NIGHTFALL

A Publication of the Huachuca Astronomy Club

December 2018

President's Notes

Happy Holidays

Hi, everybody it's December and I just received my new Royal Astronomical Society of Canada, Observer's Handbook for 2019. The handbook is at the same time a textbook and an almanac, always different and always familiar. Month by month, planet by planet the handbook lays out the wanderings and wobbling as our ride (plant Earth) falls around the sun for another year. But the handbook has so much more.

Some of us have been observers for a very look time. We've grown up learning the sky through an eyepiece. Along the way we've tried (and bought) a lot of different eyepieces and telescopes and sky charts and, and, and. In the long run not all of those choices were positive. Promised astounding eyepieces were fizzlers in our telescopes, our telescopes did not allow us the views we believed they would, and, star charts ran out of stars well before our telescope's light grasp. In short, we've made some mistakes. Reading the various articles in the handbook could have saved us many of those missteps.

Now I understand that a mix of mistakes and self-discoveries are vital to reinforcing learning but the handbooks articles on recommended reading and resources have a wealth of information that would have saved us a lot of lost time and inefficient effort. The article, "Magnification and Contrast in Deep-Sky Observing," paints a picture that is illustrious and counter intuitive. Read it along with, "Telescope Exit Pupils," and you have whittled years off the learning curve of buying your collect set of eyepieces.

I suggest reading the handbook from cover to cover but one last article I recommend (for this month at least) is, "Deep-Sky Observing Hints." More of a check list than an article; it packs a lot of wisdom in a cramped bit of real estate. I want you to read it yourself but I will ruin the suspense on a couple of points. Don't be afraid to use higher power on those faint fuzzies. Now I usually tell people to use the least power their telescope can tolerate at first when looking for and at a new object. However using higher powers darkens the background sky and increases contrast in the object. You may see a lot of detail not observable at lower power; wispy patches in dusty reflection nebulas and structure in planetary nebulas come instantly to mind. Finally, filtering, in this case filters for aiding contrast to deep-sky objects by cutting down stray light, atmospheric pollution and severely reducing passage of sections of the spectrum. Sometimes using the right filter, is the difference between seeing and not seeing your target. I guess what I'm saying is learn from the articles in the handbook then go out and make totally different mistakes that is what progress is all about.

Well, the nights are long, the skies are cold and clear so, happy holidays and get out there and stare.

Welcome our new members

Ken Cameron of Hereford joined the club in November. He observes with a 130mm Stellarview and a 16" f/4.5 Lightbridge that was rebuilt by Dobstuff. He enjoys visual observing and star hopping. Welcome to the club, Ken, we are glad you joined.

2019 Dues

Most HAC memberships expire each December. If you have not yet paid, your 2019 dues there are a number of ways to renew. The easiest way is to go to https://www.hacastronomy.org and pull down the membership menu. You'll be able to renew using your credit card or Pay Pal account.

You can mail your dues payment to PO Box 922 Sierra Vista 85636. Make checks payable to Huachuca Astronomy Club.

You can pay in person by cash or check at any of our upcoming events. Regular dues are $35 family and $25 individual, active duty military pay $25 family and $20 individual and students with valid ID pay just $10.

For those of you that have already paid your 2019 dues, thank you very much! If you are unsure of your membership status and/or due date please contact me.

Holiday Pot Luck

The December meeting scheduled for December 14 will be replaced with a holiday potluck party at the Patterson Observatory. This will be the debut for the observatory's new kitchen and restroom addition! Details are still coming together but the party starts at 6 PM.

Please plan to attend and bring a dish to share.

2019 RASC Handbooks and Astronomy Magazine Calendars

The 2019 RASC handbooks and Astronomy Magazine calendars are in. Those that purchased them can pick them up at the Pot Luck or at any of the upcoming events at the Patterson Observatory

Say Goodbye to Yahoo

We have converted our Yahoo group (HACLIST) to a groups.io group called HACASTRO. If you were already a member of the Yahoo group, your membership in HACASTRO is automatic. If you were not a member of the Yahoo group, you are invited to join the new group. Just let Ted Forte know you'd like an invite or send a message to HACAstro+subscribe@groups.io

Groups.io has several advantages over Yahoo – the most obvious one being that no special ID is required. That makes it much easier to join than Yahoo. The replacement group is designed to look and feel similar to Yahoo but it works better and is supported with customer service and tech support. We've all experienced frustrations with the Yahoo groups at times and for many of you I'm sure this will be a good riddance more than a goodbye.

Telescope Clinic

Mark your calendars: Saturday, January 12 starting at 3pm we will conduct a telescope clinic at the Patterson Observatory.

Members can help each other or get help with their telescopes. The event is open to the public as well. The last few times we've done this we've gotten a half dozen people bring in their unused or underused scopes.

Sometimes the scopes need minor repairs or adjustments but just as often, the owners just need a little instruction and to have their questions answered.

Please plan to attend if you like helping new astronomers with their telescopes or if you need help yourself. You'll have fun!

This article is distributed by NASA Night Sky Network

The Night Sky Network program supports astronomy clubs across the USA dedicated to astronomy outreach. Visit nightsky.jpl.nasa.org to find local clubs, events, and more!

NASA Space Place Partner Article December 2018

NASA Night Sky Notes: Observe Apollo 8's Lunar Milestones

By David Prosper

December marks the 50th anniversary of NASA's Apollo 8 mission, when humans first orbited the Moon in a triumph of human engineering. The mission may be most famous for "Earthrise," the iconic photograph of Earth suspended over the rugged lunar surface. "Earthrise" inspired the imaginations of people around the world and remains one of the most famous photos ever taken. This month also brings a great potential display of the Geminids and a close approach by Comet 46P/Wirtanen

You can take note of Apollo 8's mission milestones while observing the Moon this month. Watch the nearly full Moonrise just before sunset on December 21, exactly 50 years after Apollo 8 launched; it will be near the bright orange star Aldebaran in Taurus. The following evenings watch it pass over the top of Orion and on through Gemini; on those days five decades earlier, astronauts Frank Borman, Jim Lovell, and Bill Anders sped towards the Moon in their fully crewed command module. Notice how the Moon rises later each evening, and how its phase wanes from full on Dec 22 to gibbous through the rest of the week. Can you imagine what phase Earth would appear as if you were standing on the Moon, looking back? The three brave astronauts spent 20 sleepless hours in orbit around the Moon, starting on Dec 24, 1968. During those ten orbits, they became the first humans to see with their own eyes both the far side of the Moon and an Earthrise! The crew telecast a holiday message on December 25 to a record number of earthbound viewers as they orbited over the lifeless lunar terrain; "Good night, good luck, a merry Christmas and God bless all of you - all of you on the good Earth." 50 years later, spot the Moon on these holiday evenings as it travels through Cancer and Leo. Just two days later the astronauts splashed down into the Pacific Ocean after achieving all the mission's test objectives, paving the way for another giant leap in space exploration the following year.

The Geminids, an excellent annual meteor shower, peaks the evening of December 13 through the morning of the 14th. They get their chance to truly shine after a waxing crescent Moon sets around 10:30 pm on the 13th. Expert Geminid observers can spot around 100 meteors per hour under ideal conditions. You'll spot quite a few meteors by avoiding bad weather and light pollution if you can, and of course make sure to bundle up and take frequent warming breaks. The Geminids have an unusual origin compared to most meteor showers, which generally spring from icy comets. The tiny particles Earth passes through these evenings come from a strange "rock comet" named asteroid 3200 Phaethon. This dusty asteroid experiences faint outbursts of fine particles of rock instead of ice.

You can also look for comet 46P/Wirtanen while you're out meteor watching. Its closest approach to Earth brings it within 7.1 million miles of us on December 16. That's 30 times the average Earth-Moon distance! While passing near enough to rank as the 10th closest cometary approach in modern times, there is no danger of this object striking our planet. Cometary brightness is hard to predict, and while there is a chance comet 46P/Wirtanen may flare up to naked eye visibility, it will likely remain visible only via binoculars or telescopes. You'll be able to see for yourself how much 46P/Wirtanen actually brightens. Some of the best nights to hunt for it will be December 15 and 16 as it passes between two prominent star clusters in Taurus: the Pleiades and the V-shaped Hyades. Happy hunting!

Catch up on all of NASA's past, current, and future missions at nasa.gov

Caption: Earthrise, 1968. Note the phase of Earth as seen from the Moon. Nearside lunar observers see Earth go through a complete set of phases. However, only orbiting astronauts witness Earthrises; for stationary lunar observers, Earth barely moves at all. Why is that? Credit: Bill Anders/NASA

Colors 2: Star Colors and Black-Body Radiation

By Alex Woronow

There is a reason that stars have the colors they do: Main Sequence stars largely radiate as Black Bodies. That is, their colors arise from black-body-radiation profiles. Those profiles, as we shall examine, relate the apparent star colors to their temperatures.

An object that absorbs all radiation falling on it, and re-emits it as thermal radiation, is called a Black Body. A true black body does not exist in nature or lab. It is a conceptual ideal that relates the temperature of an object, in complete thermal equilibrium, to the spectrum (wavelengths) of light (visual and not) that it emits. A black body might look something like Figure 1, where atoms (and walls) in a perfectly insulated sphere repeatedly radiate and absorb thermal photons until all the atoms achieve thermal equilibrium. Then, if we measured the ensemble of photon wavelengths inside the sphere, we would find it follows a particular profile indicative of the overall temperature inside the sphere.

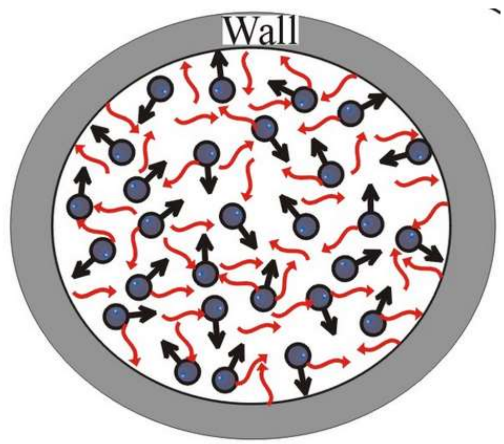

Figure 1: One depiction of a blackbody situation where the atoms (spheres) repeatedly radiate and absorb thermal energy and achieve thermal equilibrium. (Source)

Obviously stellar temperatures vary with radial position within stars; therefore, they are not in complete thermal equilibrium, no less being perfectly insulated. So then, do they radiate like black bodies? Actually, the photosphere of a star, where the light we see arises, is pretty nearly in thermal equilibrium. A photon is bounced around many times--absorbed, emitted, many times. So many times, in fact, that photosphere's atoms nearly come into thermal and radiative equilibrium, as per a black body. The occasional photons that escape to space and, perhaps eventually reach our telescopes or eyes, sample the blackbody temperature of the photosphere. So, Main Sequence stars generally exhibit black-body colors.

If you placed a piece of iron in a furnace, as it heats, it first becomes red-hot, then white-hot, and eventually, blue-hot. Red-hot objects glow at long wavelengths (~480 nm) and blue-hot objects glow at short wavelengths (~650 nm). This range replicates the color range of stars, as Figures 2 and 3 appear to validate, at first glance anyway.

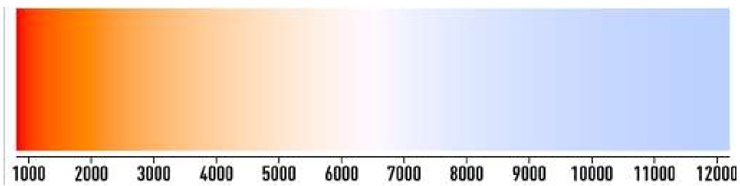

Figure 2: Perceived colors of blackbody radiation. The bottom scale is temperature in degrees K. (Source)

However, there's a significant difference between the two figures (other than the reversal of color ordering). Why do we not have "green-hot" radiation--where are the green stars? Where are the really hot violet-colored stars (~400 nm)? The answer to these questions is, they actually do exist, but human color perception does not register green stars, green-hot iron, or violet stars. Much more about human perception of color will be covered later in this series.

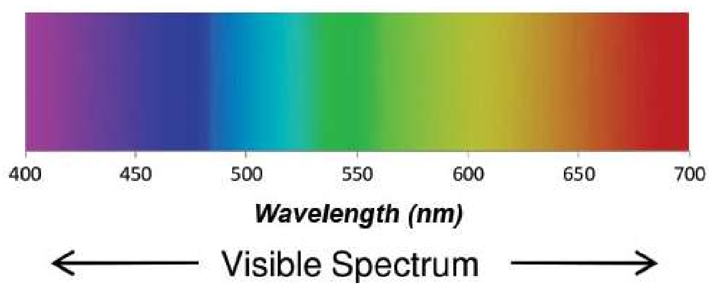

Figure 3: Colors with corresponding wavelengths. (Source)

Now, let us look at the spectra of blackbody radiation of stellar photospheres (Figure 4). The photosphere of the Sun is about 5778° K (and roughly fits a blackbody temperature 5520° K). The peak blackbody radiation at this temperature is in the green, just where our eyes are most sensitive. This, of course, is evolution at its finest; not a fortuitous coincidence! But it does raise the question, "Why does sunlight appear white, and not green?" Figures 3 and 4 suggest that a 5520-5780° K star should appear greenish, but Figure 2 says we will see it as white. Why? For now, I will say that all three figures are correct, when you factor in human color perception (as we shall see in subsequent articles).

As a physics sidelight, we can see from Figures 2 and 4 that as the radiative temperature of a star increases, its color shifts toward shorter wavelengths. Shorter wavelengths carry higher energies than longer wavelengths. Specifically,

$$E=hc/\lambda$$

where E is the energy of the photon, λ is its wavelength, c is the speed of light, and h is a constant, "Planck's Constant".

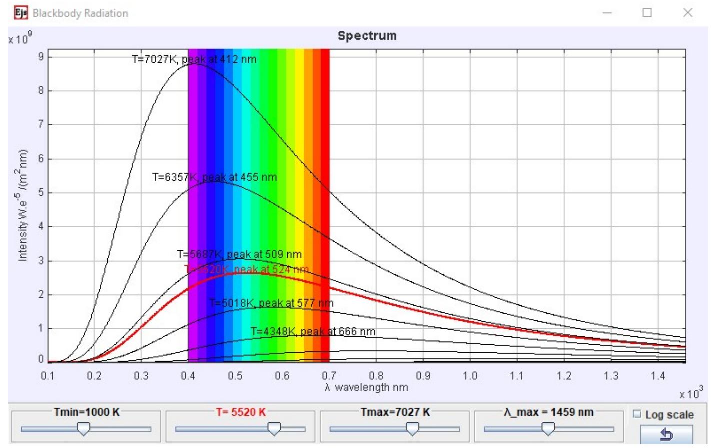

Figure 4: Curves of blackbody radiation for different temperature black bodies. The Red curve approximates the Sun's radiation. Note: the above is an interactive app available here.

A PBS online article with the title, "*Planck's Constant: The Number That Rules Technology, Reality, and Life,"* clearly touts the importance of this constant! In fact, when its intellectual value was discovered, Max Planck (early 1900s) was trying to explain blackbody curves (e.g., Figure 4). He found that he could not use the current "Classical Theory of Radiation," (*Rayleigh-Jeans law*), to do that. Therefore, he resorted to the assumption that radiation is emitted as discrete quanta with discrete energy levels. Years later, Einstein received his only Nobel Prize for validating Planck's assumption of quantization of radiate emissions through his *photoelectric effect* experiment. So, Planck's work marks the birth of Quantum Physics. But I digress, somewhat…Getting back on track….

Finally, let's look at the spectrum distribution of radiation from our Sun (Figure 5). Obviously, the radiation spectrum seen through our atmosphere is a shabby remnant of what hits the top of the atmosphere. Atmospheric molecules absorb great proportions of the light in specific wavelength bands, particularly in the infrared. The UV cut-off is dominated by ozone absorption. To ameliorate the effects of these molecular-absorptions bands, infrared observatories, and observatories in general, locate on mountaintops. But the rainbow of colors, red through blue, survives most of the absorption to reach our sensors: eyes and cameras—again, not a coincidence but an evolutionary adaptation.

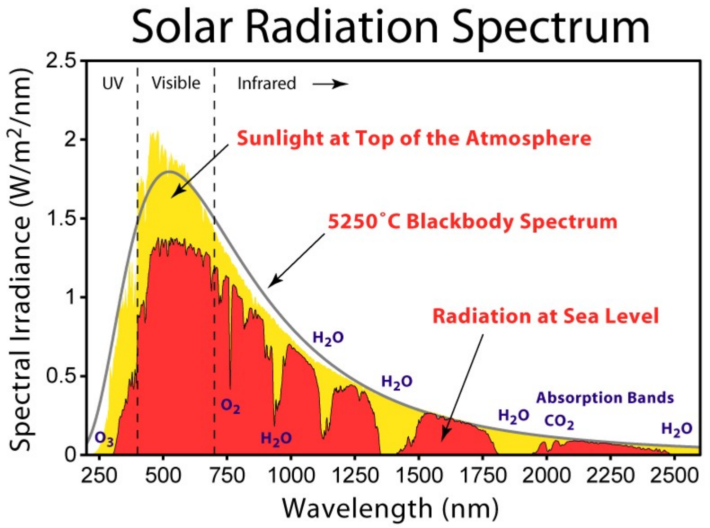

Figure 5: The flux of radiation from our sun plotted against wavelength. The 5250º C (5520º K) Black-Body curve approximately fits the observed solar output.

Some Final Notes:

- My illustrations' colors, as I see them, may not be the same as you see. As Juan Conejero, of PixInsight fame, said about the internet, "… a lot of people won't see your images as you expect, and a fraction of them will see your images horribly. We have to live with this, at least for now."
- I'm expecting that Part 3 of this series will move from this discussion of star colors to explanations of colors of nebulae.
- As usual, I'd be happy to try to answer any questions on this topic. You can ask them directly to me (alex@awkml.com) or, better, on our club hosted-email.

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Pictures from HAC Members

NGC 253 Sculptor Galaxy by David Roemer

NGC 288 by David Roemer

NGC 925 by David Roemer

NGC 281 Pacman Nebula by Richard Pattie

Comet 46/P by David Roemer

M77 with Supernova by Craig Anderson

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***Nightfall* Editor:** Cindy Lund cindy.jean.lund@gmail.com
Webmaster: Ken Kirchner
Facebook Editors: Bert Kelher

Website: http://www.hacastronomy.org
Facebook: http://www.facebook.com/HuachucaAstronomyClub
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And many thanks to our new friends at Rune Wines

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HAC Dec/Jan Calendar of Events

SU	MO	TU	WE	TH	FR	SA
2	**3**	**4**	**5**	**6**	**7** **12:20AM**	**8** **Member Star Party**
9	**10**	**11**	**12**	**13** **Patterson Public Night 6:00 PM** Geminid Meteors	**14** **Hac Holiday Pot Luck Patterson** Geminid Meteors	**15** **4:49 AM** Geminid Meteors
16	**17**	**18** Cookies and Cocoa with Santa Patterson Obs 6PM	**19**	**20**	**21** Winter Solstice 3:23 PM	**22** **10:49 AM**
23	**24**	**25** 	**26**	**27**	**28**	**29** **2:34 AM**
30	**31** 		**2**	**3** Quadrantid Meteors	**4** Quadrantid Meteors	**5** **6:28 PM** Venus western elongation
6	**7**	8	**9**	**10** **Patterson Public Night 6 PM**	**11**	**12**  **Telescope Clinic at Patterson 3PM**
13 **11:46 PM**	**14**	**15**	**16**	**17**	**18** **Coronado Elementary at Patterson 9 am** **HAC Meeting Student Union 7pm**	**19**
20 **10:16 PM** Total Lunar Eclipse Watch Patterson	**21**	**22**	**23** Palominas Elementary at Patterson	**24**	**25** Family Astro Night Boys & Girls Club SV	**26**
27 **2:10 PM**	**28**	**29**	**30**	**31**	**1 Feb**	

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