



OCTOBER 2019 EDITION

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Editorial:

Welcome to the October edition of Janus.

This month's edition sees two articles from John Murrell; one follows on from his article last month on Image Metadata in Astronomy, the other requires careful reading as it contains lots of numbers!

Gary sent me a single piece which I have chosen to split into two smaller pieces, one of which discusses his attempts to decide how dark the night sky he was viewing actually was. In this article, Gary refers to the "Bortle Night Sky scale". Doubtless many of you will know precisely what this scale is, although others (like myself) will not have come across it. For the benefit of those who aren't familiar with it, a brief explanation follows.

The Bortle Scale is a nine-level numeric scale that measures the night sky's brightness at a particular location. It quantifies the astronomical observability of celestial objects and the interference caused by light pollution. John E. Bortle created the scale and published it in the February 2001 edition of Sky & Telescope magazine to help amateur astronomers evaluate the darkness of an observing site and, also, to compare the darkness of observing sites. The scale ranges from Class 1, the darkest skies available on Earth, through Class 9, inner-city skies. It gives several criteria for each level beyond naked-eye limiting magnitude (NELM). Fuller details can be found in Wikipedia, and a Google search will reveal a number of articles on the subject.

John

The Solar System October

MERCURY: is not observable this month, reaching its highest point in the sky during daytime, and being below the horizon at dusk.

VENUS: recently passed behind the Sun at superior solar conjunction and will not be observable this month. Reaching its highest point in the sky during daytime, it is never higher than 2° above the horizon at dusk.

MARS: recently passed behind the Sun at solar conjunction and will not be observable this month. At the beginning of the month it is very close to the Sun, at a separation of only 9° from it, and at the end of the month it will reach its highest point in the sky during daytime and is no higher than 7° above the horizon at dawn.

JUPITER: starts the month as an early evening object, receding into evening twilight. It will become visible around 18:58 (BST) as the dusk sky fades, 13° above the southern horizon, and will then sink towards the horizon, setting 2 hours and 51 minutes after the Sun at 21:27. By the end of the month it will become visible around 16:56 (BST) as the dusk sky fades, 10° above the south-western horizon. It will then sink towards the horizon, setting 2 hours and 14 minutes after the Sun at 18:47.

SATURN: is also an early evening object receding into evening twilight, so visible in the evening sky. At the beginning of the month, it will become accessible around 19:14 (BST) as the dusk sky fades, 16° above the southern horizon. Reaching its highest point in the sky at 19:19, 16° above the southern horizon, it will continue to be observable until around 21:33, when it sinks below 10° above the south-western horizon. By the end of the month, it will become visible around 17:14

(BST), 15° above the southern horizon. It will then sink towards the horizon, setting 3 hours and 54 minutes after the Sun at 20:27

URANUS: is currently approaching opposition and is visible as a morning object. At the beginning of the month, it becomes accessible around 21:45, when it rises to an altitude of 20° above the eastern horizon. Reaching its highest point in the sky at 02:35, 51° above the southern horizon, it will be lost to dawn twilight around 05:38, 36° above the south-western horizon. By the end of the month, it will become accessible around 18:44, when it rises to an altitude of 20° above the eastern horizon. Reaching its highest point in the sky at 23:29, 51° above the southern horizon, it will become inaccessible around 04:18 when it sinks below 21° above the western horizon.

NEPTUNE: is currently approaching opposition. At the beginning of the month, it becomes accessible around 20:42 (BST), at an altitude of 21° above the south-eastern horizon. Reaching its highest point in the sky at 23:31, 32° above the southern horizon, it becomes inaccessible around 02:23 when it sinks below 22° above the south-western horizon. By the end of the month, it becomes accessible around 17:55 (BST), 22° above the south-eastern horizon. Reaching its highest point in the sky at 20:30, 32° above the southern horizon, it will continue to be observable until around 23:17, when it sinks below 22° above the south-western horizon.

MOON PHASES:

| | |
|---------------|--------------|
| New Moon | 28 September |
| First Quarter | 5 October |
| Full Moon | 13 October |
| Last Quarter | 21 October |
| New Moon | 28 October |

Observations of Planets and other objects – Gary Walker

On the nights of 5th and 6th September, I observed the planet Neptune, passing very close to a magnitude 4.4 star - Phi Aqr. It passed only 66 arcseconds from the star on 5th September, and only 37 arcseconds - less than the angular size of Jupiter - on 6th September.

On the first night, Neptune was on the left

hand side of Phi Aqr, but on the following night it had moved round to the opposite side.

In my 8" SCT, Neptune only appears as a bluish "star" at 62X, but at 100X I could just about see it appear as a disk. I got my best view at 166X, where it appeared as a small, slightly bluish-grey disk. Of course, inevitably, Neptune will always appear tiny, even at high powers, as it is only 2.2 arcseconds in size!

The star, Phi Aqr, appeared as a beautiful bright (at least in the telescope), golden star. With the close passage of Neptune, they appeared like a double star, perhaps similar to Alberio, in Cygnus.

For some reason, the GOTO on my scope appears to miss Neptune and Uranus by about half a degree, but will point correctly to other planets such as Saturn.

Saturn is still prominent in the evening sky, but Jupiter is now starting to go out of view. On 5th September, I saw for the first time this year, that the shadow of Saturn's globe was falling across the rings, making them appear to be "cut off" just before they go behind the planet.

In this "season", on Jupiter, the Great Red Spot has been fairly prominent, and like last year, still appearing a pinkish colour in my scope. The Southern Equatorial Belt has remained, but much thinner than the Northern Equatorial Belt.

On 31st August, around 22.13 (BST), I saw 2 satellites moving South-North. They were visible with the naked eye, probably about magnitude 3, but were much better in binoculars - indeed, they were easily visible in the same binocular field of view. What was unusual was that one was following the other in the same path, only about 3-4 degrees apart. Were these part of one of SpaceX's satellite "Constellations" I wonder?

How dark is a night sky? – Gary Walker

On 1st-2nd September, I was trying to discover how many stars I could see with the naked eye, within the Square of Pegasus, as this is a good measure of how dark your local night sky is - the more stars you can see, the

darker (and better!) it is. At best, I saw 6 stars, which means my night sky had a limiting magnitude of +5 to +5.5. This type of sky has been classified as "average", or "good". On the Bortle Night Sky scale, my sky must be 6, or 7 (ie. "Bright-Suburban", or "Suburban-Urban"). However, if that seems good, some areas can see up to 35 stars within the Square of Pegasus. The brightest stars in this Square, are a pair of magnitude 4.4 ones.

It has always been said that in a dark sky, the faintest star visible to the naked eye, is of magnitude 6. However, in really dark skies some people have pushed this to magnitude 7, or even 8. The most distant object visible to the naked eye, has always traditionally been the Andromeda Galaxy, M31 at 2.2 million light years away. However, in really dark skies some have managed to see M81 and M82, about 12 million light years away.

Image metadata in astronomy part2 – more on the FITS format – John Murrell

The first part in the September edition of Janus gave a brief introduction to Image Metadata and the FITS format. This second part looks at FITS files in more detail, and one of the tools that can be used to convert FITS format files into a format understood by image processing software.

There is not room here for a detailed description of the FITS format; however, it is important to note that the metadata is in the form of human (and machine) readable text. As a result, it is possible to open a FITS file in a text editor such as Notepad and view the metadata. If you try this, you will find all the metadata in one long line with no line endings to break the data into separate lines to aid reading. This is largely a relic of the early days of FITS where the data was designed to be stored on 80 column punched cards! As a result, each metadata keyword and the associated data must fit in one row of 80 columns, but it does not have a Carriage Return (CR) & Line Feed (LF) at the end of each line.

Rather than using a standard text editor it is preferable to use a viewer designed to

present the metadata in a friendlier format. A number of these are available on the link below. Using a dedicated viewer also removes the risk of accidentally editing either the metadata or the data itself. Editing the existing metadata will normally result in the data in the file becoming unusable. However, the standard allows users to add new lines of metadata. This is frequently used to document the processing steps that have been carried out to the image after it was initially produced.

While the IAU control the FITS format, in practice, a lot of the legwork is carried out by NASA. They have a webpage at https://fits.gsfc.nasa.gov/fits_documentation.html that contains an extensive set of information about the FITS format as well as links to most of the tools. Certainly, the links in the General Introduction section are worth reading. The website also has links to tools and utilities, I will look at these in more details in future articles.

Some cameras sold for amateur astronomy export their colour images as FITS format files. This is done as the FITS format is lossless - unlike image formats such as JPEG that compress the image data to produce smaller files and as a result lose information and may produce artefacts in the image. There can be a problem with "colour" FITS images in that the standard does not define how a colour image is to be stored. There is a de-facto standard that stores the image in 3 planes, one for each colour, but some programs interpret the data either as 3 monochrome images or else may swap some of the colours. While this occurs infrequently it should be borne in mind particularly if you open "colour" FITS images in a programme such as the Aladin Sky Atlas (<https://aladin.u-strasbg.fr/>). While FITS images can be very large, the data being uncompressed - it is possible to reduce the size by using a lossless compression such as ZIP or GZ.

A second problem is that some image processing software such as Photoshop will not open FITS images – but there is a work around - you need to download a programme called FITS Liberator 3 from https://www.spacetelescope.org/projects/fits_l

[iberator/](#) . This is provided by ESA/ESO/NASA free of charge. As well as allowing FITS files to be converted into TIF format image files this also provides some image processing facilities, and it allows you to view the FITS header as well as the Metadata for the image. For colour images this programme shows each of the 3 planes of a colour image separately and allows you to carry out different scaling (stretching) operations in each of the three planes. The user guide, which contains the installation instructions, is available at: https://www.spacetelescope.org/static/projects/fits_iberator/v301files/userguide.pdf

In preparation for the next part(s) of this series download & install Fits Liberator from the address above and then find some FITS format image files on the Internet and examine the information FITS headers & Metadata as well as experimenting with the scaling (stretching) operations.

If you want to recreate the iconic Hubble Pillars of Creation image the data is available at: https://www.spacetelescope.org/projects/fits_iberator/eagledata/ .

How much energy was in the gravitational waves from the pulsar merger in 2016? – John Murrell

You may remember the announcement in 2016 that after many decades of development the LIGO interferometers had detected the gravitational waves from the merger of two black holes, an event known as GW150914. The gravitational waves were detected for a time of 0.2 seconds and changed the length of the 4km arm of the LIGO detector by around 1/1000 of the width of a proton i.e. around 10^{-18} m (or 0.0000000000000000001m). This small change is the reason that it took so long to develop a detector capable of detecting a signal that small amongst all the noise sources. While the merger released a large amount of energy - around 5.3×10^{47} Joules - it was around 1 billion light years away.

In his presidential lecture to the Royal Astronomical Society, Mike Cruise compared

the amount of energy received at Earth from the gravitational wave to the optical energy received from Jupiter. The result rather surprised me in that the amounts of energy were about the same. How come then that the gravitational waves were so difficult to detect compared to detecting Jupiter which is easy to see with the human eye?

The answer is that a gravitational wave has to bend space time, and space time is extremely stiff. Stiff in the physical sense is defined as how difficult it is to bend it i.e. how much it deflects if a unit force is applied. You probably know how difficult it is to bend a steel rod, but it turns out that space time is around 10^{20} (100,000,000,000,000,000,000) times as difficult to bend as steel! As a result, the comparatively large amount of energy received resulted in a very small bend in space time at the Earth.

Up Next:

NEXT MEETING: Friday 11 October 2019 Nonsuch High School for Girls Library 8pm.

*There will be a Presentation by Mike Maunder on "Eclipses".
Ron Canham will also give his usual presentation on the sky at night for the coming month*

NEXT VIEWING GROUP: Monday 7 October 2019 Nonsuch High School for Girls 8pm.

This is an informal session for members to meet and discuss anything related to their telescopes and sky events and, if weather permits, to go up on the roof for observing.

NEXT DENBIES OBSERVING SESSION:

Please watch our social media and email alerts for updates.

AD HOC OBSERVING AT WARREN FARM:

These will be at short notice when the weather is favourable. Please watch our Whats App feed for alerts.