No. 566 Registered Charity 271313 June 2020

# OASI News

The newsletter of the Orwell Astronomical Society

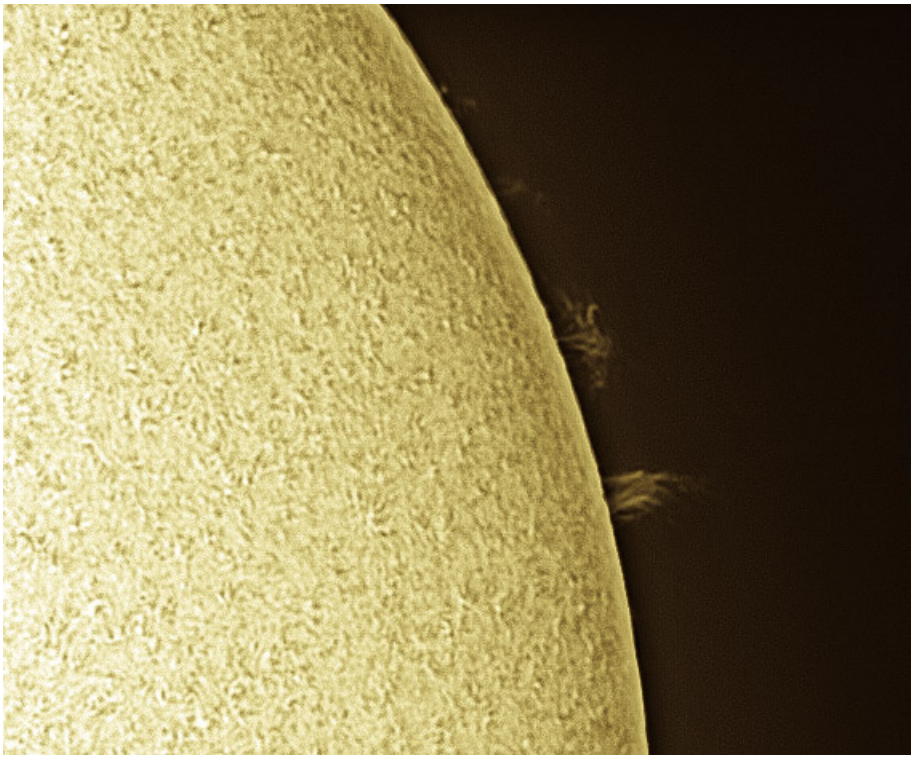


**Image of a prominence on the solar limb in Hα light on the 9/5/2020 at 11:00UT.**

***Photo by Martin Cook***

## Contents

# Society Notices

## Advice regarding Coronavirus COVID-19

**Dear Members,**

Following the 16 March Press Conference from the Prime Minister and leading Scientists from Public Health England, it is clear that the number of Coronavirus cases in the UK is accelerating rapidly.

One of the key points was to "Avoid any non-essential social contact". The time has come to protect the health of our members and their families, therefore, I regret that we will be suspending all OASI activities until further notice. This includes our meetings at Orwell Park and Newbourne, plus all outreach events.

I will send an email to all members when the Committee decides it is safe to resume our activities, hopefully, in the not-to-distant future.

Let's all keep in touch during the OASI "lockdown", one bonus of being forced to stay at home means more time for star gazing and astrophotography!

Thank you,

***Andy Gibbs, Chairman***

## Society Contact details

| | |
|---|---|
| Observatory (meeting nights only) | 07960 083714 |
| Email queries: | info@oasi.org.uk |
| Facebook: | Orwell Astronomical |
| Twitter: | @OASIpswich |
| Members-only message board | https://groups.io/g/OASI |

**Please send material for the OASI web site and newsletter e.g. observations, notices of events, general interest articles, to**

**news@oasi.org.uk**

**Other contact details will be issued to members on a separate printed list.**

## Access into the School Grounds and Observatory Tower

**The Observatory is closed.**

## Articles for OASI News

News, pictures and articles for this newsletter are always welcome. Please send them to

**news@oasi.org.uk**

**The CLOSING date is the 15th day of the month**

Please submit your articles in any of the following formats:–

Text: txt, rtf, rtfd, doc, docx, odt, Pages, pdf
Spreadsheets: xls, xlsx, OpenOffice/LibreOffice, Numbers
Images: tiff, png, jpg
Please send tables as separate files in one of the above formats.

If you don't feel up to writing a major article, perhaps you might write a short note for OASI News along the lines of *"This month I have mostly been observing/constructing/mending/reading/etc."*?

Newsletter archive www.oasi.org.uk/NL/NL_form.shtml

**Authors, please note that your articles will now be publicly available worldwide!**

### Reproducing articles from OASI News

If you plan to reproduce an article exactly as per OASI News then please contact the Editor – otherwise, as a matter of courtesy, please seek permission from and credit the original source/ author. You may not reproduce articles for profit or other commercial purpose.

## Committee 2020

| | | |
|---|---|---|
| Chairman | Andy Gibbs | Set overall agenda for OASI,<br>Chair committee meetings,<br>Press and publicity, |
| Secretary | Roy Gooding | Outreach meetings (jointly with Chairman), observatory decoration. |
| Treasurer | Paul Whiting FRAS | Finance, Supervision of applications for grants. |
| | | Visits by outside groups, Observatory tours, Public appreciation of astronomy, Outreach activities. |
| Committee | James Appleton | Committee meeting minutes, Web site |
| | Martin Cook | Membership, Tomline refractor maintenance & user testing |
| | Matt Leeks | Safety & security |
| | Peter Richards | Lecture meetings, Email distribution lists |
| | John Wainwright | Equipment curator |
| | Mike Whybray | Astronomy Workshops, Child protection officer, Orwell Park School Astronomy Club. |
| | Andy Wilshere | Librarian |
| | Avtar Nagra | OASI @ Newbourne |

### Assistants

| | | |
|---|---|---|
| | Martin Richmond-Hardy | Newsletter, OASI @ Newbourne |

### Signing in and out

Please ensure you sign in and out when visiting the Observatory and/or Newbourne. This is for fire safety precautions and also provides an historic record.

## Committee Meeting

This will be held on **Friday 4 September,** 8pm by Skype. Please join the **OASImembers** Skype group to attend. Contact Martin Cook for details.

## Welcome new & returning members

Graham Wood

*We wish all our readers and their families good health during this difficult time. Clear skies!*

# OASI and BAA Events

**For the latest event details, please see www.oasi.org.uk/Events/Events.php**

There's a Google Calendar on the OASI web site with the latest dates (and corrections!). If you want to easily add OASI Events to your own computer/ phone/tablet calendar application click this button on the website Events page (bottom right of the calendar) or use this address to access this calendar from other calendar applications.

https://calendar.google.com/calendar/ical/1jhs9db71ncki4sojo7092vfvc%40group.calendar.google.com/public/basic.ics

**For other astronomy news and astro pictures try our**

Twitter feed https://twitter.com/OASIpswich

Facebook page https://www.facebook.com/pages/Orwell-Astronomical/158256464287623

Subscribe to the OASI Yahoo group by emailing oasi-subscribe@yahoogroups.com

Key:

**OASI public events** *BAA & SPA events* *Other events*

| **Date, Time & Location** | **Contact** | **Event** |
|---|---|---|
| Weekly, every Wednesday, 20:15–22:00<br>Orwell Park Observatory | Martin Cook,<br>Roy Gooding | OBSERVATORY CLOSED<br>Meet via Skype. |
| Mon 8 June from 19:00<br>Skype | Martin Richmond-Hardy<br>newbourne@oasi.org.uk | OASI@Newbourne.<br>**Meet via Skype.** |
| Wed 17 June 19:30 | See page 9 | *Free Public Online Astronomy Lecture on Wednesday 17 June at 7:30 pm BST. The Lecture is "The Far Side of the Moon: Is it Just Aliens?" and will be presented by Dr Julian Onions from the University of Nottingham* |
| Mon 22 June from 19:30 via Skype | Martin Richmond-Hardy<br>newbourne@oasi.org.uk | OASI@Newbourne.<br>**Meet via Skype.**<br>Talks by:<br>Bill Barton on the night sky.<br>Paul Whiting: *Wartime Astronomy* |
| Saturday 27 June | Pete Richards<br>lectures@oasi.org.uk | Summer BBQ, is cancelled. |

## Please note that the listed events may change depending on the progress of the pandemic.

# Meetings via Skype

**Martin RH**

I've set up an OASImembers group on Skype. To join, please first contact Martin Cook with your Skype name. OASI members only. Be sure to download the latest version of Skype.

We meet on Wednesday evenings from 19:30 and on Newbourne nights (see below) from 19:30.

The Committee are considering moving to using Zoom or another videoconferencing service in order to accommodate more participants.

# OASI @ Newbourne

**Martin Richmond-Hardy newbourne@oasi.org.uk**

We normally meet at Newbourne Village Hall, Mill Lane, IP12 4NP on the 2nd and 4th Mondays (with a few exceptions). **BUT In view of the COVID-19 situation all meetings at Newbourne are suspended. If OASI members would like to meet up via Skype on those evenings, please first contact Martin Cook with your Skype name to receive an invitation. Members only, please.**

**OASI@Newbourne Meetings**

Subsequent meetings will be assessed in line with the current Government Guidelines in place at the time. Thank you for your understanding.

| | | | |
|---|---|---|---|
| 8 Jun | 22 Jun (S+W) | July 13 (W) | July 27 (S) |
| Aug 10 | Aug 24 (S+B) | Sept 14 | Sept 28 (S+B) |
| Oct 12 | Oct 26 (S+B) | Nov 9 | Nov 23 (S+B) |
| Dec 14 | Dec 28 (S+B) | | |

We open up for all meetings at 7pm. Star Guide (S) at 7:30pm and Workshops (W) at 7:45pm.

## Stargazer's Guide

On the last meeting each month Bill Barton FRAS will give a short presentation of what can be viewed in the following 4 weeks plus a reminder of OASI events. During the COVID-19 isolation period these will be available on our website and in OASI News.

## Astronomy Workshops/Informal talks

**Contact Mike Whybray** **Location: Newbourne Village Hall IP12 4NP**

**Doors open at 7:00pm.** **Workshops start at 7:45pm**

If you are a new OASI member, or haven't been to one of these informal workshops before, they are a mixture of events of different characters including beginners talks, interactive workshops, films, etc., suitable for all. They are also a chance to chat with other members over a cup of tea and a biscuit, in a venue rather warmer than the observatory dome on a winter's night!

Given a clear night, we can make use of the field for a workshop or continue afterwards with some observing.

**Meetings will depend on COVID-19 situation. Talks will be via Skype during lock-down..**

- Paul Whiting: *Wartime Astronomy*, date 22 June (via Skype/Zoom).

Paul Whiting, Bill Barton and James Appleton have offered to lead workshops as follows:

- Paul Whiting: *Galaxy Collisions*, date TBA.
- Bill Barton: *Celestial Coordinates*, date TBA. New members at Newbourne have requested this workshop; Bill is willing to lead it but will defer if anyone else would rather do so.
- James Appleton: *Update on OASI All-Sky Meteor Cameras*, date TBA.

Do you have a subject you could workshop? You could do a short one, or share the effort with a partner. Drop Mike Whybray a line! workshops@oasi.org.uk

# Lecture Meetings


**Contact: Peter Richards lectures@oasi.org.uk**

We have an exciting and interesting set of lectures by guest speakers for the Autumn.

There is a new venue for lectures this year which is:

St Augustine's Church Hall
Bucklesham Road
Ipswich IP3 8TH.

The start time for all talks will be 8pm and, as usual, the talks will be held on Friday evenings.

Friday 25th September

Nik Szymanek

"Adventures in Deep Sky Astrophotography"

Friday 23rd October

Sonali Shukla

“Brown dwarfs: Linking stars and planets”

Stars and planets are fundamentally different astronomical object yet the formation processes for each of these types of objects are heavily intertwined. Brown dwarfs straddle the realm of both stars and planets, exhibiting characteristics of both but not fully fitting into either category. I will explore the history, discovery and latest results from our study of brown dwarfs and relate them to our lowest mass dwarf stars and biggest known planets. Understanding brown dwarfs can lead us to better understand how stars and planets form in tandem, both in our solar system and beyond.

Friday 20th November

Matt Bothwell:

“Big bangs to big rips: a history of 20th century cosmology”".

# Other local astronomy society meetings

## Athaneum Astro Society

**www.3a.org.uk/index.htm**

We meet fortnightly on Thursdays, from 7.30pm, at our dark-sky site in the Walled Garden at Nowton Park, just outside Bury St Edmunds. If you're planning on joining us for the first time, please contact us in advance, just to make sure the meeting is going ahead. We recommend that you wear warm clothing (even summer nights can be chilly, especially when the skies are clear!) and bring a flask, or insulated mug, for a warm drink. We have tea and coffee-making facilities on-site. Events are listed here http://www.3a.org.uk/events.htm

## LYRA Lowestoft & Yarmouth Regional Astronomers

**www.lyra-astro.co.uk**

**Due to current Corona Virus outbreak all LYRA meetings are cancelled until further notice.**

## DASH Astro

**Darsham And Surrounding Hamlets http://dash-astro.co.uk**

Meetings are held at New Darsham Village Hall and all DASH Astro observing sessions will take place at WESTLETON COMMON. ASOG observing sessions and locations may be arranged at the time of observation. Unless stated all group meetings will take place from 7:30 pm. on Sundays

**Meetings will be assessed in line with the current Government Guidelines in place at the time. Thank you for your understanding at this time. Stay Safe.**

**Note * Guest Speaker Evenings - Admission Fees:- Members Free, Non Members £ 2:00**

**Meetings are now on Sundays.**

| | |
|---|---|
| **06 Sept** | **Meeting:- Ian Lomas - Quantum Mechanics for Beginners** |
| 13 Sept | Dash Observing Session ( Sunset 19:14 Moonset 17:46 21.5% Moon) |
| 19&20 Sept | Outreach:- Henham Steam Rally. Solar Observing and Displays |
| **04 Oct*** | **Meeting:- Stewart Moore – Globular Clusters** |
| 18 Oct | Dash Observing Session ( Sunset 17:50 Moonset 18:57 4.7% Moon ) |
| 01 Nov | Meeting:- Talk T.B.C. |
| 15 Nov | Dash Observing Session ( Sunset 15:59 Moonset 16.21 0.2% Moon ) |
| 29 Nov | Meeting:- Talk T.B.C. |
| 12- Dec | (Saturday) DASH Christmas Social ( Members and Guests only ) |

# BAA news

## BAA meetings in June–July

Sat., June 20 Advanced Planetary Imaging Workshop **POSTPONED**

For full details of all meetings or cancellations, please go to https://britastro.org/meetings.

## BAA Wednesday Webinars

https://britastro.org/node/21142

| | | |
|---|---|---|
| 3 June | Nick James, BAA Comet Section Director | A Journey through the Comet Section archives |
| 10 June | Prof Frazer Pearce, University of Nottingham | Adventures in the Goldilocks Zone |
| 17 June | Mike Frost, BAA Historical Section Director | Revd Dr William Pearson: co-founder of the RAS |
| 24 June | Mike Foulkes, BAA Saturn, Uranus and Neptune Section Director | Observing Saturn in 2020 |
| Wed, July 1 19:00 | Jeremy Shears, BAA Variable Star Section Director | Is SS Cygni losing the plot? Observing unusual outbursts in a well-known dwarf nova - Webinar |
| 4 July | | BAA Summer Webinar |
| Wed 8 July 19:00 | Stewart Coulter | Cook, the Transit of Venus, Aftermath and Legacy |

# FAS: GoSpaceWatch Virtual Meeting - 17th June

**Michael Bryce, FAS Newsletter Editor**

## Meeting Details

Go Space Watch presents a free Public Online Astronomy Lecture on Wednesday 17 June at 7:30 pm BST. The Lecture is “The Far Side of the Moon: Is it Just Aliens?” and will be presented by Dr Julian Onions from the University of Nottingham.

## About the Lecture:

The Moon is a shy body, it only ever shows one side of itself to the Earth. Before the space age, we had no idea what was on the far side of the Moon. This has led to a number of conspiracy theories that it is a haven for aliens. In this talk, we’ll chart the progress of how we got to see what was on the far side of the Moon, and what we found there. Tin foil hats are optional!

## About the Speaker:

Julian works with computer simulations of large fractions of the universe to understand trends in galaxy formation and evolution. Investigating the tools that help us form and analyse such simulations such as halo finders, tree builders and semi-analytic models. He also does a number of outreach activities, giving talks to astronomy societies and other interested groups such as rotary and U3A, as well as working with schools and scouts/guide groups. He also helps with the teaching of undergraduates in some of the astronomy courses.

Register for free through Eventbrite at the following link:

https://www.eventbrite.co.uk/e/free-public-online-astronomy-lecture-registration-105940583136

More details about Go Space Watch and CAPCOM Magazine can be found at

www.gospacewatch.co.uk

# The Night Sky in June 2020

**Martin RH**

All event times (**BST unless otherwise stated**) are for the location of Orwell Park Observatory 52.0096°N, 1.2305°E.

## Moon

Source: http://heavens-above.com/moon.aspx

| New Moon | 1st Quarter | Full Moon | Last Quarter |
|---|---|---|---|
| | | 05 June 20:12 | 13 June 07:24 |
| 21 June 07:42 | 28 June 09:16 | | |

## Sun, Moon and planets

Source: http://heavens-above.com/PlanetSummary.aspx **Times are BST (UTC+1)**.

| Object | Date | Rise | Set | Mag. | Notes |
|---|---|---|---|---|---|
| **Sun** | 1 | 04:41 | 21:06 | | Summer solstice Jun 20, 22:43 |
| | 30 | 04:39 | 21:18 | | |
| **Moon** | 1 | 15:19 | 02:58 | | Perigee 03 June 04:39 and 30 June 03:13<br>Apogee 15 June 01:57 |
| | 30 | 15:50 | 01:42 | | |
| **Mercury** | 1 | 05:49 | 22:54 | -0.2 | In evening sky, greatest elongation June 04 (24°). Good observing opportunity mid May to mid June |
| | 30 | 05:19 | 20:41 | 5.1 | |
| **Venus** | 1 | 05:18 | 22:10 | -4 | Venus occultation by moon 19 June |
| | 30 | 03:04 | 18:09 | -4.3 | |
| **Mars** | 1 | 02:17 | 12:28 | 0.1 | |
| | 30 | 00:42 | 12:16 | -0.5 | |
| **Jupiter** | 1 | 00:32 | 08:35 | -2.4 | |
| | 30 | 22:02 | 06:01 | -2.6 | |
| **Saturn** | 1 | 00:45 | 09:02 | 0.4 | |
| | 30 | 22:19 | 06:35 | 0.2 | |
| **Uranus** | 1 | 03:49 | 18:12 | 5.9 | |
| | 30 | 01:34 | 16:04 | 5.8 | |
| **Neptune** | 1 | 02:30 | 13:39 | 7.9 | |
| | 30 | 00:13 | 11:23 | 7.9 | |

## Occultations during May 2020

**James Appleton**

The table lists occultations during the month under favourable circumstances. The data relates to Orwell Park Observatory, but will be similar at nearby locations.

The events should be readily visible in small telescopes or binoculars. The first two columns list the date and time (UT) of the occultation. Column three gives the phenomenon: 'D' denotes a disappearance and 'R' a reappearance. The table lists circumstances of disappearances and reappearances as dictated by the visibility of each phenomenon (determined by altitude, lunar phase, etc). Column four details the lunar phase ('+' for waxing and '-' for waning). Columns five and six give the altitude of the Sun and the star, both in degrees. A negative solar altitude means that the Sun is below the horizon. Columns seven and eight provide the star's magnitude and catalogue number.

The data relates to Orwell Park Observatory, but will be similar at nearby locations.

Please note that **times are shown in UTC**.

| Date | Time (UT) | D/R | Lunar Phase | Sun Alt(º) | Star Alt(º) | Mag | Star |
|---|---|---|---|---|---|---|---|
| 02 Jun | 23:09:43 | D | 0.89+ | -15 | 24 | 7.2 | 97 Vir, MU Vir |
| 12 Jun | 02:24:17 | D | 0.61- | -8 | 14 | 4.1 | 71 Aqr, τ2 Aqr |
| 29 Jun | 22:21:24 | D | 0.68+ | -12 | 18 | 6.2 | ZC 1994 |

## Meteor showers

**Source: BAA Handbook 2020 p100-101**

| Shower | Normal limits | Maximum | ZHR at Max | Notes |
|---|---|---|---|---|
| Daytime Arietids | May 22 – July 2 | June 7 | 30? | Most active of the daytime showers. Good for radio observers. ZHR and radiant location uncertain. |
| Daytime ζ-Perseids | May 20 – July 5 | June 9 | 20? | Peak overlaps with that of Daytime Arietids. Good for radio observers. ZHR and radiant location uncertain. |

For radio observation, use reflections from Graves radar on 143.050MHz or the Brams transmitter in Belgium on 49.97MHz.

## Visible ISS passes ≥15º max altitude

**Martin RH**

Source: http://heavens-above.com/PassSummary.aspx?satid=25544

**Times are BST.** Predictions are approximate (26 May) due to craft adjustments. Check the day before.

| Date | Bright-ness (mag) | Start | | | Highest point | | | End | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Time | Alt. | Az. | Time | Alt. | Az. | Time | Alt. | Az. |
| 30 June | -1.4 | 03:51:50 | 10° | S | 03:53:37 | 14° | SE | 03:55:25 | 10° | ESE |

## Starlink passes

https://heavens-above.com/AllPassesFromLaunch.aspx

## Comets with magnitude brighter than magnitude 10

Source: https://heavens-above.com/Comets.aspx

Some new ones not in the BAA Pink Book.

| Comet | Brightness | Date of peak | Constellation |
|---|---|---|---|
| C/2020 F8 SWAN | 6.8 | ? | Perseus |
| C/2019 U6 | 7.0 | ? | Canis Major |
| C/2020 F3 NEOWISE | 8.2 | ? | Monoceros |
| C/2017 T2 PANSTARRS | 8.7 | May 12 | Ursa Major |
| C/2019 Y1 ATLAS | 9.8 | ? | Ursa Major |

## Astronomy on the radio

**During virus isolation these slots will either be reports read by the host or via phone to the studio.**

### Bill Barton's Radio Broadcast

ICRFM (Ipswich Community Radio) 105.7 MHz at about 08:25 in the morning of the first Wednesday of each month. I aim to cover what there is to see in the sky and then a little bit on something topical. ICRFM is also available to listen to over the Internet and there is a listen again option on their website. http://www.icrfm.com

### David Murton's Radio Broadcast

On 1st Tuesday of the month, 2.40pm (note change of time) on the Lesley Dolphin show on BBC Radio Suffolk – now digital (channel 10c) and FM 103.9 (Ipswich), 104.6 (west Suffolk), 95.5 (Lowestoft), 95.9 (Aldeburgh) and the internet. https://www.bbc.co.uk/radiosuffolk

# Venus

**Andy Gibbs**

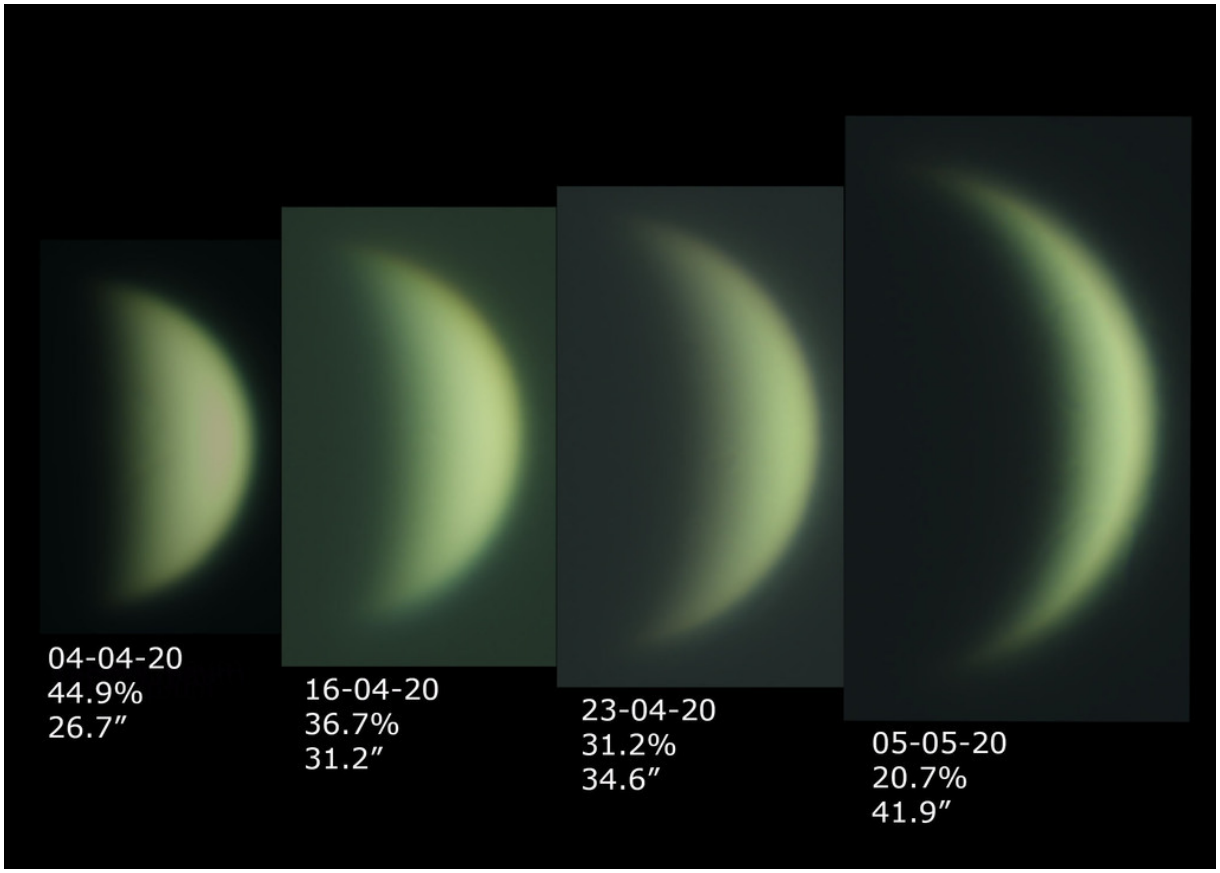
Venus has been superbly placed in the evening sky over the last few months. It is now moving closer to the Sun where it will reach Inferior Conjunction on 3 June.

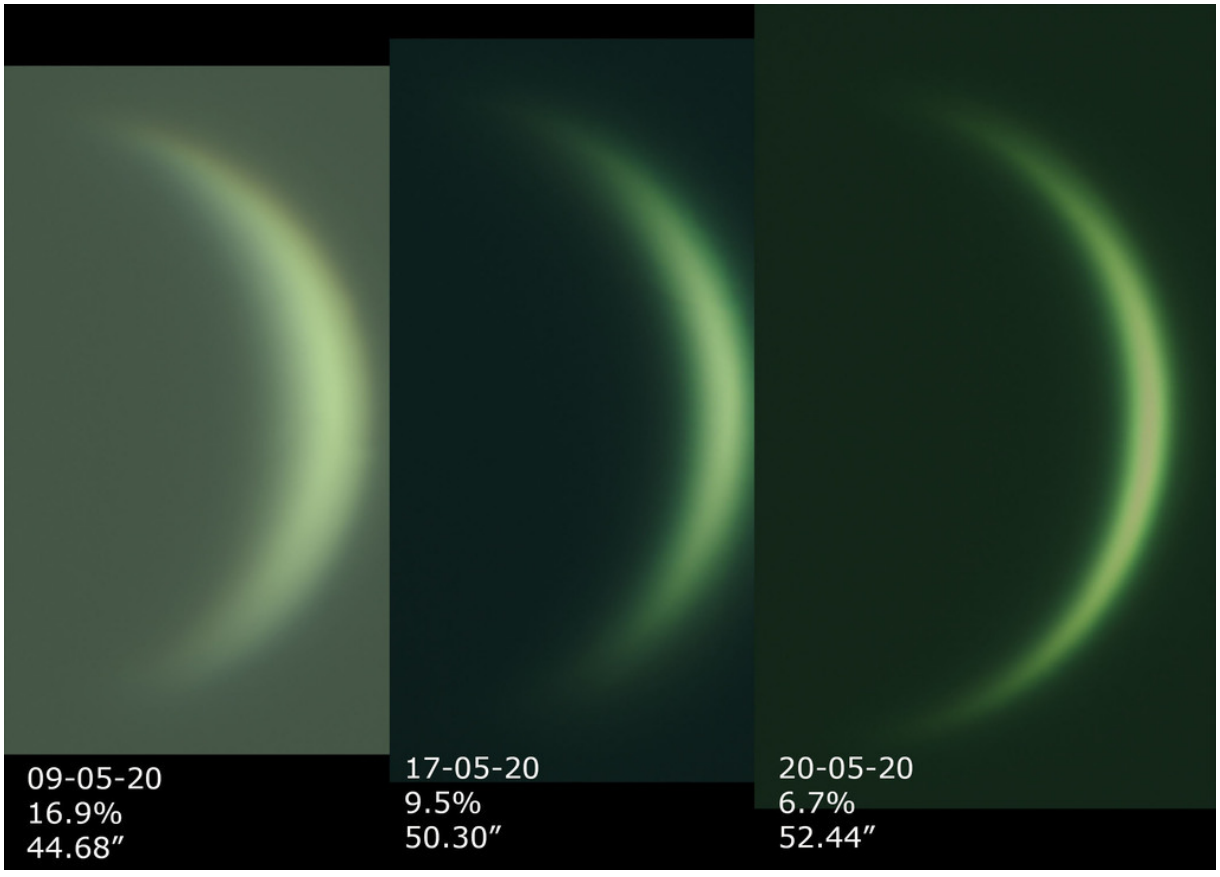
The many clear days during lockdown has given me chance to take a series of images, recording the decreasing phase and the increase in apparent diameter.

I have taken my images during daylight, when the planet was around 60 degrees in altitude, although I was troubled by high cloud at times.

My last image was taken on 20 May, I did try again on 22 May, but was defeated by cloud. It is now getting too risky for me to attempt any more images during daylight. During the forthcoming Inferior Conjunction, Venus will only be around half a degree from the Sun.

Equipment used : QHY 5 II L camera and Meade 200mm LX200 with 2.5x Barlow Lens. Processed in Sharpcap 3, Registax 6, Affinity Photo and Photoshop CC 2020.


04-04-20
44.9%
26.7″
16-04-20
36.7%
31.2″
23-04-20
31.2%
34.6″
05-05-20
20.7%
41.9″


09-05-20
16.9%
44.68″
17-05-20
9.5%
50.30″
20-05-20
6.7%
52.44″

# Today at the proms

**Martin Cook**

Action on the Sun on 9 May. Is the Sun coming out of lockdown?

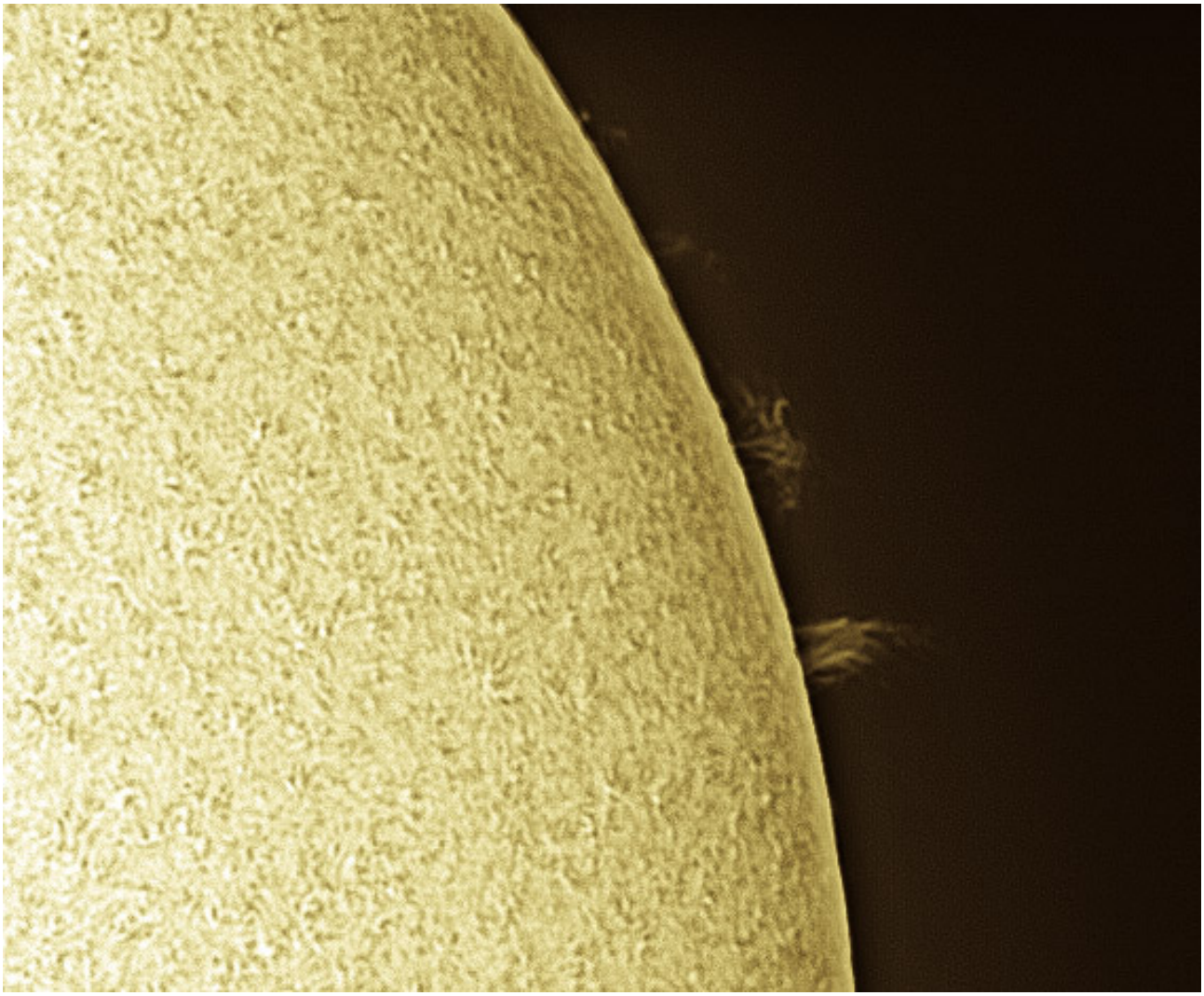


**Image of a prominence on the solar limb in Hα light on the 9/5/2020 at 11:00UT.**

The image is made up of 2 images stitched together. The surface image was  0.005sec exposure and the proms was a 0.025 sec exposure. The best 20% of 2000 frames were stacked together to form the starting image.

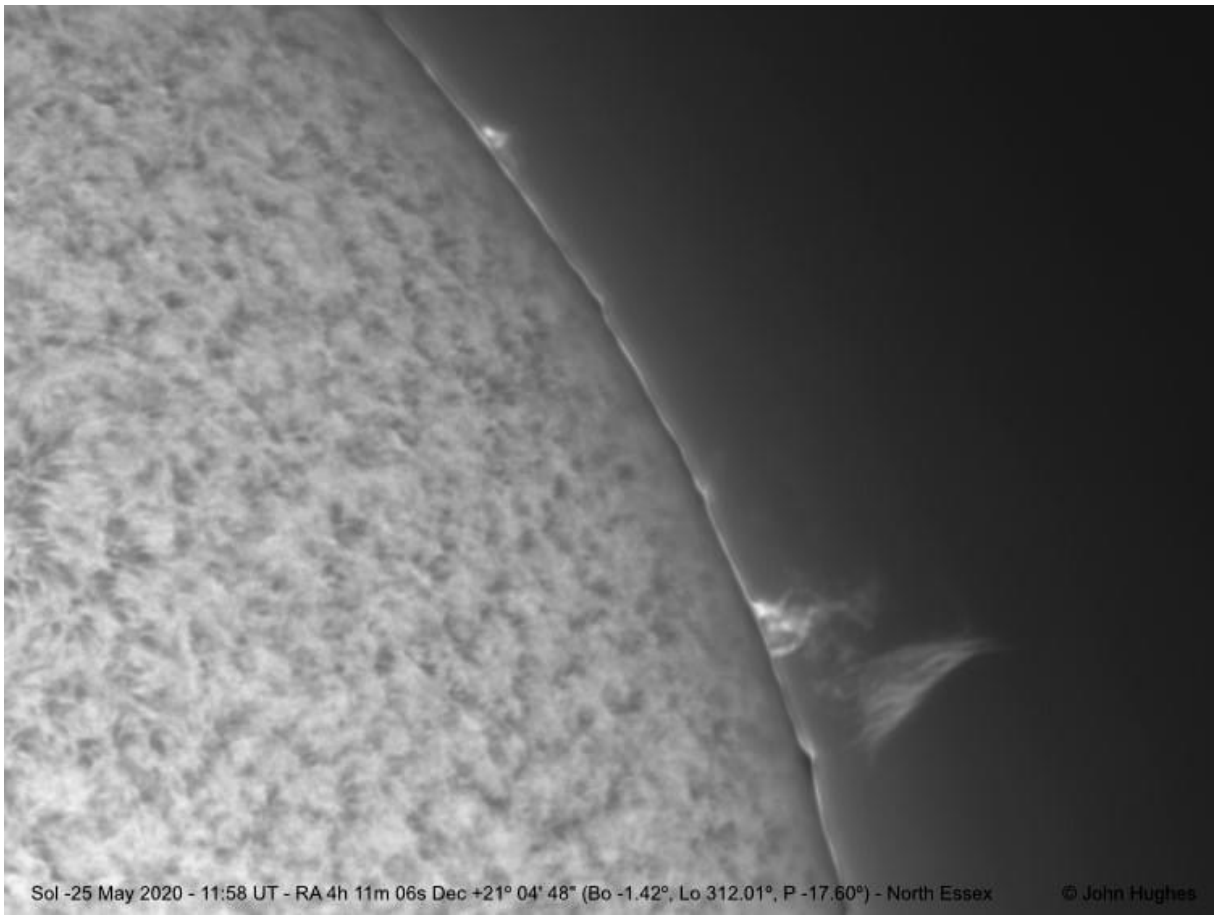
The B&W image was then with coloured using photoshop.

Lunt LS60THa/B1200 telescope X2 Barlow lens.

ZWOASI178mm camera

# The Sun, 25 May 2020 with prominence.

**John Hughes**




## Capture details

An 500 frame video of the chromosphere was taken to reveal the surface detail of the Sun. The exposure settings were then increased to deliberately overexpose the surface and show the prominence and a second 500 frame video was obtained.

Both videos were then stacked in Autostakkert 2 and integrated using the best 50 frames to create two separate image files.

## Processing details

These two files were then processed with histogram, contrast adjustments and sharpening in PixInsight.

The prominence image was then laid on top of the chromosphere and the position adjusted to match the arc of the Sun's limb. A mask was then used and painted away in Affinity Photo to reveal the chromosphere beneath.

## Equipment

Image acquired using;

William Optics Z61 refractor ZWO ASI174mm camera Quark H-alpha filter Sharpcap

Skywatcher EQ6r-Pro mount.

Light cloud was drifting in throughout the session and seeing was fair.

# Mercury, Venus and the young crescent Moon

**Nigel Evans**


Yesterday evening [24 May] provided another chance to image Venus before a big block of cloud rolled in. The resultant image is just as unimpressive as the one the from the evening before (the original was mislabelled, so it is attached again).

I missed out on the recent Mercury-Venus conjunction due to the weather, but later last evening it cleared and another photo opportunity beckoned - Venus, Mercury and a young crescent Moon. These were too low to see from the garden or the street, so they were seen from an upstairs window. Mercury was some 20 degrees from the Sun - Venus only 15. It is only on occasions like this, where there are other bright 'marker' objects nearby, that it is possible to find and see Mercury with the naked eye. I have only seen Mercury with the naked eye on a handful of occasions before.

# Comets

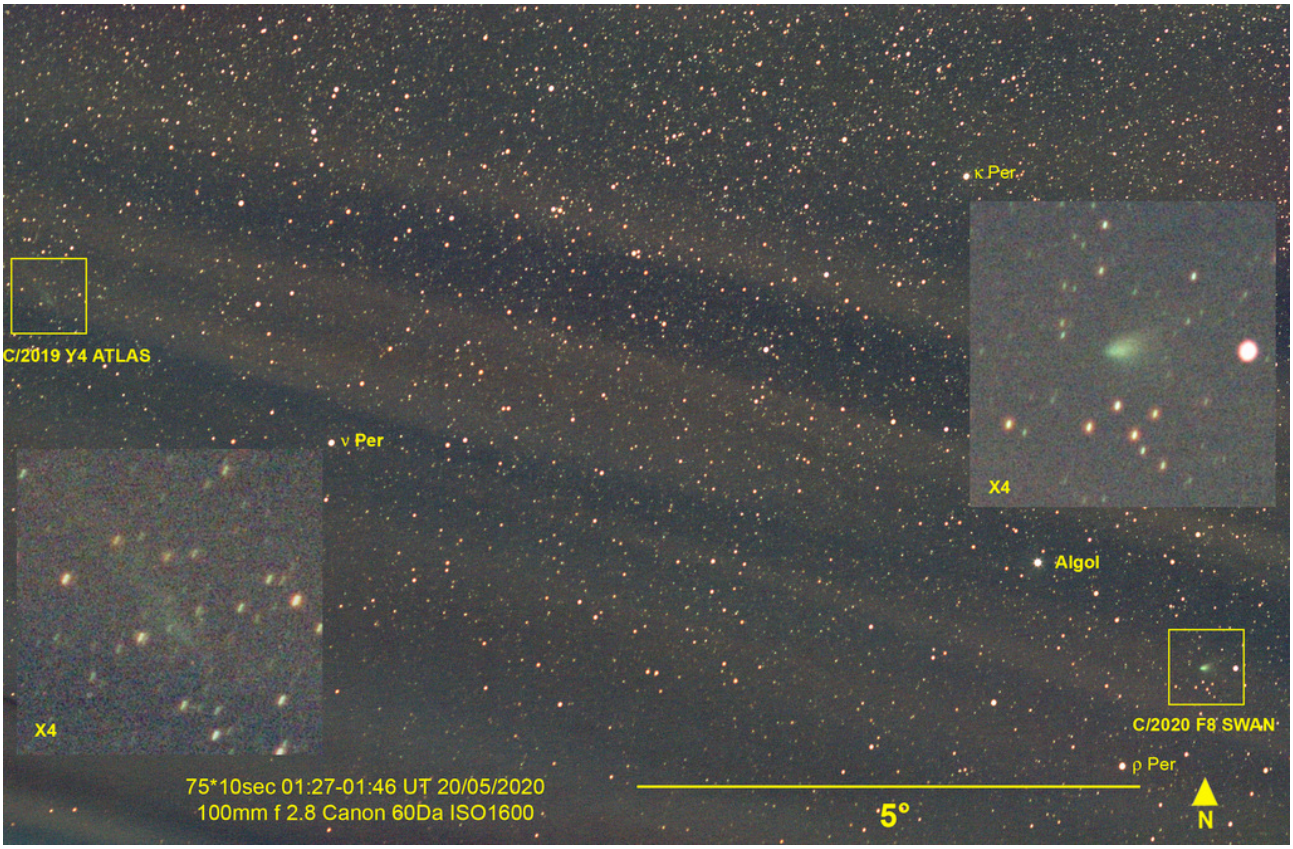
**Nigel Evans**

Earlier this year there were high hopes for C/2019 Y4 ATLAS to put on a decent show in May - that was before it fell apart :-( . However the remnants are still in orbit around the Sun.

By the time we got to May a new boy had arrived - C/2020 F8 SWAN. On the morning of 20th May I went out into the countryside north of Ipswich, primarily to photograph SWAN, but also with a secondary objective of seeing whether it was possible to record 2 comets in the same moderate field of view

At the time the Sun was 14-15 degrees below the horizon so there is some lighting from the dawn. Also refraction meant the multiple images do not stack terribly well and there were cirrus clouds or haze parallel to the horizon in the distance.

The result? F8 SWAN is easily recorded, looking like a smaller-scale version of the image I have previously posted. However in the left hand edge is a faint smudge that is in the position of Y4 ATLAS. It is just a smudge, and realigning the images on the comet doesn't really improve things.



# An Estimate of the Radius of Venus' Orbit

**Bill Barton.**

Advantage was taken of the recent 'greatest eastern elongation' of the planet Venus to estimate the radius of her orbit, although no claim is made for the originality of this method.

Offsetting from the Sun Venus was easily found at around 5:00pm. Indeed the observer reported never seeing the planet looking so bright against a bluer sky (a result of the recent drop in air traffic?). With the planet in the centre of the telescope eyepiece (a Carl Zeiss Telementor) a piece of string was looped around the eyepiece and pulled out straight. The free end of the string was then moved around until the shadow of the free end aligned with the one attached to the eyepiece. The distance between the string and the telescope barrel was then measured an arbitrary 20cm along each. This measurement was 16cm. The co-sine formula was used to find the size of the angle between the Sun (taut string) and Venus (telescope) as 47°. This was slightly in excess of with the figure published in this year's BAA Handbook (O-C residual +1°). When viewed under high magnification Venus was seen to exhibit a half phase which, knowing it to be a globe, implies its source of illumination was at right angles to the view through the telescope. A second triangle can now be formed with the Sun, Earth and Venus as its vertices. The angle at Venus is 90° and at the Earth is 47°. Taking the Earth's radius as one (otherwise known as the 'Astronomical Unit') the triangle can be solved with the Sun-Venus edge being 0.71 of the Sun-Earth edge. The accepted value for this measurement is 0.723, so the error in this experiment was in the order of minus 1.8%. For centuries that was as far as astronomers could go, to say only what the relative sizes were as the Sun-Earth distance was incapable of independent actual measurement.

This experiment only works because of the similar sizes of the quantities being measured, for instance if it is tried with the Moon (whose distance is capable of independent measurement by parallax) the experiment fails because the resultant triangle has an angle at the Sun of negligible size and the angles at Earth and Moon are both virtually right angles. Also the surface of the Moon is rocky and insufficiently smooth to permit determination of the exact moment of 'half phase'.

# More On Planetary Orbits

**Bill Barton**

Last time I demonstrated how the orbital radius of an inferior planet (those that orbit between the Earth and the Sun) could be determined by trigonometry, but what about superior planets (those with orbits outside the Earth's)?

Johannes Kepler (1571-1630) devised laws of planetary motion building on data recorded by Tycho Brahe (1546-1601). In his third law Kepler revealed that the cube of each planet's orbital radius divided by the square of its 'year' produced a numbers which were highly similar (a 'constant' in mathematical speak) no matter which planet was under consideration.

| Planet | Mean solar distance, R (AU) | Period, T (Earth years) | $R^3/T^2$ |
|---|---|---|---|
| Mercury | 0.4? | 0.2409 | 1.103 |
| Venus | 0.7 | 0.6160 | 0.904 |
| Earth | 1 | 1 | 1.000 |
| | mean constant | | 1.002 |

Upon finding this pattern Kepler wrote:

> *"I first believed I was dreaming… But it is absolutely certain and exact that the ratio which exists between the period times of any two planets is precisely the ratio of the 3/2$^{th}$ power of the mean distance." (from Harmonies of the World, 1619)*

There is a complication we need to be careful to take account of here and that is that can only observe the other planets in our solar system from the Earth, which is itself in motion. Thus to find length of any of the other planets orbital periods (or years) we need to take account of this motion which can be done using the following formula

$$1/T_{syn} = |1/T_E - 1/T_P|$$

Where $T_E$ is the Earth's orbital period.

Where $T_P$ is the period between successive oppositions of any superior planet, and

$T_{syn}$ is the orbital period of that planet.

(The vertical bars are called 'absolute value', i.e. ignore the polarity of the answer of the calculation and always take it as positive)

Using data that was regarded as correct in Kepler's time.

| Planet | Period between oppositions (Earth years) | True orbital period (Earth years) |
|---|---|---|
| Earth | 1 | |
| Mars | 2.136 | 1.787 |
| Jupiter | 1.092 | 11.726 |
| Saturn | 1.035 | 29.057 |

Having previously established that the constants for Mercury and Venus (whose orbital radii can be determined by trigonometry) is around one and knowing the length of each superior planets 'year' we can go on to estimate each superior planets orbital radius.

Rearranging Kepler's third law formula to make R the subject

$$R=\sqrt[3]{1.002T^2}$$

| Planet | Constant | Orbital period, T (Earth years) | Inferred mean solar distance, R (AU) | Modern value (AU) | Error |
|---|---|---|---|---|---|
| Mars | 1.002 | 1.787 | 1.47 | 1.52 | -3.29% |
| Jupiter | 1.002 | 11.726 | 5.16 | 5.20 | -0.77% |
| Saturn | 1.002 | 29.057 | 9.46 | 9.58 | -1.25% |

Since Kepler's time new planets were discovered

| Planet | Constant | Orbital period, T (Earth years) | Inferred mean solar distance, R (AU) | Modern value (AU) | Error |
|---|---|---|---|---|---|
| Uranus | 1.002 | 84.0205 | 19.196 | 19.218 | -0.11% |
| Neptune | 1.002 | 164.8 | 30.079 | 30.11 | -0.10% |
| Pluto | 1.002 | 247.94 | 39.493 | 39.482 | +0.03% |

Again I would like to stress the final comment from last time that these distances are only relative to the Earth and no absolute values (in miles or kilometres, for example) could historically be found.

# Molecular Oxygen Observed Outside the Solar System

**Article from the Library**

**Picture credit: NASA picture of Markarian 231**

Far into outer space, 581 million light years away, with a supermassive binary black hole at its centre, exists Markarian 231, a type 1 Seyfert galaxy. It languishes at an Ra of 12 h 56 s and a Declination of +56 °51' 59''. It was initially discovered in 1969, but it is only recently that further investigation has been performed. Astronomers from the Shanghai Astronomical Observatory in China under the leadership of Junzhi Wang began observations around Mrk 231 in August 2015 and again December 2017. They used IRAM (Institute for Radio Astronomy in the Millimetre Range) 30m telescope and NOEMA (Northern Extended Millimetre Array). This culminated in the detection of molecular oxygen, at the 12 sigma level with FWHM ( full width at half maximum) line width travelling at approximately 450 km/s towards the QSO Mrk 231. IRAM is to be found on the Sierra Nevada area of Spain and NOEMA in the French Alps. Several other papers have been written using data from the Herschel/PACS instrument, formally known as 'FIRST'.

Atomic and molecular oxygen exist as different entities, one as a free radical and one as an ion. Atomic oxygen is a free radical, i.e. it has one or more unpaired electron, whereas ions have paired electrons, and can subsist, having dropped or acquired an electron, as positively or negatively charged molecules or atoms, which are comparatively stable.

Sub-millimetre astronomy has been used to attempt to search for oxygen; however its use is greatly reduced due to atmospheric emission, noise and depletion. It is also controlled by water vapour absorption bands which occasionally allow a 'window of opportunity' between these bands to provide a slot to permit surveillance. Mauna Kea in Hawaii is one of the few astronomical sites on Earth that avail themselves of this "window". However when looking for Oxygen line sources in deep space, they are found to be red-shifted, allowing Earth–based telescopes to be used. Perhaps a better choice for this astronomy may be from space, which removes all Earth limitations.

Markarian 231's power is obtained from a quasar via the binary supermassive black hole, and in fact astronomers think that there may be two of these gargantuan monsters gyrating about each other. Velocity ranges of the molecular oxygen calculated mainly from red-shifted gas was found to exist approximately 10 kpc away north and south from the centre of Mrk231. There were also lower velocity contents providing fainter emissions closer to the centre. O2 emission asymmetry including deficiency approaching the nuclear region via line of sight was considered by " Wang et al" to be due to molecular gas geometry in Mrk 231, and AGN molecular outflow asymmetry. What causes the oxygen emission? It is thought that a sizeable AGN molecular outflow could be the instrument to construct a 'shock' that causes a surge in oxygen profusion. Recently there have been several papers that describe models of shock chemistry, which suggest that a quantity of low velocity shocks created in the outflow (<20 kms-1) could result accumulatively in a larger quantity of O2. One recent paper (Goddard et al. 2019) produced a study that gave consideration to the generation of stationary molecular shocks at a slow velocity of 5-25 km s-1 in conditions highlighted by an extraneous ultra-violet radiation field. They concluded that the effectiveness of the UV radiation field in

promoting low velocity interstellar shocks was cogent.

Prior to this project, molecular oxygen had only been found in the Milky Way; the Orion Nebula and Ro Ophiuchus Cloud. The astronomers in the present experiment with Markarian 231 demonstrated that the O2 content compared to Hydrogen appeared to be 100 times greater than in the Orion Nebula, with one interpretation being that Mrk231 is far more energetic and gives rise to 700 solar masses of gas each year. This O2 propagated can then be utilised in the manufacture of new stars.

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# And finally – a Wordsearch

**Andy Willshire**

| O | Y | A | L | A | G | G | A | L | A | X | Y | T | L |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| D | X | A | D | U | S | T | I | C | O | M | D | F | J |
| C | C | Y | U | B | N | W | E | A | P | O | G | E | E |
| A | O | C | G | G | B | P | L | C | A | N | J | K | D |
| T | T | R | S | E | D | R | C | O | P | R | A | B | H |
| C | I | R | O | S | N | O | U | M | O | E | I | T | E |
| O | D | T | D | N | B | M | N | E | R | G | T | G | L |
| T | U | G | A | A | A | I | N | T | U | N | R | I | I |
| G | T | A | H | N | K | N | O | M | E | E | E | E | U |
| J | S | M | E | T | I | E | F | L | A | Y | N | L | M |
| R | F | O | D | R | B | N | H | G | L | X | I | N | R |
| A | G | C | O | M | C | C | J | A | X | O | N | A | E |
| K | E | P | L | E | R | E | T | I | T | A | P | F | T |
| M | U | I | L | G | T | M | E | T | E | O | R | A | A |
| R | E | T | A | R | C | P | I | O | N | E | E | R | P |

| | | | | | |
|---|---|---|---|---|---|
| APOGEE | AP0LLO | COMA | COMET | CORONA | CRATER |
| DUST | EUROPA | GALAXY | HELIUM | INERTIA | KEPLER |
| METEOR | NUCLEI | OXYGEN | PIONEER | PROMINENCE | TITAN |