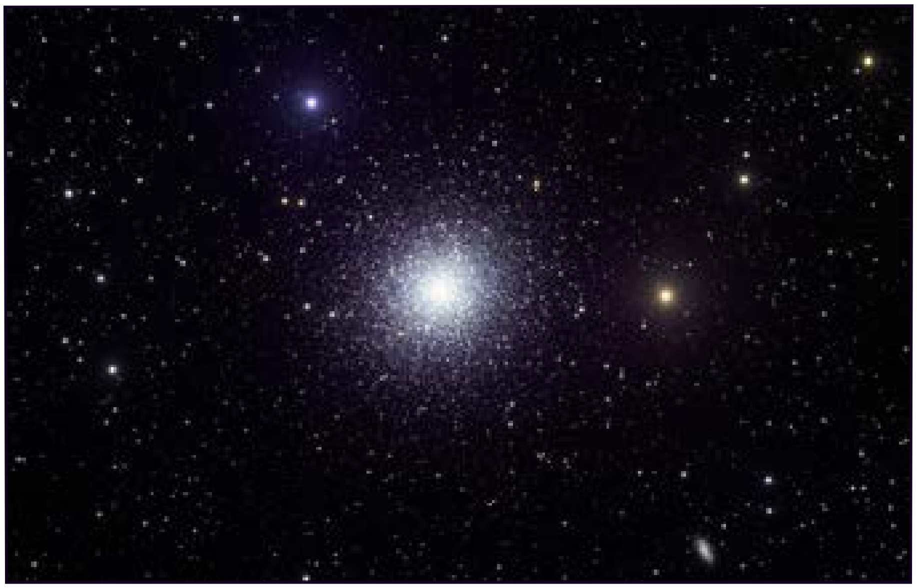
VOLUME 33 ISSUE 6

JUNE 2019

THE OBSERVER



M13: A Great Globular Cluster of Stars - APOD June 17, 2009
Credit and Copyright - Danny Lee Russel

UPCOMING EVENTS:

EVAC Star Party - June 1

EVAC Public Star Party - June14

EVAC Meeting - June 21

EVAC Star Party - June 29

Check out all of the upcoming club events in the Calendars on page 14.

INSIDE THIS ISSUE:

From the Desk of the President

by Tom Mozdzen

We have a couple of behind-the-scenes activities progressing nicely. The first is the redesign of the EVAC website. We have seen some early versions of it and it is looking very nice. Another four to eight weeks of testing and tweaking should do the trick.

Ken Milward is our new Outreach and Events Director. He is putting together some initial ideas for an EVAC sponsored trip to either the Lowell Observatory, Kitt Peak, or the Mirror Lab. Please contact Ken if you have a strong preference. More details to be shared in the coming weeks.

The EVAC clothing event was a great success. About fifty hats and fifty shirts were purchased at cost by EVAC members. We still have a couple of items available, but we are virtually sold out at this point. We will test the demand later in the Fall or perhaps in the Spring of next year. Many thanks to David Douglass for spearheading this effort!

Membership is healthy, and the club is not facing any major issues. A topic that has percolated to the surface is observing sites. While we currently recommend PicketPost

From the Desk of the President

Continued from page 1

Trailhead, we would like to find an even darker site that is not too far away. We may begin ramping up this search in the coming months.

As always, volunteering for any of our club outreach events is very much appreciated. Contact Claude Haynes or Ken Milward if you'd like more information on how to get involved.

See you at the June meeting

Tom Mozdzen

EVAC General Meeting Notes for May 2019

by Tom Polakis

The meeting opened at 7:40 p.m. with President Tom Mozdzen introducing the officers and Board, and welcoming visitors. Claude Haynes was up next, giving a pitch for volunteers to work at the Gilbert Rotary Centennial Observatory on Fridays and Saturdays. He also summarized recent efforts by the billboard industry to change the Maricopa County lighting ordinances to allow for larger, brighter, and more dense signs. He and Tom Mozdzen attended meetings with the Planning and Development Department. Tom will send out documentation to the Club. Claude encouraged members to comment on how these changes impact light pollution.

After years of great service as the Events Coordinator, Lynn Young has been forced to step down due to health issues. EVAC is fortunate that Ken Milward has volunteered to move into this important position.

There were two member presentations. Woody Sims spoke about his spectroscopic measurements of the quasar 3C273. He showed the greatly shifted spectral lines of Oxygen III and Hydrogen Beta, and how the redshift, z, is calculated. Then he went on to show how z can be used to compute recessional velocity, and ultimately, distance. His measurements of the redshift are very closely in line with published values. Caden Markley was up next. Caden is 11 years old, and as such, now holds the record for youngest member and presenter at an EVAC meeting, eclipsing Frank Kraljic's record set in the 1980's. He spoke about a star party that he organized for his 5th grade class at Eduprize School.

The main speaker was Chad Trujillo from Northern Arizona University. His topic was "Search for a Giant Planet in the Solar System." Chad is experienced in these types of searches, having discovered the large and very distant planet Sedna with two colleagues. Dynamical simulations of the Solar System have been run to show the evolution of orbits, and their impact on the Kuiper Belt. The current arrangement of planets and asteroids indicates that there could be a very distant and large planet in the outer reaches of the Solar System. Using large-array cameras on the 4-meter Blanco Telescope at Cerro Tololo and the Subaru Telescope on Mauna Kea, they have set out to survey targeted locations for such a planet, which willlikely be fainter than 25th magnitude. At the end of his talk, Chad noted that the presence of both Neptune and Pluto were predicted before their discovery.

NEW MOON ON JUNE 3 AT 06:02

FIRST QUARTER MOON ON JUNE 10 AT 01:59

FULL MOON ON JUNE 17 AT 04:31

LAST QUARTER MOON ON JUNE 25 AT 05:46

The Backyard Astronomer

by Bill Dellinges (June 2019)

Summer's Deep Sky Cornicopia

Let's review this summer's plethora of celestial delights. We'll start with the most remote – **Galaxies: M51**, the Whirlpool Galaxy in Canes Venatici. This is a face on spiral galaxy 26 million light years (LY) away. In a dark sky its spiral arms can be detected in an 8-inch telescope. **M81/82** in Ursa Major. The two galaxies are only 12 million (LY) away and are a sweet sight together if you can manage a telescopic field slightly larger than a half degree. Each one shows interesting detail at higher power. **M104**, the Sombrero Galaxy in Virgo. This edge-on galaxy 30 million LY away is noted for its prominent bisecting dark lane.

Open Star Clusters: Thousands of these clusters are found in the plane of the Milky Way and are made up of primarily young stars. **M7** in Scorpius is one of the finest open clusters in the night sky. It's visible to the naked eye as a distinct bright patch of Milky Way just east of the Scorpion's Stinger. The cluster is rather large with a diameter of just over one degree. A stunning view of M7 can be had in the four-degree field of a 15x70 binocular. **NGC 6231** in Scorpius is just a hop and skip southeast of M7. This cluster is overlooked by many northern latitude gazers due to its southernly position. If you have a clear southern horizon you won't be disappointed in this little jewel box. Its southern location and long pass through our atmosphere cause its multi-colored stars to sparkle unlike its northernly cousins. A degree or so to its northeast is another cluster, **Trumpler 24**. Together they form what appears to be a comet when viewed at low power or in binoculars, and is sometimes called the "False Comet." **M11** in Scutum: The Wild Duck Cluster is an old favorite of stargazers. The two stars forming Aquila the Eagle's tail point right at it. It's a fine small, dainty cluster. It won't blow your socks off like M7 but maintains a quiet dignity of its own.

Globular Star Clusters: About 150 known globular star clusters form a halo around our galaxy and are comprised of older stars. Whereas open clusters may contain 100 to 1000 stars, globulars can run up to a million or more stars. **M13** in Hercules is generally considered the best globular in the northern skies. Hard to argue with that. But **M22** in Sagittarius is no slouch either. They're both outstanding examples of their species. Slightly less impressive but still worth a look are **M3** (Canes Venatici), **M4** (Scorpius), **M5** (Serpens Caput) and **M15** (Pegasus). Globulars are best observed at midrange powers of 100x to 200x.

Planetary Nebulae: M27, the Dumbbell Nebula in Vulpecula the Fox is the brightest and most impressive of the planetary nebulae; even a modest telescope will show it well. **M57** in Lyra is always a thrill. It's probably the best "donut" shaped planetary out there. **NGC 6543** in Draco and **NGC 6826** in Cygnus are known for their visible central stars which are white dwarfs (or on their way to being one). White dwarfs are collapsed stellar cores of medium sized stars like our Sun. Nuclear reactions have ceased in white dwarfs but their cores still radiate energy from compression alone. Their hot 20,000K – 100,000K surface temperatures emit ultraviolet radiation causing the expanding nebula to fluoresce. They're called white dwarfs because they're white hot but relatively small, about the size of Earth. They'll eventually cool off to a solid chunk of carbon and oxygen (definitely a navigational hazard) but astronomers tell us the universe isn't old enough for any white dwarf to have reached that point yet – an amazing statement, no?

Emission Nebulae: Bright impressive ones are surprisingly rare. Although interstellar gas (mostly hydrogen) is abundant in ye old lumbering Milky Way, it takes stars in or near the gas to stimulate the gas to emit light. Two of the best on display during summer both reside in Sagittarius, **M8**, the Lagoon Nebula and **M17**, the Swan Nebula.

Double Stars: Over 50% of stars in our galaxy are comprised of two or more members in orbit around a common center of gravity. It can be interesting to observe the different colors and separation of the stars. Here are a few of summer's more interesting pairs. Listed are their name, abbreviated constellation if applicable, separation in arc seconds and SAO (Smithsonian Astrophysical Observatory) number to assist in finding them: **Mizar**, U. Maj., 14.4", SAO 28737. **Gamma Delphini**, 9.4", SAO106475. **Rho Ophiuchi**, quadruple, SAO 184381. **Epsilon Lyrae**, quadruple (The Double-Double), SAO67310. **Kuma**, Dra, 62", SAO 30477. **Albireo**, Cyg, 34", SAO 87301 (Recent data shows Albireo may not be a true binary pair. But it's still darn pretty). You will now be ready for the perennial question, "What did you do on your summer vacation?"

White Dwarf Cooling

by Henry DeJonge IV (June 2019)

Introduction

White dwarfs are the remnants of dead low mass stars that have exhausted their hydrogen fuel and have compacted via gravity into planet sized objects mainly composed up of carbon and oxygen nuclei, with some smaller amounts of other elements. They are prevented from total collapse by electron degeneracy pressure and have surface temperatures ranging from usually around 3,000 degrees K to over 80,000 degrees K. Therefore, they are usually very bright and hot, but yet very small.

It has always been a bit perplexing to me exactly how they cool down as their temperature, lifetime, and stability are basically derived from quantum mechanical principles and not from a classical physics approach. Their lifetimes are thought to be extremely long, on the order of the present age of the Universe, which is much longer than any regular small body of that size and heat content situated in the vacuum of space. We will not go into other details about white dwarfs but focus on their cooling aspects. For an overview of white dwarfs in general please see my 2 EVAC papers from July and August 2010.

White Dwarfs and Quantum Mechanics

A white dwarf, (WD) is an approximately solar mass "dead" star interior that is roughly the size of Earth. It results from the star ceasing to fuse elements and generating an interior pressure to balance the continual gravitational collapse of the stars mass. The star therefore begins to shrink in size as gravity plays the dominant role. There are quite a few different types of WD which by itself is fascinating, but it is believed they all share similar cooling mechanisms.

WD come in a mass distribution that peaks in the mid solar mass range. They can be approximately about 0.15 solar masses to just below the Chandrasekhar limit at 1.44 solar masses. This makes them about 0.8% the radius of the sun to about 2% the radius of the sun, (the Earth is about 0.9% the radius of the sun for comparison).

It is now understood that WD are prevented from total collapse by a quantum mechanical process called electron degeneracy pressure that comes into play at the extremely high densities and pressures experienced in such a compact mass. It actually occurs in regular stars to a very slight degree but is of little consequence due to their relatively lighter densities.

For about a hundred years it has been known via classical physics that WD are very small and extraordinarily compact, yet extremely hot on the surface. Astronomers had a hard time understanding how such a star, (they were called WD stars before anyone knew they were actually the remains of dead stars) could exist. It was not until quantum mechanics, (QM) rose to the forefront that a better understanding of how they could exist was established, as it also became clear that they were not actually stars in the traditional sense, (fusing H in the core). In a WD interior quantum mechanics rules!

The Heisenberg uncertainty principle established in 1927, states that it is impossible to determine simultaneously and with any great precision, both the position and momentum of a quantum particle. The product of the uncertainty in the measurement of the position and the uncertainty in the momentum always exceeds Planck's constant divided by 2π. As the electrons are compressed in the WD interior their position becomes better defined, (smaller) which causes their momentum to increase.

The Pauli exclusion principle established in 1925, says that no 2 electrons, (or fermions) can occupy states in the same volume with exactly the same quantum numbers. This volume is determined by the de Broglie wavelength of the electron, which is Planck's constant divided by the momentum. In the incredibly dense WD interior, the de Broglie wavelength becomes smaller as the electron momentum increases, so that the electrons move ever faster. The electrons move rapidly around the WD interior trying to find a "vacant" state to reside in.

As an example of these consequences we look at the WD Sirius B, (about 1 solar mass). Here we find that the mean density is 2.4 million grams per cubic cm. That is roughly saying that an H atom is compressed to about 5% of its original volume! Obviously, there are no electrons bound in the usual sense to an atomic nucleus so that the atoms are fully ionized by the tremendous pressure and the electrons move about freely like in a metal.

White Dwarf Cooling

Continued from page 4

Due to the uncertainty principle, if an electron is confined to an extremely small volume then its momentum must be extremely high. So much so, that their velocity can be close to the speed of light! This also means that we must use special relativity to understand WD.

From the exclusion principle, what this means is that when the quantum states with the lowest momentum, (quantum numbers representing the momentum in 3 axis) are filled, then the remaining electrons must occupy the next level of larger allowable momentum, etc. until all the electrons are accounted for. This means that they are in different energy states and temperatures, (as defined by the average KE of the particles). The highest-level state that is filled is called the Fermi energy, (energy dividing the occupied states from the vacant states) of the distribution. This type of quantum distribution of electrons, (from the lowest band to the highest band of electron states) is called "degenerate". The electrons in a WD then completely fill up all the lower energy levels possible and are constantly seeking the lowest energy level. As a consequence, the pressure of a completely degenerate gas is independent of its temperature. This then removes the relationship between the mechanical structure of a WD from its thermal properties.

In this type of situation where the electrons are moving close to the speed of light, their KE is much greater than any electrostatic interactions. This "degenerate electron pressure" resists the crushing force of gravity. Interestingly when doing the modeling, these effects allow the temperature of this interior WD matter to be considered zero, since the relativistic velocities of the electrons are so much higher than any ordinary thermal electron velocity. However, the velocity of the electrons cannot exceed the speed of light, (as cannot the information passed from electron to electron).

Using these ideas Chandrasekhar calculated the maximum mass that a WD can have before gravity overcomes the pressure support, and it's approximately 1.4 solar masses, (Chandrasekhar limit). The more massive the WD, the more electron degeneracy pressure is created and the smaller in size the WD becomes as it is compressed, (the mass-volume relationship). Therefore, the WD density is the dominant factor in creating this gravitational counter pressure.

Obviously WD do not have a temperature of zero, and if their surfaces are tens of thousands of degrees then their interiors must be much hotter. It turns out that this degenerate matter has an extremely high thermal and electrical conductivity. Their interior density is on the order of 1,000,000 grams per cubic centimeter. This metallic, degenerate, interior of a WD can have a very uniform temperature of over 10 million degrees which is very hot, although not hot enough to fuse He or have a nuclear reaction sustainable core.

Inside a WD the electron conduction is by far the dominant from of energy transport due to the high density and pressure. As one approaches the surface of the WD the density decreases and radiative transfer of energy becomes dominant. This forms a "degeneracy boundary" on the surface of the WD. This boundary is where the thermal energy equals the Fermi energy, is relatively thin, and acts as an insulating blanket, usually only a few percent of the radius of the star.

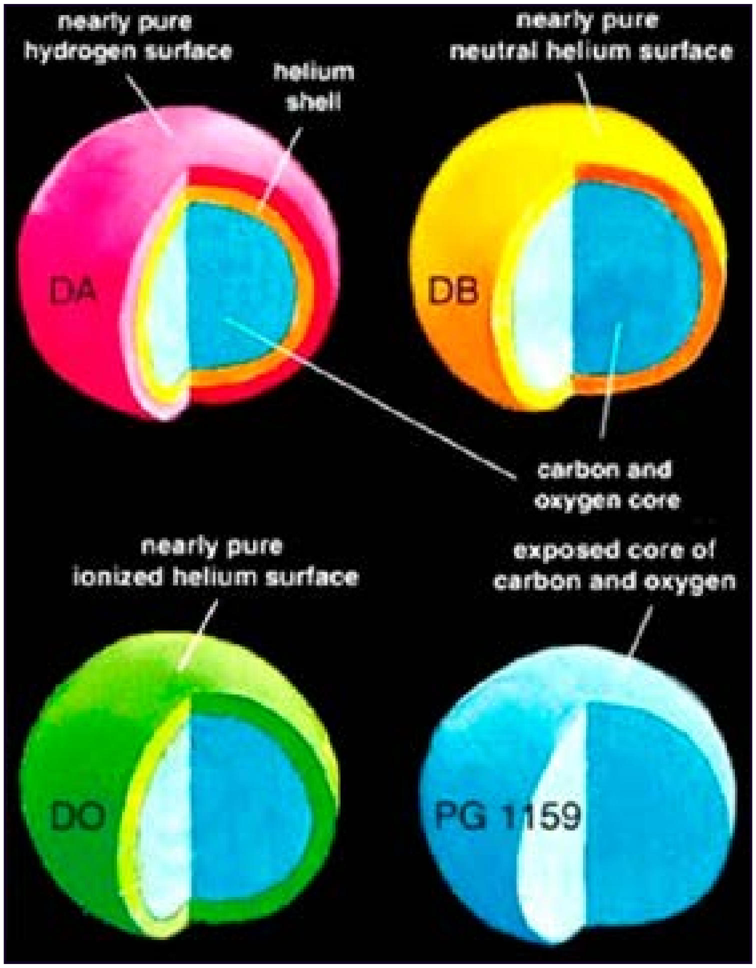


Figure 1. Some of the types of WD

White Dwarf Cooling

Continued from page 5

WD Cooling

Primarily the heat of a non-accreting WD comes from latent heat in the shielded interior which is gradually lost over a long period of time. WD cool by a few different mechanisms, some of which are dependent upon the evolutionary stage of the WD. Remember that a WD also has a considerably smaller surface area than any regular star, (planet sized) which helps limit heat loss.

All compacting bodies release energy thru gravitational contraction and so do WD, especially during the early stages and end stages of their evolution. This energy loss may be continual, but does not play a major role in WD cooling. As the WD initially forms, the heavier nuclei move towards the center of the WD while the lighter nuclei move towards the surface and form the outer layer. This may result in some residual burning in the thin outer shell of the WD via H or He burning or other fusing processes, however this too is fairly insignificant.

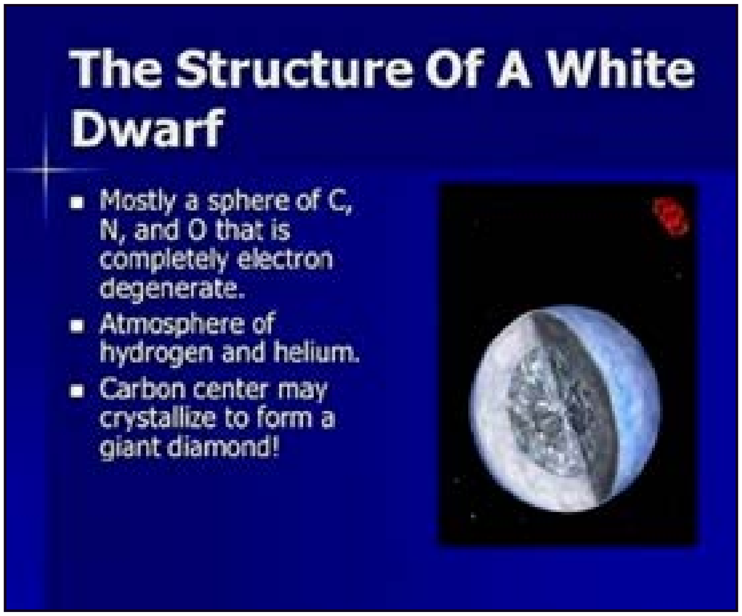
There does seem to be a direct correlation with the core temperature and the luminosity of the WD.
Overall the WD cools increasingly slowly as the core temperature falls. This is also roughly dependent on the initial mass of the WD, with lower mass WD cooling faster due to their larger size, (less gravitational contraction). Thus, it takes a very long time for WD to cool. This also has some observational consequences since for a given magnitude interval there are far more WD at lower luminosities.

The main cooling mechanisms in WD are loss of neutrinos, thermal energy, and latent heat from crystallization.

The process of releasing heat via neutrinos in WD is called the Urca process. In WD this is due to an electron absorbed by the nucleus of an ion and then convectively carried upwards from the degenerate core where beta decay ensues. This results in the release of an electron or a muon and a neutrino, (or anti-neutrino). The neutrino almost always easily escapes from the WD while the nucleus is transported back down into the interior of the WD for the process to begin anew. The WD also loses neutrinos via nuclear reactions and radioactive decay, particularly in its early evolutionary stages.

In thermal heat loss the heat is conducted thru the dense interior and then transported via radiation and convection thru the outer envelope. The properties of this "insulating" envelope play a critical role in determining how efficient this process will be and evolves as the WD ages. The heat diffusion is largely dependent upon the opacity of the envelope; however, we know very little of the exact chemical makeup and structure of this outer envelope. For example, it makes a big difference if it is primarily H or He. This is the most complex factor in the cooling process and plays a major role in determine the lifetime of a WD, (despite the outer layer being so relatively thin!).

In the interior the WD has a very low opacity, that is it is poor conductor of heat, (energy) via radiation transport, since the absorption of a photon would move the electron to a higher energy state that may not be available. The degenerate electrons can move long distances before losing energy in a collision with a nucleus since most of the lower energy states are already occupied by other electrons. This dominating electron conduction process carries energy for long periods in the WD making it very nearly isothermal and maintaining the temperature for a long period of time. The electrons cannot find a home. As a result, the interior has a high thermal conductivity and maintains its relatively uniform temperature of millions, (up to tens of millions) of degrees, for a considerable period, (hundreds of millions to billions of years).



The Structure Of A White Dwarf

- Mostly a sphere of C, N, and O that is completely electron degenerate.
- Atmosphere of hydrogen and helium.
- Carbon center may crystallize to form a giant diamond!

Figure 2. Likely rough structure of a common WD

White Dwarf Cooling

Continued from page 6

As a WD cools it is predicted that the core will start to crystalize, (becomes more like a lattice) and this begins in the center and moves outwards. This occurs when the WD interior "cools", (like water forming ice) to about 10,000,000 degrees. The latent heat released from this crystallization then accelerates the WD cooling. This is due to the gradual loss of the thermal KE and so the interior begins to shrink some more while minimizing the electrostatic interaction energy.

This predicted cooling phase and the subsequent WD cooling acceleration has been observed and analyzed in the recent Gaia data, (2019) which seems to indicate that the models of crystallization are correct. This release of latent heat slows down the WD evolution and is calculated to become very dominant when crystallization is about 80% of the WD interior. More massive WD cool down more rapidly and reach the crystallizing temperature more quickly. This may happen in only a few billion years or less, while smaller WD can take as long a 6 billion years to reach this temperature.

Even though we now believe we have data to support these crystallization models, this process which usually lasts for billions of years, slows down the WD evolution and may even temporarily cause their dimming to cease and make them appear younger than they really are. In other words, it can be very difficult to determine their true age during this period. This gradual contraction of the core as it loses heat also causes the outer envelope to contract which increases its contribution to the WD luminosity in these final stages and adds to the age confusion. In the future better crystallization models and data should help refine this dilemma.

When most of the WD interior becomes crystalized the heat loss speeds up even more. This coherent internal structure of the WD acts in unison to promote heat loss. This is called Debye cooling. This is the point where the specific heat of a classical solid that is independent of temperature, moves to that of the quantum phase where the specific heat goes down from that constant value with decreasing temperature. Therefore, the specific heat decreases quickly with cooling, which in turn rapidly depletes the thermal energy of the solid, and dramatically increases the cooling rate of the WD.

After crystallization has begun another process begins that complicates the cooling evolution. This is called convective coupling and occurs when the outer layer convection reaches deeper into the core of the WD than previously. This process is somewhat mass dependent so that for low mass WD it begins when crystallization starts and for more massive WD it begins long after crystallization has begun. This further accelerates the cooling process of the WD, thru the outer "insulation" layer, much more effectively than before.

Just to complicate thigs a bit further, theoretically it is now thought that there is a relationship with the magnetic field of a WD and its cooling rate, (or evolution) since a strong magnetic field will slow convection in the outer envelope and thus slow the energy exchange between it and the degenerate core. This relationship is still being investigated and may also be dependent upon the mass of the WD as well.

In the end as the WD slowly evolves into a black dwarf, (BD) and becomes a solid chunk of matter, its surface temperature will cool down to about 2,000 to 3,000 degrees. As such it may well last as long as the Universe, unless the nuclear particles themselves also have a finite lifetime, (proton decay?). The BD will most likely have a body-centered cubic lattice structure of carbon and oxygen like metallic sodium on Earth, (not a large engagement ring diamond). This is where we have always heard about BD being large diamonds in the sky!

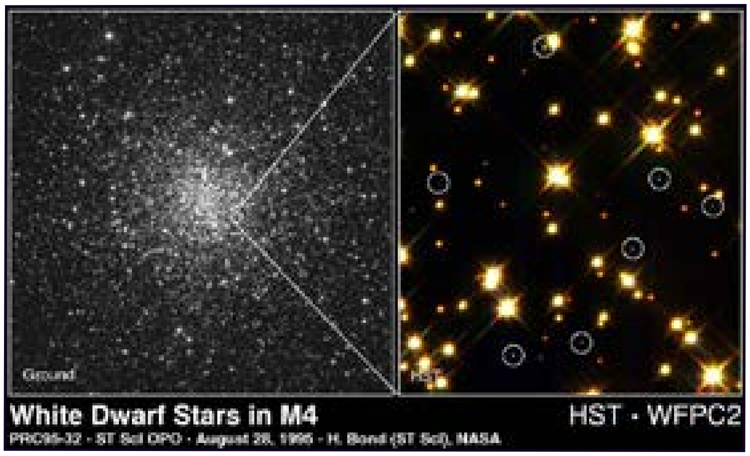


Figure 3. Some Observed WD

White Dwarf Cooling

Continued from page 7

A few observations

Since the 1800's we have collected observational data on thousands of WD ever since Sirius B was detected in the early 1860's with an 18.5-inch telescope. In the past few years we have observations and data on many more WD. The SDSS alone has observations of well over 30,000 WD. The Gaia mission currently has a potential WD set of over 250,000 and is expected to catalog over 400,000 well defined WD when it is completed, at distances out to over 100 pc. This data has also allowed us to determine their exact distances and thus their intrinsic brightness, (which is related to their age). WD modeling has also benefited from observations, since as we saw before in recent Gaia observational data, (which includes distance, spectra, brightness, and color), evidence was gathered that indicates the signature stage of WD crystallization in certain types of WD populations.

The luminosity of a WD decreases fairly rapidly in its early lifetime then slows down for a very long period before it finally cools to become a black dwarf, (BD), a dead solid sphere. Their spectra will also begin to redden as it ages. It makes sense therefore to look for WD during these intermediate stages as they will be most numerous at this time, and this is what we detect. It has long been thought that there is very low number to no WD that have cooled to their lowest temperature in the Universe, since there has not been enough time for a BD to have formed. It is estimated it could take about 8-10 billion years for a BD to form from a WD.

In other observations, using WD modeling and the associated cooling curves, astronomers often use WD as an age indicator for clusters and galaxies. Our Milky Way is thought to contain at least a few tens of billions of WD. It is believed that there may exist many BD in our galaxy but they have yet to be directly detected.

Figure 4. Comparison of Sirius B and the Earth in size.

Conclusions

It is now a bit clearer to me how WD cool and why they take so long in doing so. Their cooling process is still very much theoretical.

WD are a common end fate for most stars, especially in the "modern era" we are in now. It is estimated that over 95% of the stars in our galaxy will become WD, and we are still just learning about them. They are used for calculating astronomical ages, distances, and discovering DE via Type I SN. A star similar to our sun will burn for about 10 billion years as a star, then form a WD that may last for another 8-10 billion years before cooling down to a BD. Easily longer than the present age of our Universe. We believe our sun will take such a path in another 4-5 billion years, with another 3-5 billion years just to reach the crystallization temperature.

It then is easy to see how if we take into account the billions of years that the WD progenitor lives and then the billions of years that the WD takes to cool down significantly, we can see how there would be relatively few, (if any) BD currently existing in our Universe.

Many questions remain such as when a WD cools and crystalizes, what happens to the various elements in the interior and how do these later cooling processes affect the internal structure of the WD. In turn how does this structure and composition affect the crystallization and cooling?

Since there are many types of WD with both different internal compositions and envelope compositions, the actual modeling becomes very complicated and is far from being complete. There are also many things that can happen to a WD after its formation with the interstellar environment that we have yet to consider, like accretion and mergers. We are just beginning to understand these interesting and enigmatic stellar remains.

Now I realize that after billions of years as a star, a WD forms and can also easily last for billions of years as it cools down via many different, interlinked, and complex mechanisms. Then after all this it will probably remain for many billions of years to come, as a relatively cool, dark remnant, of its former glory.

Find Out What's Happening – Join EVAC-Announce List

If you would like to receive email announcements about EVAC meetings and activities, please join the EVAC–Announce mailing list. Click on the link below to subscribe. Enter your full email address in the box titled User Options and press OK. You will receive a confirmation email. Your privacy is respected by EVAC and we will never sell your email address, or use it for non-club relevant solicitations. This mailing list is designed for communication from EVAC, and does not enable users to respond to the message. If you wish to contact club officers, please use the list on the Contact-Us tab. To subscribe to the EVAC–Announce mail group click: http://www.freelists.org/list/evac-announce. To unsubscribe use the same link, enter your email address and select Unsubscribe from the "Choose An Action" list. Another list that may be of interest is AZ-Observering. To subcribe click http://www.freelists.org/list/az-observing.

EVAC also has a Facebook Group where members may share ideas, photos, and Astronomy related information. To join: EVAC Facebook Group.

The Gilbert Rotary Centennial Observatory (GRCO) also has a Facebook Group where members may share ideas, photos, and Astronomy related information. To visit, please click on Gilbert Rotary Centennial Observatory - GRCO.

Looking for that perfect weekend activity?

Why not resolve to getting involved?

Contact Claude Haynes to join the staff at GRCO

Email: grco@evaconline.org

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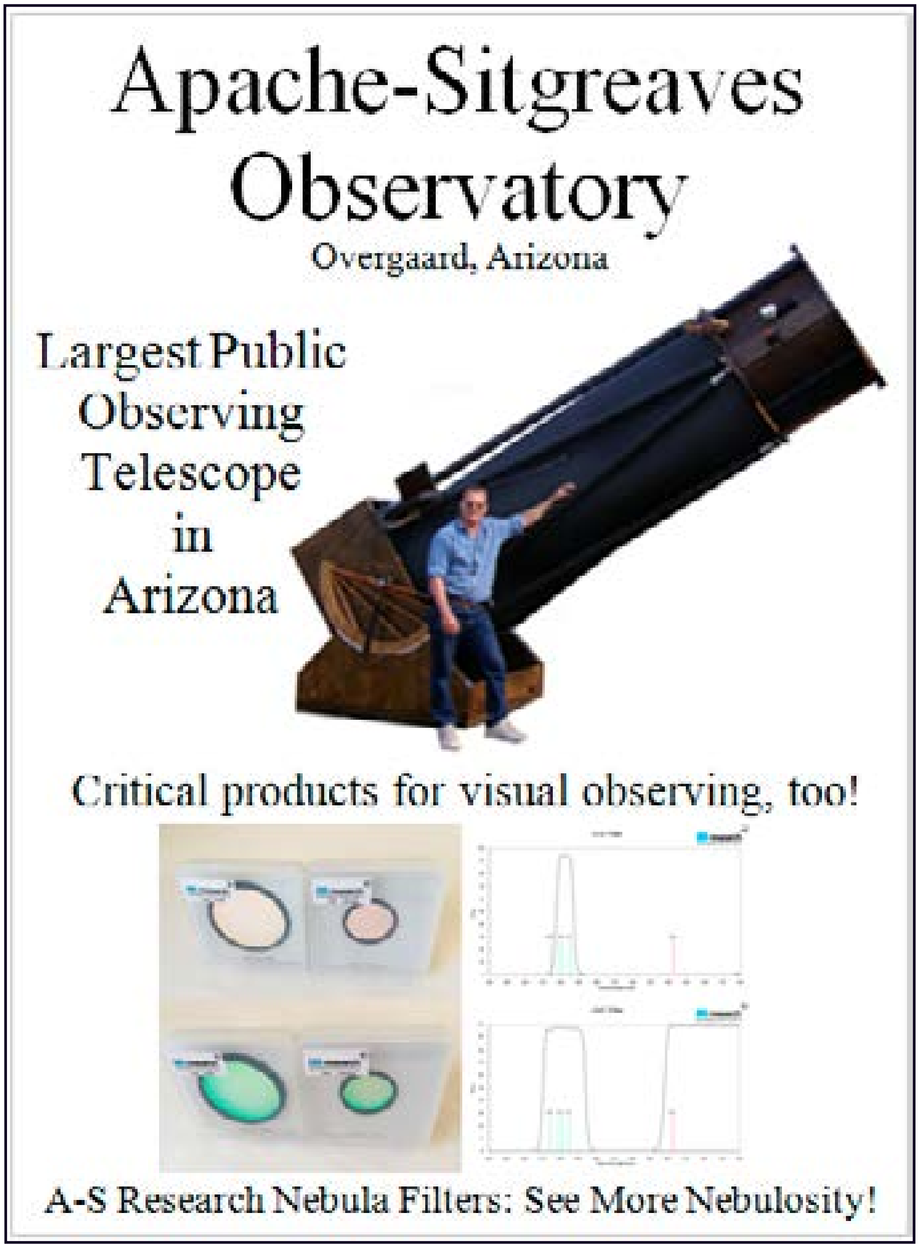

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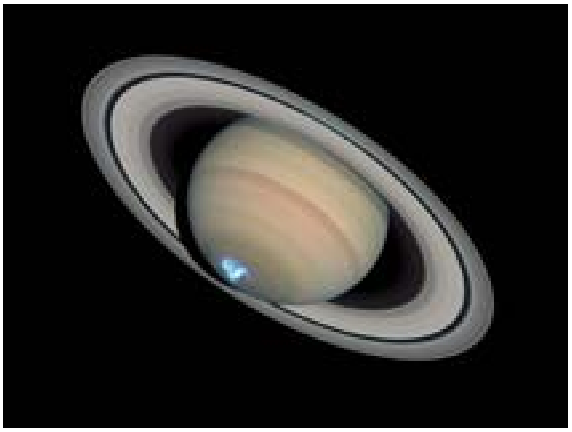


For Sale

Starter Telescope kit with Upgrades

Orion 90 mm mak cas w tabletop base
Orion EQ-1 adjustable tripod mount + adapter
Sirius plossl 25 mm eye piece
Sirius plossl 10.0 mm eye piece
EZ finder II
Finder scope 6x30
90 deg Star diagonal
Correct image diagonal

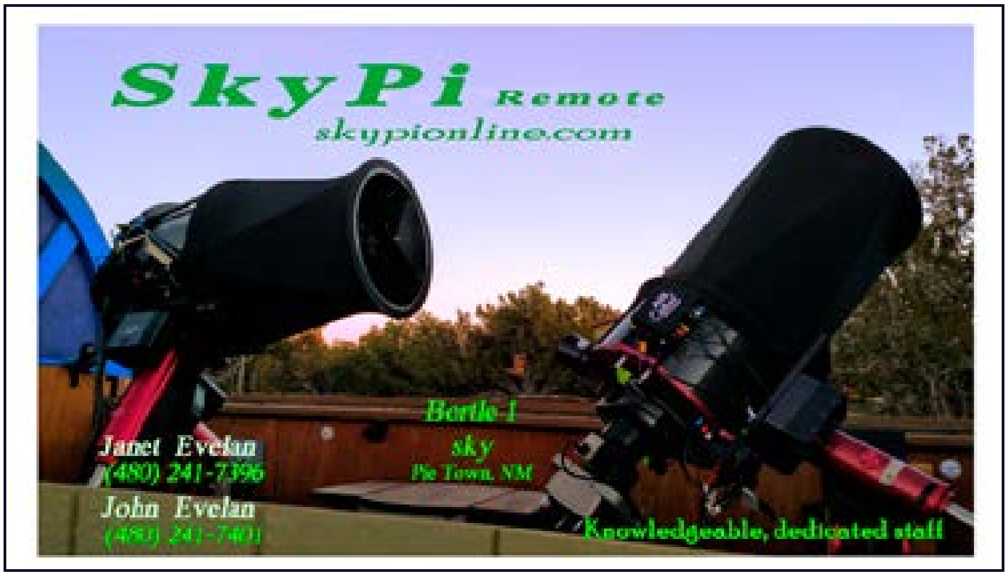
Perfect, light weight telescope for home, traveling, kids, or adults. Comes with 2 mounts, tabletop and tripod w/ equatorial mount. It has 2 eyepieces, and 2 finder scopes, 2 diagonals: star and correct image.

This was purchased in the Fall of 2015 by an EVAC member and sold it to me 2 years later. It is in perfect condition. I added a carrying case to hold the scope and eye pieces. Over the past three years I have had many health issues with lengthy hospital stays. This has reduced my ability to use the telescope as often as I had wanted to.

For Sale Complete for $250

David Smith

Classified Ads



The darkest, most Pristine, sky in the continental U.S. !

At the site: Bathroom facilities, running water, 5 pads w110v, wifi, acres of grassy camp sites.

From the site: Very Large Array 42mi E, The Astronomical Lyceum 55mi E, MRO Observatory 80mi E

IC 405

Insight Observatory
16" ATEO 1 Telescope

[SkyPi Remote Observatory]

Club Sky-Watcher Star Adventurer Mini (Black)

I have too many toys and am selling my Star Adventurer Mini. It includes all components, Manual and box. It's fully functional and in 'Like New' condition. You can control the SAM from an Android or iOS device. Details can be found on the Sky-Watcher website below. Does not include DEC Bracket or Wedge.

- https://www.skywatch...adventurer-mini
- https://www.youtube....h?v=qVSmHghQxbQ
- https://www.youtube....h?v=e4ecJOceRjY
- https://www.peterzel...rer-mini-course

Cost new is $299. I am asking $180.

Space is not black…

Jim Waters SAC/EVAC jimwaters@cox.net

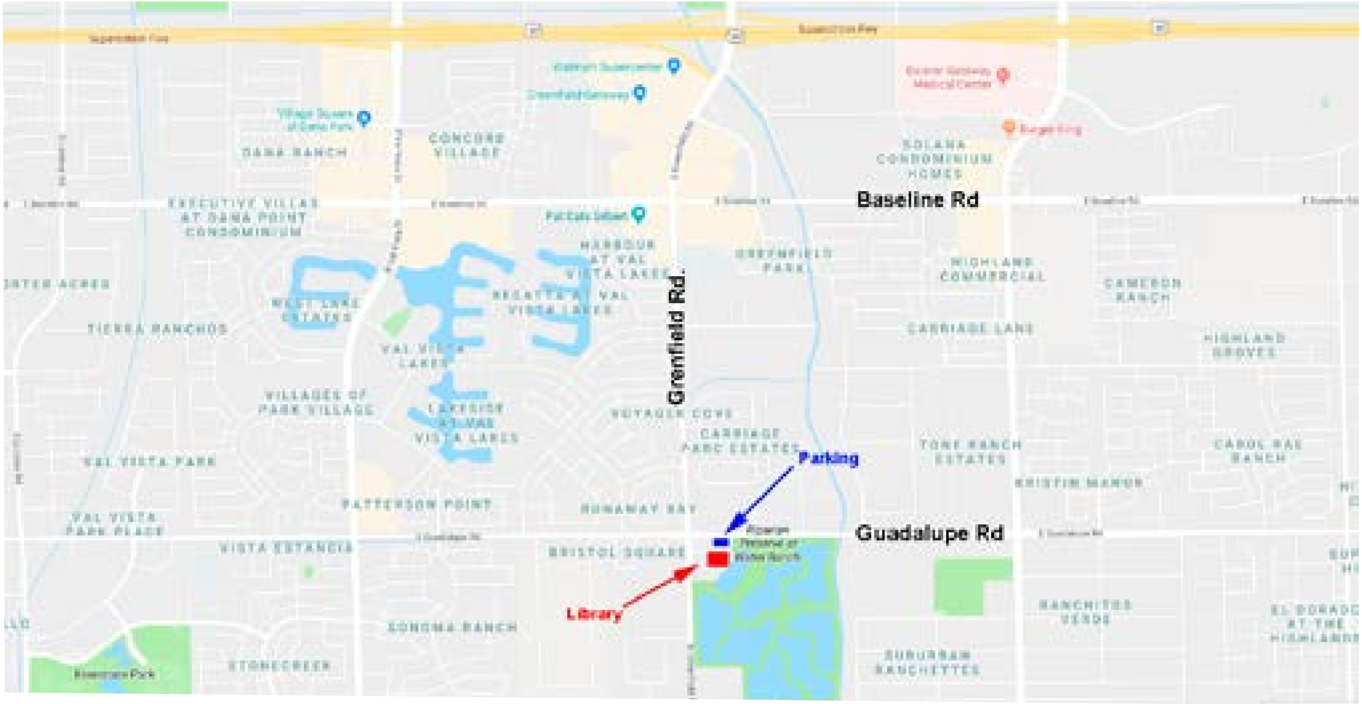
Upcoming Meetings

June 21
July 19
August 16
September 20
October 18
November 15
December 20

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.

Visitors are always welcome!



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

JUNE 2019

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	29	28	**29**

June 1 - EVAC Star Party

June 14 - Public Star Party

June 21 - EVAC Monthly Meeting

June 29 - EVAC Star Party

JULY 2019

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			

July 12 - Public Star Party

July 19 - EVAC Monthly Meeting

July 20 - EVAC Star Party

July 27 - EVAC Star Party

East Valley Astronomy Club -- 2019 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

☐ **$15.00 Individual** July through September
☐ **$17.50 Family** July through September

☐ **$22.50 Individual** April through June
☐ **$26.25 Family** April through June

☐ **$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

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Name:

Phone:

Address:

Email:

City, State, Zip:

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.

☐ General Observing
☐ Lunar Observing
☐ Planetary Observing
☐ Deep Sky Observing

☐ Cosmology
☐ Telescope Making
☐ Astrophotography
☐ Other

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

How did you discover East Valley Astronomy Club?

To join via Paypal: http://evaconline.org/join_evac.htm

Joining the club implies you agree to the liability waiver. http://evaconline.org/join-liability_release_form.htm

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. 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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Vice President: Rob Baldwin

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Refreshments: Jan Barstad

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AL Representative: Rob Baldwin

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Webmaster: Marty Pieczonka

SkyWatch Coordinator: Claude Haynes

Observatory Manager: Claude Haynes

East Valley Astronomy Club
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