Volume 34 Issue 10

October 2020

The Observer

Big Mars from Hubble - APOD August 27, 2003
Credit: J. Bell (Cornell U.), M. Wolff (SSI) et al., STScI, NASA

Upcoming Events:

Some meetings will be held online.

EVAC Meeting via Zoom - October 23

Featured Speaker is Anthony Wesley -

HighResolution Planetary Imaging in 2020.

Inside this Issue:

From the Desk of the President

by Gordon Rosner

Greetings from your President.

As always, I sure hope everyone is still doing well and keeping healthy. We all continue to have public health concerns but it appears at least things are not getting worse around here. So, all EVAC in-person group activities still remain cancelled, and we are still uncertain when events will return. Our Leadership Team continues to monitor other Arizona astronomy clubs for any positive thoughts and actions. As always, check our website for the latest information.

Remember that the Hovatter Airfield is no longer available to us as our dark sky location. This and the current health concerns result in the cancellation of the October All Arizona Star Party (AASP). We are still taking ideas for possible future sites but no decision has been made.

Now the broken record reminder. Any in-person gatherings are up to individuals and none are EVAC sponsored events at this time. This also applies to any gatherings at the Picket Post Trailhead. Those gatherings are personal decisions and proper safety precautions must be observed by each individual. Any group gatherings are entirely personal decisions with no EVAC endorsement, guidance, or oversight at this time.

We all joined an astronomy club to socialize and do things together sup-

From the Desk of the President
by Gordon Rosner

Continued from page 1

porting our astronomy passion. That has been cut very short over the last few months and looks like it will continue for at least a few more. However, we still can do things together even though we are apart. A great example of this was ASU's 'International Observe the Moon Night' held on the evening of 26 September. This was the first time this event was held online via Zoom and for those that attended this, all must have thought the same as I did… What a great idea and event!

ASU's Ric Alling hosted this event which included live views from our friends who connected cameras to their telescopes and fed them through the internet. They showed and explained the equipment used for these live views. The event concentrated on the Moon, but included some views of Jupiter, Saturn and other objects currently in the sky. How could anyone pass those targets up? Also, short live presentations of lunar missions by ASU students were also included.

Ric Alling started the event giving us some 'Moon History' to get our attention. He then showed a live view of the waxing gibbous Moon through his 10" Meade SCT and Cannon DSLR camera pointing out some prominent features. This got us hungry for more.

Rick Scott then came online and described his personal dome observatory using a Newtonian and cooled ZWO camera controlled by FireCapture software that was also seen on the shared screens. He described the issues with thermal noise and gave us a demonstration of different settings to see Jupiter and its moons.

ASU's Meg Hufford then came on board describing the activities and events of ASU's School of Earth and Space Exploration and the outreach events available to all of us.

Ric then introduced Leo Heiland who gave a tour of his roll-off roof observatory converted from his golf cart garage. What an example of "if you can think it, you can do it!" The camera on his 12.5" Planewave is not cooled, so it was just a little too warm to provide live views. But he did give us a motivational chat about using his equipment to participate in exoplanet investigations. Yes, you read that correctly. An amateur astronomer converting his golf cart garage into a personal observatory gathering data to support NASA's exoplanet investigations. Who thought golf and astronomy could be combined? Another example of creativity and our passion having no limits.

A break from viewing was provided by excellent examples from some of our youth in space exploration. ASU students Megan McGroarty and Alicia Hyatt gave explanations and updates on the Lunar Reconnaissance Orbital (LRO) cameras and future lunar missions to map the lunar surface looking for hydrogen rich areas of ice and frost.

Back to Moon viewing! Tom Polakis used his Dobsonian and QTY camera using FireCapture software to give us a live tour of the lunar landscape describing the features flowing across our screen. Again, both the live images and the controlling software settings were a treat to see.

Kevin O'Donnell then came online and shared photos he used with just a Cannon DSLR camera on a tripod using various lenses. No telescope, no tracking or stacking used. Images of the Moon, Neowise comet, Jupiter, Saturn and the Solar Eclipse all taken with just a camera. Another aspect of what we can do even without a telescope.

Then, ASU student Alex Huft talked about his current work integrating downloaded LRO data into pictures directly supporting the LRO Program. A college sophomore actually having a job supporting a major space exploration program! At his age, I would get lost trying to find my way back home! Supporting comments by Robert Wagner of the LRO Program was provided as he also answered live chat questions throughout this event.

Back to viewing. Mark Johnston then gave an excellent presentation and live views on Electronically Assisted Astronomy (EAA) using live video feeds of deep sky objects using SharpCap software. This process takes a continuous series of images and stacks them into a stream that adds the latest image and drops off the oldest one providing a live 'stacked' video of the object. This is great for outreach programs as guests see these colorful and intricate live views of DSOs.

This was certainly a top-notch event that inspired everyone and an excellent example of doing things together even though we are apart. This event was done through ASU's School of Earth and Space Exploration and I encourage everyone to visit the events page of their website

From the Desk of the President
by Gordon Rosner

Continued from page 2

(sese.asu.edu) and see the list of the many upcoming virtual events and join in. I certainly will be. And remember other organizations and clubs also give live events and presentations online for everyone.

Remember that our online monthly meetings are being recorded and a link is placed on the monthly meeting page of our club's website. Now all those who could not watch the meeting live can view it at their convenience. Our October meeting will be held on the FOURTH FRIDAY, October 23rd. Not the usual third Friday. This was because our club calendar was originally created last year and we subsequently decided to keep that original date instead of changing it again due to the cancellation of the AASP. Our October meeting will be held on Friday, 23 October starting at 7:30PM. The main speaker will be Anthony Wesley presenting "High Resolution Planetary Imaging in 2020" presenting live all the way from Australia!

Everyone remember that member presentations are a fun and valuable part of our monthly meetings. These are about ten minutes long regarding any astronomy related subject you would like to share with the club. I encourage you to do one of these. Just let me know you would like to do this by using the 'Contact President' link near the bottom of the main page of our EVAC website. I'll then get back with you and we can discuss. If needed, we can also do a dry run sometime before the actual meeting.

I'll 'see you' at the October meeting.

"Keep your feet on the ground and keep reaching for the stars."

Your President,

Gordon Rosner

EVAC Zoom Meeting Notes for 2020 September 18, at 07:30 P.M. AZ Time
by Wayne Thomas

Meeting Minutes.

President Gordon Rosner welcomed those in the "audience" to the virtual meeting at 7:34 p.m. Gordon introduced the leadership team in charge of keeping EVAC running, and noted that some have term limits.

Under club news, he noted that club sponsored events with personal contact are still cancelled.

Gordon gave the member presentation on Beginning Astrophotography. He shared his experience with sky diving in which he combined the sport he loved with taking photographs while plunging towards earth. In his analogy, this is like astrophotography combining the love of stars with photography. He described various types of telescopes and how to adapt each to astrophotography. He then described various cameras and their adaptability to astrophotography. Finally he recommended just start doing it. Take notes to remember what worked and what didn't. And a caution – Don't point at the Sun, unless you have the specialized equipment to make it safe to do so.

A special announcement was made by Ric Alling about the "International Observe the Moon Night." Saturday, September 26 starting at 7:30 p.m. EVAC members can share their views of the moon over the internet in webinar format.

Tom Mozdzen then introduced the main speaker, Dr. Rogier Windhorst, Regent's Professor at ASU.

Rogier presented the outline of his talk as follows:

1. James Webb Space Telescope (JWST) updates
2. What Hubble has done
3. How can JWST improve on that
4. The future – Next Gen telescopes and LTLAST
5. Summary and Conclusions

Rogier began by reviewing some of the major discoveries of the Hubble Telescope, and comparing the James Webb Telescope to the Hubble Space Telescope. He discussed why Beryllium was chosen for the mirror segments, what the launch constraints were and where the JWST would reside in space. The mirrors are coated in gold because it has a 98% reflectivity at infrared wavelengths. He then described the mirror supports – the hexapods which allow controlling each mirror with 7 degrees of freedom. Compared to Hubble which could reach 26th to 27th magnitude in the IR, JWST will be able to reach 31.5

EVAC Zoom Meeting Notes for 2020 September 18, at 07:30 P.M. AZ Time

by Wayne Thomas

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magnitude. This is equivalent to one firefly at the distance of the Moon!

JWST will reside at the L2 Lagrangian point which is opposite the Sun from Earth's perspective. This is not a stable location so some fuel must be expended to keep the telescope in this fuzzy location. The telescope will follow a Lissajous path ranging in distance from 3x to 5x the Earth-Moon distance.

JWST will carry 4 main instruments – the Fine Guidance Sensor (Canadian), the Mid IR Instrument (ESA), the Near IR Camera (U of A), and the Near IR Spectrometer (ESA). The Near IR camera and the Near IR Spectrograph will operate in the 1 to 5 micron range, while the Mid IR Instrument will operate in the 5 to 29 micron range.

In order to take spectra of a "deep field" an array of 62,000 micro shutters has been built. An image of a field is taken, and then a map of the distant galaxies is used to open specific shutters to allow spectra to be taken of each galaxy in the field. The resulting multi-spectra image then contains spectra of all of the galaxies selected in that field. When the telescope is about to pass through the plane of the orbit of the Perseid meteors, the telescope will be oriented to reduce the probability of meteors impacting the telescope.

Rogier had a short video showing the unfolding of the telescope after it is in space. Also included were several slides showing the assembly and testing of the various system components. Testing required special equipment to simulate a zero gravity state so as to not burn out the motors which unfolded the components.

Rogier included a discussion of Black Holes since studying them is part of the mission of JWST. Supermassive Black Holes must have been voracious eaters in the early universe to attain their observed masses today. These may have started from the first massive stars which spawned relatively massive black holes when they went supernovae. JWST should be able to image the first quasars to redshift z => 10 (the first few hundred million years after the Big Bang).

Population III stars should be visible to JWST. To observe them, a filter set which goes further into the Infrared than the Hubble filter set will be used. So far, Hubble has observed one galaxy at redshift z = 11. JWST will use gravitational lensing to see further back in time. However, the further back in time, the more confusing the images become. The plan is to push the envelope to z = 10 to 15.

In summary:

1. Hubble set the stage to measure galaxy assembly in the last 12.7 to 13.0 Gigayears.
2. JWST had been built and is in final integration and test. Launch is now planned for October 2021.
3. JWST has been designed to map the epochs of First Light, Reionization, Galaxy assembly, and Super Massive Black Hole growth in detail. This includes the formation and evolution of the first star clusters after 0.2 Gigayears after the Big Bang. Also included is how dwarf galaxies formed and reionized the universe after 1 Gigayear.
4. JWST will have a major impact on astrophysics in this decade. It will provide an IR sequel to Hubble starting in 2021, and define the next frontier – The Dark Ages at z > = 20.

For those interested in viewing a recording of this evening's meeting, it is archived on the EVAC website. Look under September 18 at https://www.evaconline.org/events-meetings.

Our next meeting will be on Friday, October 23, the 4th Friday due to a scheduling conflict, and will feature guest speaker Anthony Wesley speaking on High Resolution Planetary Imaging.

Close Approach of Mars in October

"Mars, by virtue of its color alone, must have seized the attention of stargazers from time immemorial, catapulting them into inescapable fantasies." Stephen O'Meara, Mars.

Earth passes Mars every two years and fifty days (on average). But every 15 to 17 years we pass Mars when it's in perihelic opposition with Earth, that is, when Mars is at its closest orbital point to the Sun. These events can bring Mars to within about 35 million miles to Earth; the last one occurred on July 31, 2018 (Earth-Mars opposition distances can be as great as 63 million miles). Next close approach: 2035, distance: 35.3 million miles, disk diameter: 24.6" (arc seconds). However, a pass either side of a perihelic opposition can still be rewarding to an observer. This will happen on October 6, 2020. Earth – Mars' distance will be 38.5 million miles, disk diameter 22.6" (arc seconds). (See note #4 below).

Mars Facts

Mean Distance from Sun: 142 million miles.

Diameter: 4,200 miles (Earth = 8,000 miles).

Length of day: 24 hours, 37 minutes.

Length of year: 687 Earth days or 1.88 Earth years.

Mass: 1/10 of Earth. Surface gravity is 38% that of Earth. (100 pounds on Earth = 38 pounds on Mars).

Escape velocity: 3 miles per second (Earth = 7 miles per second).

Orbital Velocity: 15 miles per second (Earth = 18.5 miles per second).

Atmosphere: 1% density of Earth's. 1/150th the pressure of Earth's. (95% carbon dioxide, 3% nitrogen, 1.6% argon, 0.13% oxygen, carbon monoxide).

Axial tilt: 25.2 degrees. (Earth = 23.5 degrees).

Surface temperature: Average daytime ground temperature is -67 F. at equator (-130 F at night to -180 at poles. Noon time ground temperature at equator in summer can reach 65 F.

Polar Ice Caps: Both north and south caps are comprised of frozen carbon dioxide. Caps also have water ice below the CO^2. It's estimated that if the ice cap water and water stored in Mars' permafrost were liquid, it would cover the planet to a depth of 33 feet.

Moons: Phobos: Diameter, 14 miles. Distance from Mars, 5,827 miles. Period of revolution, 7 hours 39 minutes. Deimos, diameter, 8 miles. Distance from Mars, 14,577 miles. Period of revolution, 30 hours 18 minutes. Both discovered in 1877 by Asaph Hall with the 26" refractor at the Naval Observatory in Washington, D.C.

Misc. Notes:

1. Because Earth is mostly covered by water (71%), Mars' and Earth's land areas are about equal.
2. The largest crater on Phobos is named Stickney, the maiden name of Asaph Hall's wife, Angeline Stickney.
3. 151 years before Hall discovered the moons of Mars, Jonathan Swift's Laputan astronomers in Gulliver's Travels (1726) had discovered two small moons around Mars.
4. Martian opposition and closet approach to Earth do not necessarily coincide due to complicated orbital dynamics. Since this opposition occurs after Mars' August 3rd perihelion, Mars is moving away from the Sun and opposition follows seven days after closest approach.

The Core and Structure of Neutron Stars Part 2

by Henry De Jonge IV (October 2020)

Magnetic Fields

We will briefly mention magnetic fields although we will not go into their effects on the structure of NS in any great detail, which is still beginning to unravel and be understood. It however definitely plays a role and is like a complex symbiotic relationship where the one affects the other and vice versa. The origin of the magnetic fields in NS, which are the most powerful magnetic fields in the universe, is still a very big mystery. The main two theories are the fossil theory and the dynamo theory. The fossil theory says that the magnetic fields come from the progenitor star while the dynamo theory says that they would be generated in the newborn NS, (also called a proto-neutron star or PNS). In the dynamo theory the interior structure and evolution of the NS obviously play a major role in this idea. This includes convection, and the differential rotation throughout the PNS, which is again dependent upon the characteristics of the interior structure. For example, the depth and rate of change of the depth of convection in the PNS as it evolves into a NS are very critical in magnetic field formation. Magnetic fields also affect the EoS and are currently very difficult to model in the simulations. This magnetic aspect of NS is another article all together.

Interior Theories

In general, we believe that during the early stages of NS formation and evolution the NS is fluid like and spinning. But eventually the NS cools down and the crust will "freeze", that is, it will crystalize. These early evolutionary stages also greatly influence the strong magnetic fields common to almost all NS and play a role in the formation of magnetars. Beginning from the surface of a NS we now enter deeper to the core.

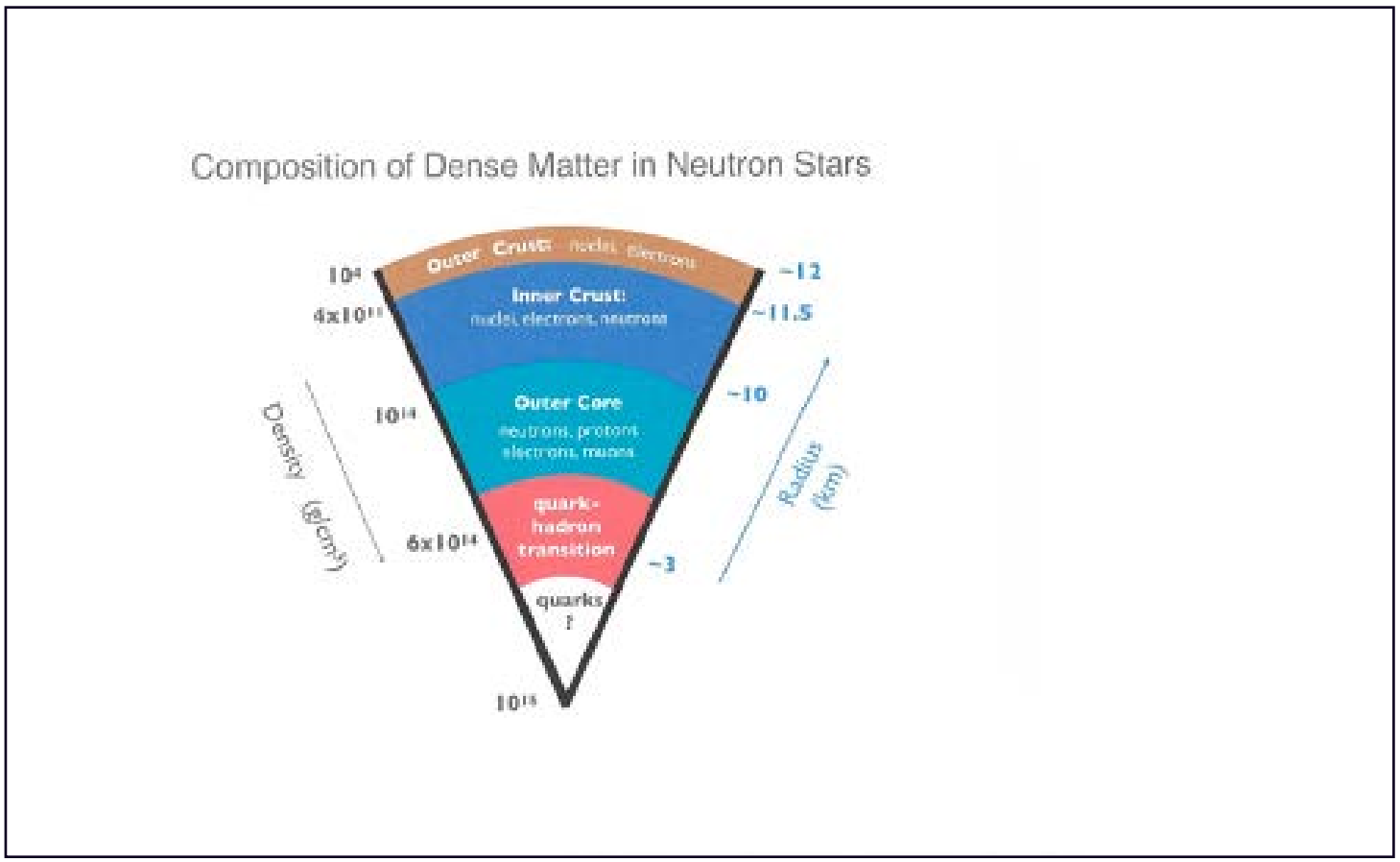

Figure 4. Overview of NS layers

The Core and Structure of Neutron Stars Part 2

by Henry De Jonge IV (October 2020)

Continued from page 6

Outer Crust

It is thought that the very outermost layers of the NS above the surface are only a few microns thick with properties that are highly dependent upon the magnetic field of the NS. Below this very thin layer the "surface" of a NS is the outer crust which is composed up of nuclei and electrons, perhaps in a lattice formation of some type. Whether or not this surface layer is a fluid or a solid probably depends upon the temperature of the NS. However, the crust of a neutron star can be approximated by a crystal lattice consisting of ions and free electrons, with the electrons carrying the electric current. This allows a single fluid approximation and a single EoS to be modeled.

The exact evolution of the crust and its relationship to the evolution of the surface magnetic field is still very much a work in progress and offers a wide range of possibilities in terms of formation models, strength, lifetime, and affects. The surface magnetic field is weaker than the internal one and can change its polar structure and strength quite rapidly. This may be due to influence by the stronger internal magnetic field via convective currents below the crust. It is thought that these influences can become so great that some NS can mimic a magnetar in X-ray luminosities, (although not in sheer magnetic field strength) without having the explosive tidal crust deformations that are believed to power usual magnetar X-ray bursts. These NS are sometimes called anti-magnetars. This outer crust layer may be only about 0.5 km thick or less.

Inner Crust

Moving inwards, the density and temperature increase so that we have a higher concentration of free neutrons, neutron rich nuclei, and electrons called the inner crust. It is a very mixed phase of matter. The densities in this layer are just below that of nuclear matter and the nuclei may be made up of or form various shapes. There are many models of the structure of this inner crust and most of them resemble different types of pasta with voids and denser regions. They are described as spherical, cylindrical, (spaghetti) and planar, (lasagna) types of pasta and are like the bubbles and droplets in in the boiling and vapor transition phases of water. These pasta layers are caused by the tension and electrical differences between the hadrons and the quarks, despite the NS being overall electrically neutral. It is highly unlikely that these pasta layers are uniform and well-ordered in the NS star. However, the polycrystalline models used to describe the inner crust become very complex if this assumption is not maintained. Magnetic field influences are also just beginning to be incorporated and their presence may actually tend to increase the rigidity of the pasta layers.

In this layer another interesting phenomenon occurs called neutron drip. This happens when the heavy nuclei are found by the relativistic electrons and they penetrate the nuclei and produce inverse beta decay. This is when the electron combines with a proton in the nucleus to make a neutron and an electron-neutrino. As more and more neutrons are created in these nuclei the energy levels for neutrons get filled up to an unacceptable energy level. At this point any electron penetrating a nucleus will create a neutron, which will "drip" out of the nucleus. As we go deeper into the neutron star the free neutron density increases and more and more neutrons drip out of nuclei so that we get nuclei in a neutron fluid. Eventually all the neutrons drip out of nuclei and we have reached the neutron fluid, (superfluid?) interior of the neutron star. This inner crust layer may be about 1-1.5 km thick.

Outer Core

Next, we enter into a layer with even more unknowns and have an outer core composed up of neutrons, protons, muons, and electrons which is about 5-8 km thick. This region is also often modeled as a superfluid. This layer is a critical phase transition layer before the core. Many models of NS propose a hybrid EoS for this layer that allows a strange coexistence of nuclear matter, hyper nuclear matter, (matter containing what is called strange nuclear matter

The Core and Structure of Neutron Stars Part 2

by Henry De Jonge IV (October 2020)

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or a hyperon) and quark matter, all in a mixed phase between the pure hadronic and quark phases. This is sometimes why NS are thought of as a sort of hybrid star. Interestingly enough these hybrid star models predict and satisfy the constraints on the mass-radius relation for neutron stars that have been obtained from recent observations.

Quark-hadron Transition Zone

Below this we have the increasingly unknown quark-hadron transition region where the QGP begins to "cool down", (Vs the temperature in the core) and form some hadrons or nuclear matter. The still relatively high temperatures and high energy collisions "liberate" the quarks and gluons and form the QGP. Unfortunately, there is not yet a unified theory or EoS which could be applied to both the hadronic and quark phase in all ranges of NS densities and temperatures!

Therefore, scientists find it acceptable to calculate the EoS of the hadronic phase and of the quark phase separately from different theories and then to construct a speculated phase transition between them. Bear in mind that the quark matter EoS at such high densities cannot violate the causality constraint where the speed of sound should not exceed the speed of light. This popular, predicted, hybrid star model has a quark matter core which is surrounded by a shell of hyper nuclear matter which joins the deconfined quark matter to nuclear matter. This layer may be only 1-3 km thick.

Core

At the very center we have the highly speculative QGP core. Here the energy level of particles, (quarks?) in the NS rises so high and is at such high densities that the appearance of the new degrees of freedom, (new particles or forms of matter) are possible. This may consist up of some new exotic forms of matter like preons, etc., and is mostly unknown. Some ideas suggest that the particles in the core may be so dense that they are actually touching

The discovery of pulsars with masses as high as 2 M and recently also the observation of the merging of two NS in the event GW170817 has revived this question about the real composition of the core of massive NS. Current models and EoS describe a NS core with a maximum mass of about 2 solar masses. The density in such a core can exceed the density of a nucleus as we mentioned. Beyond this we come to a black hole. One interesting idea is that the phase transition into material beyond the quark gluon plasma that may exist in the cores triggers the BH formation.

Summary

In summary, the outer layers of a NS are much better understood than the inner layers and especially the core. In the inner crust the neutrons are believed to travel freely between layers and release some of the NS energy over time. The NS gradually loses temperature over time and neutrino loss is a key factor in this temperature decline. It is believed that some NS that are not near the maximum mass of about 2 solar masses may not have the full complex structure of the more massive NS. For example, they may not have sufficient density and temperatures to form a quark core but have instead some hybrid state core or transition layer. All of this is still very much a work in progress.

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 in the Contact-Us area on the Home page of our EVAC website. 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 to consder is AZ-Observing@groups.io, simply click on this link https://groups.io/g/AZ-Observing and follow the instructions on the page. 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

EVAC Outreach Events
by Gordon Rosner

Again, unfortunately another very short column this month as all outreach events remain on hold due to supporting the public health concerns. For more information, see the President's column at the beginning of this newsletter or at the top of the EVAC website.

As always, still looking very forward to our outreach program getting back and to hearing all those "OH WOW's" we so love to hear.

Gordon Rosner
EVAC Outreach Events Coordinator

Full Moon on October 1 at 14:05

Last Quarter Moon on October 9 at 17:40

New Moon on October 16 at 12:31

First Quarter Moon on October 23 at 06:23

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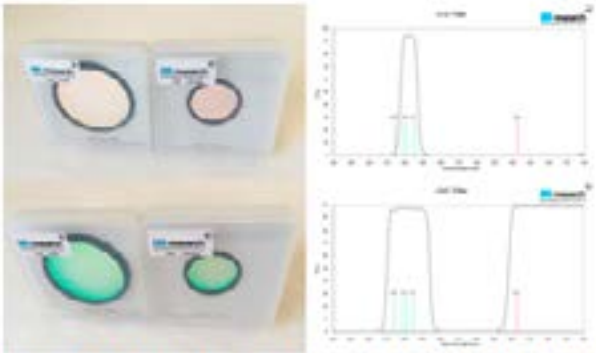

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Insight Observatory
16" ATEO 1 Telescope

SkyPi Remote Observatory

Monthly Meetings will be presented live online using Zoom. See the EVAC Website for updates. All other events are on hold until health concerns are resolved.

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

October 2020

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

October 23 - EVAC Monthly Meeting Live

Online via Zoom

***The EVAC Monthly Meeting will be held live online via Zoom. All other meetings and events have been cancelled until further notice.**

November 2020

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					

November 19 - EVAC Monthly Meeting Live

Online via Zoom

***The EVAC Monthly Meeting will be held live online via Zoom. All other meetings and events have been cancelled until further notice.**

East Valley Astronomy Club -- 2020 Membership Form.

IMPORTANT: All memberships expire on December 31 of each year

New Member Dues (select according to the month you are joining the club)

	Individual	Family	
January, Feburary & March	**$30.00**	**$35.00**	
April, May & June	**$22.50**	**$26.25**	
July, August & September	**$15.00**	**$17.50**	
October, November & December	**$37.50**	**$43.75**	(*Includes following year)*

Renewal (current members only):
☐ **$30.00 Individual** ☐ **$35.00 Family**

☐ **Astronomical League:** $7.50 Annually (per person)

Name Badges: Quantity: _____
☐ **$10.00** Each
Name to imprint: _____

Total amount enclosed:

Please make check or money order payable to EVAC
Payment will be made using PayPal ☐

Name: | Phone:

Address: | Email:

City
State
Zip | URL
For website

Would you be interested in our outreach program? ☐ Yes ☐ No

How did you discover East Valley Astronomy Club?

Liability Release Form

In consideration of attending any publicized Star Party hosted by the East Valley Astronomy Club (hereinafter referred to as "EVAC"), the receipt and sufficiency of which is hereby acknowledged, I hereby affirm that I and any related entities, predecessors, successors, affiliates, attorneys, guarantors, insurers, transferees, assigns, parents, spouses, children, subsidiaries, accountants, officers, directors, employees, agents, shareholders, members, and trustees, past and present, hereby forever release, acquit and discharge to hold EVAC and its related entities, predecessors, successors, affiliates, attorneys, guarantors, insurers, transferees, assigns, parents, spouses, subsidiaries, accountants, officers, directors, employees, agents, shareholders, members, and trustees, past and present, from any and all causes of action, claims, losses, damages, liabilities, expenses (including attorneys' fees) and demands of any nature whatsoever, known or unknown, that in any way relate to, arise out of, or concern EVAC and/or my presence on the premises of any EVAC Star Party and related areas, whether or not those causes of action, claims, damages, liabilities, and demands are part of the specific subject matter of EVAC or any EVAC Star Party. This release is intended to and does cover all injuries and damages, and the consequences thereof, whether known or unknown at the time of the execution of this release, which have occurred or may hereafter occur or which may hereafter be discovered, and which may have been caused or may be claimed to have been caused by the said incident, and specifically includes, but is not limited to, bodily injuries, mental and emotional injury, pain and suffering, medical treatments, and loss of earnings or income.

My signature upon this form also indicates agreement and acceptance on behalf of all minor children (under 18 years of age) under my care in attendance. EVAC only recognizes those who are members or invitees and who also have a signed Liability Release Form on file as participants at an EVAC Star Party.

Signature _____ Date _____

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.

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