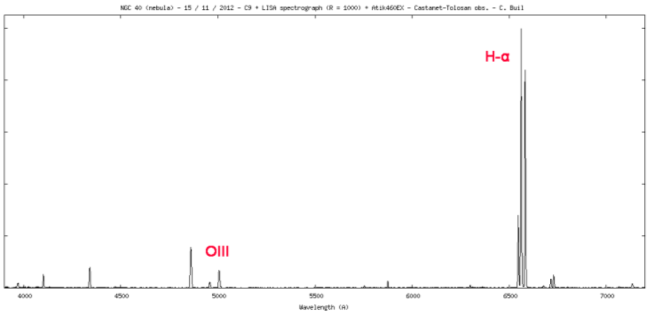
Spectral sensitivity of the human eye under photopic (daylight, V(λ)) and scotopic (dark-adapted, V'(λ)) conditions

The Bow-Tie in Cepheus (Caldwell 2) is well-placed for observing in the autumn. It was first glimpsed by Herschel in 1787. About 3,500 light-years distant, it's estimated to be one light-year across. In an eyepiece it's about the size of Jupiter. In perhaps 30,000 years it will disappear as its central star becomes a white dwarf and ceases to release sufficient energy to excite the shell's atoms.



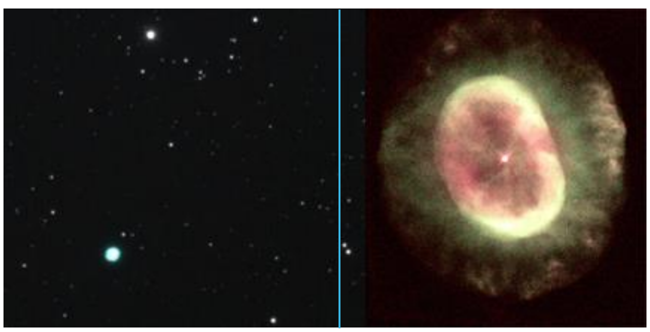
Bow-Tie Nebula (Caldwell 2, NGC 40) (Chabot Space)

The Bow-Tie appears redder on images than many other planetaries. Its spectrum is dominated by hydrogen-alpha emission, quite different from the Cat's Eye spectrum displayed earlier. The central star in the Bow-Tie is a Wolf-Rayet star, more massive and hotter than the central star in many other planetaries, with very active atmospheric winds. But it too will collapse into a white dwarf and end the show.

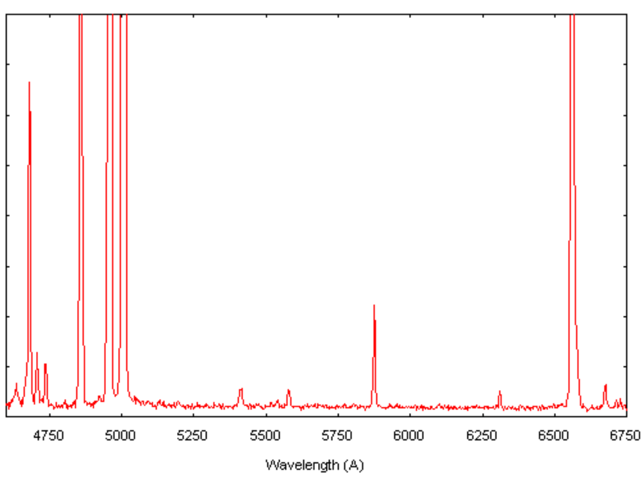


Spectrum of the Bow-Tie Nebula

Caldwell 22, the Blue Snowball, is another Jupiter-sized fall and winter planetary. Its spectrum is rich in emissions in the 500 nanometer range, even though it still shows a good bit of hydrogen alpha signal. The central star has a surface temperature of 75,000° K, which makes it quite easy to see even in a small telescope.



Blue Snowball, (C22, NGC 7662) (L) C8 (Celestron Images), (R) Hubble

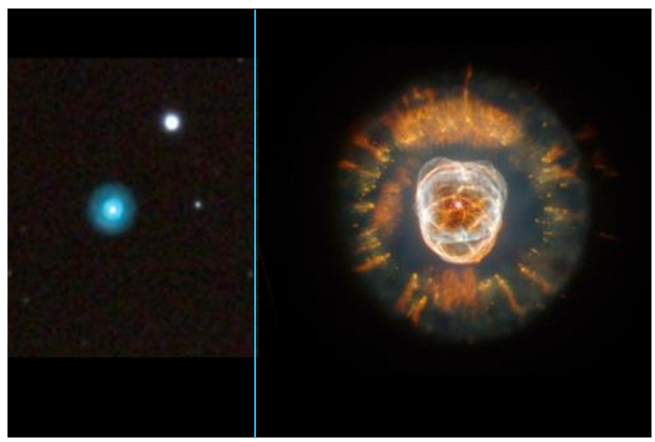


Spectrum of the Blue Snowball

Like the Ring, Dumbbell and Owl when captured on a CCD, the Skull Nebula, NGC 246 (Caldwell 56) shows a mixture of red hydrogen emission and blue oxygen emission, reflecting variances in the chemical distribution and mass densities within the shell.

NGC 246 (Caldwell 56). 12.5” RC (Bob Franke)

The Eskimo Nebula, NGC 2392 (Caldwell 39) can show internal structure on a clear night for visual observers. The Hubble image, in false color, is truly spectacular. It was the first image taken by the space telescope after the 1999 repair mission.



Eskimo Nebula, NGC 2392. (L) 8” SCT, DSLR (Manuel Castillo), (R) Hubble

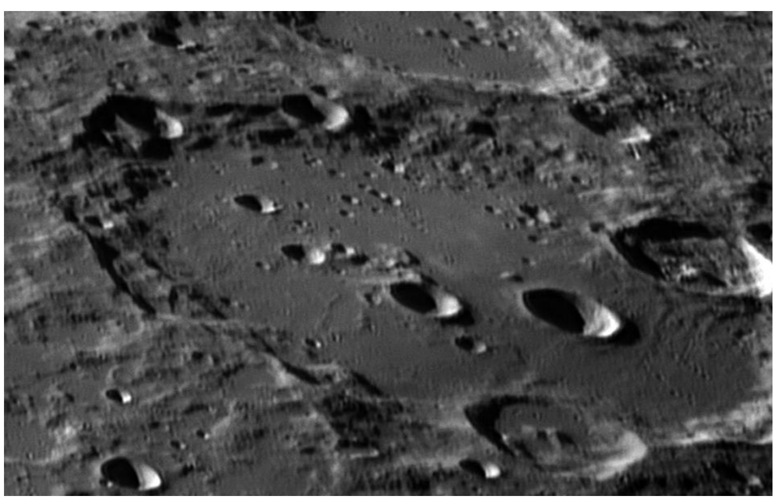
Planetary nebulas are much easier to see than galaxies of equivalent magnitude because of their high surface brightness. They survive light pollution reasonably well, and they can be nicely enhanced by filters. Averted vision is always a useful technique for any deep sky object, filter or no. Planetaries are testimony to the dynamic and dramatic nature of stellar evolution. The transformation of an aging star accelerates rapidly as it nears the end of its capability to sustain fusion. In terms of cosmological time, planetaries are exceedingly transient, really just the blink of a celestial eye (which some of them even resemble.) It’s well worth your while tracking the brighter ones down, and of course it’s a piece of cake with a go-to telescope.

Photos

Venus will be brilliant in the morning sky throughout October. It will transition from a crescent to a gibbous phase, shrinking in size slightly, remaining brilliant at -4.5 magnitude and dropping imperceptibly to magnitude -4.4 at the end of the month.

This image was taken at 6:15 am during nautical twilight (sunrise was at 6:38 am) on September 19th from Larchmont with an Orion 127 Maksutov on an iOptron Minitower. The camera was a Celestron NexImage 5. Best 280 of 2800 frames processed with AutoStakkert!2 and tweaked with Photoshop Elements.

- - Larry Faltz



John Paladini took this image of Clavius crater through a 9.25 SCT. At approximately 4 billion years old, Clavius is one of the most ancient formations on the Moon. The crater is about 225km in diameter.