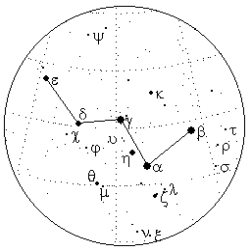


Wadhurst Astronomical Society Newsletter February 2015

ANNUAL SUBSCRIPTIONS

We have now entered the Society's new session and membership fees remain the same as they were last year. Membership for the year is £16 and £23 for two members within the same family at the same address. Children and students under 17 remain free and are always welcome.
Subscriptions can be paid at the meetings, preferably by cheque made payable to "Wadhurst Astronomical Society" or can be posted to our Treasurer;

Michael Wyles at:
31 Rowan Tree Road
Tunbridge Wells
Kent
TN2 5PZ

MEETINGS

JANUARY MEETING

John Vale-Taylor introduced the meeting starting with the Annual General Meeting. He gave thanks to members of the Committee such as Phil Berry, our Secretary, who puts so much effort behind the scenes to make the meetings the success they are. Also to others behind the scenes and to our knowledgeable Director of Observations, Brian Mills, for all the talks and sky notes he produces.

He then introduced our Treasurer Mike Wyles who presented the accounts for the past year. Mike said we had had a good year. Membership had been healthy and we had ended up with a slight increase in our finances over last year. Our Current Account stands at £648-43, up from £482-22 last year and our Reserve stands at £501-70, the same as last year with added interest of a staggering 26 pence. John thanked Mike for his continued work as Treasurer.

Phil Berry said he had made considerable progress with the talks programme for this year. Only April and July remain to be arranged. He gave a particular thanks to members of the Society who had offered to give the main talks during the year. This means subjects are appropriate to the membership and also save on fees to outside speakers.

There will be a Society Astro-barbecue again this coming August and he said once again Jim Cooper has generously offered to host it in his garden. More details will follow nearer the time

John then introduced our speaker for the evening.

The Big Bang
John Wayte

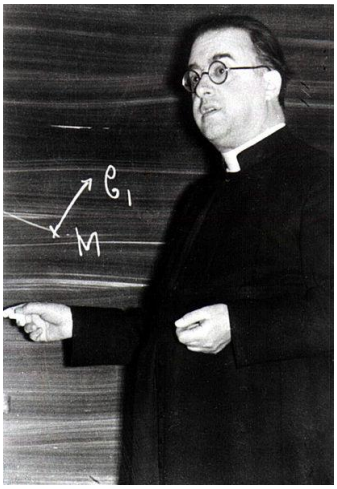
John began his talk by saying that there are many interpretations of how old the Universe is. In the Bible it is suggested that the world was created exactly 4004 years BC so the world would now be 6019 years old. We were told that in fact no one really knows. Our physics only goes back to 10^{-42} seconds after it all started. Originally it all started with what was called the "Primeval Atom" or the "Cosmic Egg" but became known as the Big Bang by default.

The earliest that scientists can go back to is 0.000,000,000,000,000,000,000,000,000,001 of a second, an incredibly small amount of time, but before that no one can tell, although John did say it may be that in the future some one might develop a theory. One thing is known for certain; the Big Bang would have been silent because there just wasn't anything there to make a sound. At this point, John said there is such a thing with the wonderful title of the "half-life of facts". It is recognised that half of the facts you heard over recent years are completely wrong…

He told us that the name, "Big Bang" came about during a radio broadcast on the 28th of March 1949 when Fred Hoyle referred to it during an interview, although at the time he himself was arguing against the concept.

A Belgium Roman Catholic priest, George Lemaître proposed the idea of the expansion of the Universe early in the 20th century. It was also Lemaître who developed the principle of what became known as Hubble's Law and the Hubble constant two years before Hubble did.

Sir Fred Hoyle



George Lemaître

John now turned to the incredibly small numbers experienced in describing what we know about the Big Bang.

To try and put "numbers" in a way we all understand - we arrived at this meeting 6×10^2 seconds or 60 minutes ago; Galileo Galilei was born 1.491×10^{10} seconds ago, and other examples in history were used to illustrate larger and larger numbers. But the Big Bang occurred 4.35×10^{17} seconds ago!

Now we turned to the incredibly small numbers used to describe time.

John described the Planck Epoch. The Planck Length as the smallest measurement of length; anything smaller than this makes no sense. The quantum of time is the time it takes for a photon to travel this distance at the speed of light and is 10^{-43} of a second and called the Planck Epoch, anything before this is a complete unknown.

We were told briefly about the four fundamental forces that exist in the Universe and unified into one combined super force.

Electromagnetism – Described as the attractive and repulsive interactions between charged particles that tend to cancel each other out. (10^{42} times stronger than gravity)

Strong Nuclear Force – The short range force that holds the protons and neutrons together in the nucleus of the atom. (10^{38} times stronger than gravity)

The Weak Nuclear Force – The weak interaction mediated by the exchange of heavy elementary particles (W and Z bosons) and also responsible for the production of neutrinos. (10^{13} times stronger than gravity)

Gravity – This force is the one we are familiar with and holds the Galaxies together, holding together particles with mass and by far the weakest of the four forces.

Between 10^{-43} and 10^{-36} seconds after the Big Bang gravity splits from the other three forces and this is known as the Grand Unification Epoch. Elementary matter and anti-matter begin to be created.

10^{-36} to 10^{-32} seconds is the Inflationary Epoch. John said this event was triggered by the separation of the Strong Nuclear Force from the others causing an exponential expansion and everything we know today was formed at that time although it is calculated that there is another 96% we don't know about and of this approximately 70% is what is thought to be Dark Matter. As he said, it is incredible to think that everything we see now was created in a split fraction of a second.

This expansion from the size of the Planck Length to the size of a small marble took place in the Inflationary Epoch! Put another way, if a Planck sized object were the size of a full stop, in this short time it grew to something like a Light Year across.

Also anti-matter was formed at the same time and in roughly the same proportions but matter and anti-matter annihilate each other although we were told that matter exceeded anti-matter by about 1 part in a billion.

Now comes the Electroweak Epoch between 10^{-32} and 10^{-12} seconds. The Strong Nuclear Force separates from the other forces and huge numbers of exotic particles are formed, including W and Z bosons and the Higgs boson.

During the Quark Epoch between 10^{-12} and 10^{-6} seconds, Quarks and anti-quarks are created and then annihilate each other leaving a surplus of one in a billion pairs and the Universe cools to 10 quadrillion degrees. The fundamental forces assume their present day forms.

Between 10^{-6} and one second the temperature cools to about a trillion degrees; quarks are able to combine to form hadrons and electrons collide with protons to form neutrons and neutrinos.

In one second to three minutes, most of the hadrons and anti-hadrons have annihilated each other, as do leptons (electrons) and anti-leptons that dominate the mass of the Universe.

In three to 20 minutes, we come to Nucleosynthesis where the temperature cools to a billion degrees and the atomic nuclei begin to form protons and neutrons through nuclear fusion, to form the simple elements, hydrogen, helium and lithium.

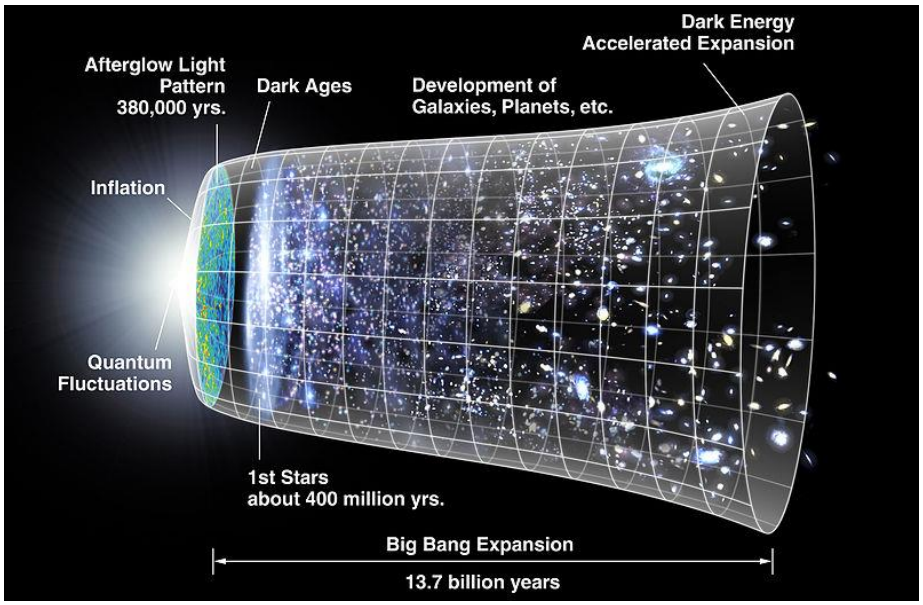
Now we come to the next 240,000 years when the Universe is filled with plasma which John calls an opaque soup of atomic nuclei and electrons. Photons dominate the Universe and this is known as the Photon Epoch.

240,000 to 300,000 years after the Big Bang, the temperature has cooled to about 3,000 degrees; ionized hydrogen and helium atoms capture electrons, neutralizing their electrical charge and the Universe becomes transparent to light with 75% hydrogen and 25% helium with traces of lithium.

This is followed by the Dark Age, which lasts to 150 million years. The first atoms form but the Universe is still dark since stars have not begun to be formed. Following this the first stars are formed although they are massive and short lived and exploded in Supernova events, creating heavier elements that eventually formed our type-1 Sun surrounded by the planets and us!

Epoch Summary

Planck Epoch	0 to 10^{-43} seconds	Unknown – Unified forces
Grand Unification Epoch	10^{-43} to 10^{-36}	Gravity splits
Inflationary Epoch	10^{-36} to 10^{-32}	The Big Bang
Electroweak Epoch	10^{-32} to 10^{-12}	Strong NF separates
Quark Epoch	10^{-12} to 10^{-6}	4 forces split – Annihilation – 10^{15} K
Hadron epoch	10^{-6} to 1 second	Hadrons formed – 10^{12} K
Lepton Epoch	1 Second to 3 minutes	More Annihilation
Nucleosynthesis	3 minutes to 20 minutes	Simple elements forming – 10^{9} K
Photon Epoch	3 minutes to 240,000 years	Soup – Annihilation over - cooling
Recombination/Decoupling	240,000 to 300,000 years	Transparent – 3000 K
Dark age (Dark era)	300,000 to 150 million years	No stars yet
Reionization	150 million to 1 Billion years	First Quasars
Star and Galaxy formation	300 -500 million years	Type 3 stars form



A graphic representation of the Expansion of the Big Bang

John's final comment was, - if this could happen to our universe, why couldn't it happen elsewhere!

Wadhurst Tennis Court Lighting Update
Phil Berry

Phil brought us up to date with the saga of the proposed lighting of the Wadhurst Tennis Courts at Sparrows Green Recreation Ground. They had applied for permission to install 12 floodlights despite this being classified E1, the highest protected dark sky area and also situated outside the designated development area of Wadhurst. Despite being refused by the Wealden District Council Planning Officers, their decision has been overturned three times by the planning committee.

Following three Judicial Reviews by the High Courts in London that quashed the WDC permission, it seems that it is all beginning again with an application extension by the private tennis club. So far the Wealden District Council has spent over £100,000 supporting the application against the decisions of their own Planning Officers. The £100,000 has accrued in consultancy fees and legal costs awarded against them in the high courts.

The Trefael Capstone Star Map
Bob Seaney

Bob has spoken on the fascinating subject of pre-historic astronomy and amateur archaeology before and on this occasion he began by briefly reminding us of some standing stones he has introduced us to at previous talks.

We were first shown a stone representation of the constellation of Orion dating back to 35,000 years BC. This was followed by the photograph of a cave painting at Lascaux in southern France dating from about 17,000 years BC and showing the Pleiades. We saw the Bronze Age Nebra Sky Disk dating from about 2,000 years BC and depicting the Pleiades and a crescent moon. Around the edge were also sight lines for sunset at the summer solstice.

Bob also spoke briefly of standing stones that aided in predicting events in the Solar System, and also of cup-marks, small depressions in the stone's surface and sometimes thought to represent stars. Locally we have Kits Coty House with a capstone on which are cup-marks.

This led to the main topic to tonight's brief talk; the Trafael capstone in Pembrokeshire that had fallen over and only recently been excavated. A photograph clearly showed cup-marks, although slightly eroded, and it is thought that they could represent star positions although they are yet to be identified.

FEBRUARY MEETING

Wednesday 18th February 2015 – Rob Cray takes as his subject "Steps to Apollo: the Mercury and Gemini Space Programs".

FUTURE MEETINGS

Wednesday 18th March 2015 – Chris Morris talks on "The Use of Heavenly Bodies for Astro Navigation"
Wednesday 15th April 2015 - TBC
Wednesday 20th May – Konrad Malin-Smith talks about "Hydrogen in the Universe"
Wednesday 17th June - Our Chairman, John Vale-Taylor, updates us on his journey of discovery in astrophotography
Wednesday 15th July - Our Observing Director, Brian Mills FRAS, goes back to basics with "Astronomy from the Ground Up"

SKY NOTES FOR FEBRUARY 2015

Planets

Mercury reached inferior conjunction at the end of January and has now moved west of the Sun to become a morning object. Although it is at its greatest elongation of 27° on 24th February, it will be poorly placed due to the shallow angle that the ecliptic makes with the horizon. On that date, with the Sun 6° below the horizon, Mercury will be less than 3° in altitude in the south east and, effectively unobservable. The next elongation of the smallest planet takes place in May and will be far kinder to those of us observing from the latitudes of the UK.

Venus is now a striking evening object low down in the south west at twilight. At the start of the month it sets two hours after the Sun, but by the end this has improved to nearly three hours. The planets brightness, at magnitude -4.0, is gradually increasing whilst its apparent size (11 arc seconds) is also growing despite its phase shrinking.

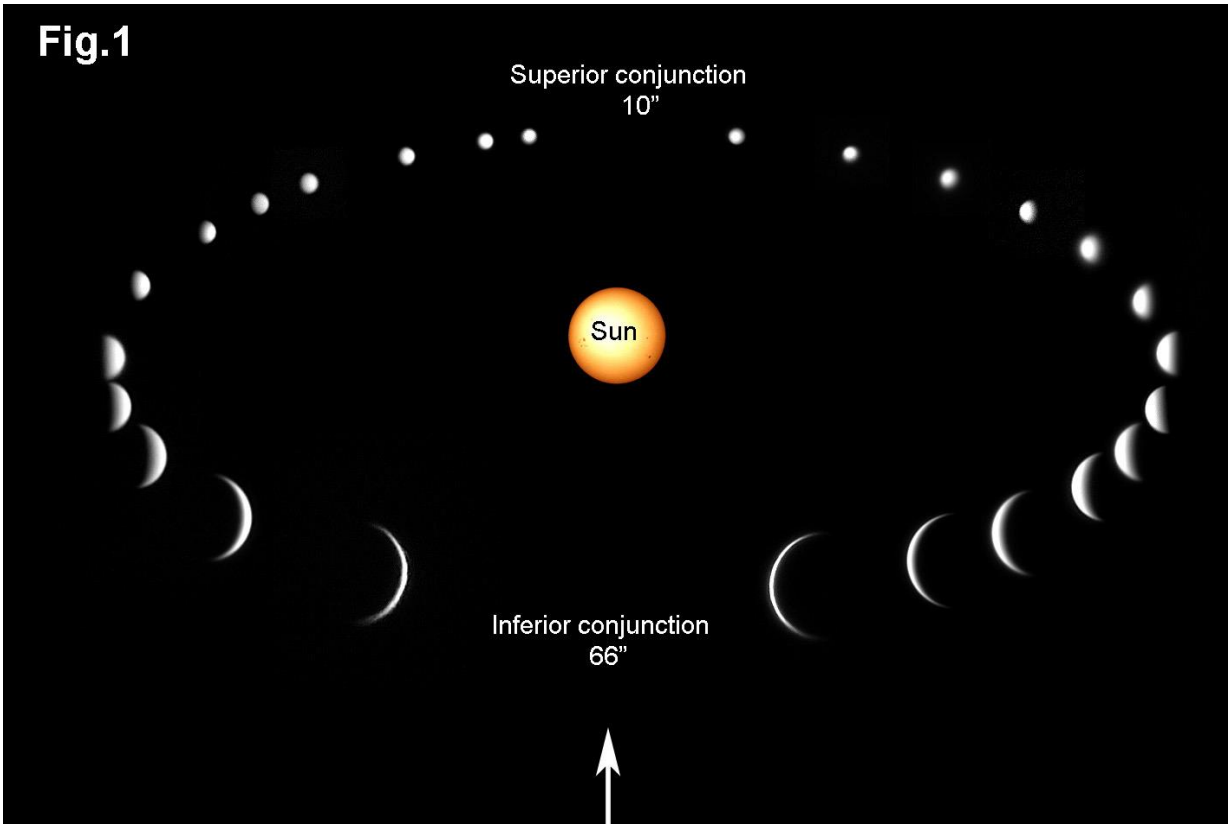
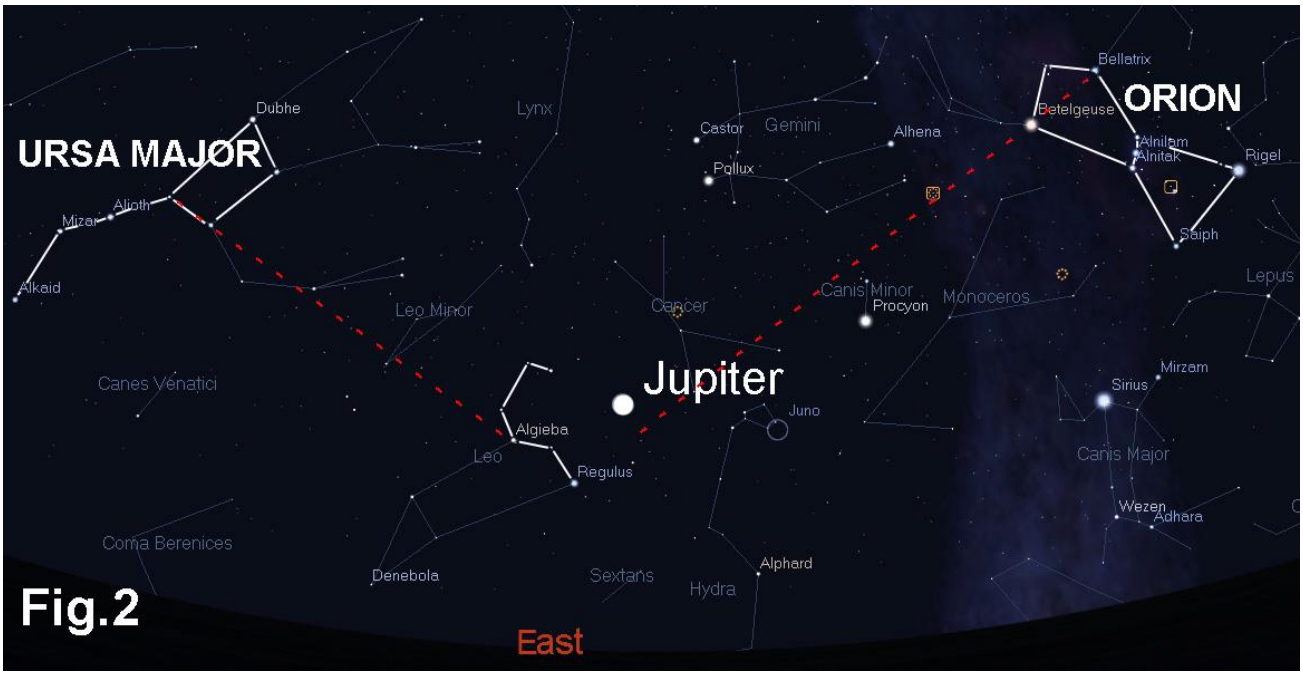


Fig. 1 shows how the phase and angular size of Venus change as seen from Earth. Of course it would be impossible to see it fully illuminated because the only time that would happen would be at superior conjunction when Venus is on the far side of the Sun. During the planets swift eastward journey it passes close to two other planets, Neptune on the 1st and Mars on the 21st.

Mars is still an evening object setting three hours after the Sun at the start of February, although this will decrease gradually throughout the month. The “Red Planet” moves briskly eastwards crossing from Aquarius into Pisces on the 11th before reaching the borders of Cetus on the 28th. Interestingly, it moves into the constellation of the whale for just one day before returning to Pisces, something that is sure to confound astrologers who must find such anomalies very difficult to explain, given that very rarely do they mention the effect on your life of a particular planet being in Cetus!

Jupiter is currently a brilliant evening object moving retrograde in the constellation of Cancer. It comes to opposition on the 6th of the month and will, by definition, be opposite the Sun and therefore on view all night, rising at sunset and vice-versa in the morning. At magnitude -2.5 it is the brightest object in that part of the sky between Orion and Leo although If you need some help to locate it, Fig 2 provides some useful tips. From Ursa Major draw a line through the two rear stars in the bucket of the plough and continue it towards the horizon. It will reach the “Sickle” of Leo which appears as a back to front question mark, and Jupiter is just to the west (right) of this. Alternatively, use a line through the two stars in the shoulders of Orion, Betelgeuse and Bellatrix, and continue it eastwards until it passes close to Jupiter.



At the time of opposition the gas giant's apparent size has risen to 45.5" (arc seconds) making it an ideal target for imagers with moderately long focal length telescopes. This is also an excellent time to follow the movements of the Galilean moons, which are visible with even modest binoculars providing they are rigidly mounted to prevent shake.

In the talk last month on the subject of longitude, we heard how it had been suggested that the moons of Jupiter could be used as a celestial clock to provide reference time for ships on the ocean that were out of sight of land. One of the observers involved in this investigation was the Danish astronomer Ole Rømer who, at the time, was working at the Paris observatory. He found that if he observed eclipses of Jupiter's moons when the giant planet was furthest from the Earth, the events always occurred later than predicted whilst those at opposition were always on time. This lead him to deduce that light had a finite speed and that it would take a beam of light 22 minutes to cross a distance equivalent to the diameter of the Earth's orbit.

In December 2013 the United Nations General Assembly announced that 2015 would be the International Year of Light (IYL 2015). As part of this event the University of Glasgow is going to recreate the observations of Rømer with the help of citizen science. The starting point for anyone who would like to find out more is http://www.speedoflight2015.co.uk/

Saturn is still a morning object rising at 03.00 at the start of the month, although by the end this will have moved on to 01.30. It will be mid April before the planet is technically an evening object rising before midnight BST. Although its brightness is constant at +0.5 this month, Saturn's apparent size is gradually increasing as it approaches opposition in late May. The rings are superbly presented to us, due to the planets north pole being tilted towards Earth by 25°. Fig 3 shows the position of Saturn around the middle of the month at 06.15, although it moves so slowly against the background stars that the map remains valid for the whole of the month. I have included several bright stars to help with identification including Antares in Scorpio which has a distinctive red hue. The colour explains its name which means "Rival of Mars" in Greek.

Lunar Occultations

In the table below I've listed events for stars down to magnitude 7.0 that occur before midnight although there are many others that are either of fainter stars or occur at more unsociable hours. DD = **d**isappearance at the **d**ark limb and RD = **r**eappearance at the **d**ark limb. The column headed "mm" (millimetres) shows the minimum aperture telescope required for each event. Please remember that the Society has telescopes that members can borrow, all of which are suitable for the such events. **Times are in GMT.**

Feb	Time	Star	Mag	Ph	Alt °	% illum.	mm
1st Feb	18.23	ZC1106	3.6	DD	30	96	40
2nd Feb	19.52	ZC1234	6.2	DD	35	99	80
6th Feb	21.15	ZC1637	5.9	RD	11	92	80

22nd Feb	21.47	ZC258	6.6	DD	5	20	50
23rd Feb	18.28	ZC376	7.0	DD	43	29	60
27th Feb	19.27	ZC944	5.9	DD	57	71	50
27th Feb	23.49	ZC970	6.3	DD	33	72	70

Phases of the Moon for February

Full	Last ¼	New	First ¼
3rd	12th	18th	25th

ISS

Below are details of passes of the International Space Station (ISS) that occur before midnight and are magnitude **-**1.5 or brighter. The details of all passes including those visible from other areas can be found at www.heavens-above.com . Please remember that the times and directions shown below are for when the ISS is at it's ***maximum*** elevation, so you should go out and look at least five minutes beforehand. **Times are in GMT.**

Feb	Mag	Time	Alt°	Az.		Feb	Mag	Time	Alt°	Az.
6th	-1.5	18.52	20	SSE		14th	-3.3	18.22	80	N
8th	-2.6	18.45	37	SSE		15th	-3.5	19.06	88	N
9th	-1.9	17.53	25	SSE		16th	-3.3	18.14	80	N
9th	-2.1	19.28	40	WSW		17th	-3.2	18.59	69	SSW
10th	-3.2	18.38	61	SSE		18th	-3.3	18.06	87	SSE
11th	-2.6	17.46	43	SSE		18th	-1.6	19.42	28	SW
11th	-2.9	19.21	61	W		19th	-2.4	18.51	43	SSW
12th	-3.4	18.30	86	SSE		20th	-2.9	17.58	61	SSW
13th	-3.4	19.14	78	NNW						

Iridium Flares

The flares that I've listed are magnitude **-**2.0 or brighter although there are a lot more that are fainter or occur after midnight. If you wish to see a complete list, or obtain timings for somewhere other than Wadhurst, go to www.heavens-above.com . Remember that when one of these events is due it is sometimes possible to see the satellite before and after the "flare" although, of course, it will be much fainter at those times. **Times are in GMT.**

Feb	Time	Mag.	Alt°	Az.°		Feb	Time	Mag.	Alt°	Az.°
2nd	17.58	-7.5	39	181 (S)		17th	18.30	-2.0	47	163 (SSE)
7th	17.37	-3.0	37	192 (SSW)		22nd	18.09	-4.1	48	177 (S)
8th	19.06	-5.6	43	143 (SE)		26th	17.53	-3.6	47	189 (S)
12th	18.51	-3.9	46	151 (SSE)		26th	19.29	-7.7	49	128 (SE)
13th	18.45	-2.6	46	154 (SSE)		27th	17.47	-7.6	47	191 (SSW)

The Night Sky in February (Written for 22.00hrs GMT mid month)

In the south Cancer, with the two open clusters M44 and M67, straddles the meridian. M44 in particular more than lives up to the description of an open cluster, being three times the size of a full Moon. M67 is smaller, around a third of the size of its larger companion, and is thought to have in the region of 500 members. Below Cancer is the quite obvious shape of the head of Draco, although the same cannot be said for the rest of the constellation as it winds its way to the southern horizon and beyond. A little later in the year it will be possible to follow all the twists and turns of the Sea Serpent once its tail has cleared the horizon. If you have a good southerly horizon look to see if you can find the two most northerly bright stars in Puppis, which represents the poop deck or stern of the ship Argo Navis. This was, in mythology, the vessel that Jason and the Argonauts used when searching for the Golden Fleece. The original constellation was so huge and unwieldy that the French astronomer Lacaille subdivided it into three separate parts. The constellation of Puppis lies astride the Milky Way and is extremely well provided for in terms of open clusters, the most noticeable from UK latitudes being M47, at magnitude +4.4, and M93 at magnitude +6.2. Just 6° to the east of M93, within the borders of Canis Major, is the open cluster NGC 2362 at magnitude +4.4. The star Tau Canis Majoris appears to be part of the cluster but is, in fact considerably closer to us.

As we look towards the west we find Orion and his retinue are all still visible though Lepus and Canis Major will soon set. In between the meridian and Orion lies the faint and shapeless form of Monoceros whose brightest star is alpha at magnitude +4.3. In common with other constellations in the area the Unicorn has its fair share of open clusters and nebulae but has no bright galaxies. The brightest clusters are NGC2264 at magnitude +3.9 that is associated with the Cone nebula, NGC2232 also at magnitude +3.9 and M50 whose brightest stars are easily resolved in binoculars. See below and Fig 4 for more information. The bright star Capella lies almost exactly due west at an altitude of 55° with the Pleiades cluster midway between it and the horizon.
Looking to the north we find that two members of the Summer Triangle, Deneb and Vega are both visible close to the horizon. Above them Cepheus and Cassiopeia occupy the sky to the west of the meridian whilst to the east of it lie Draco and the two bears.

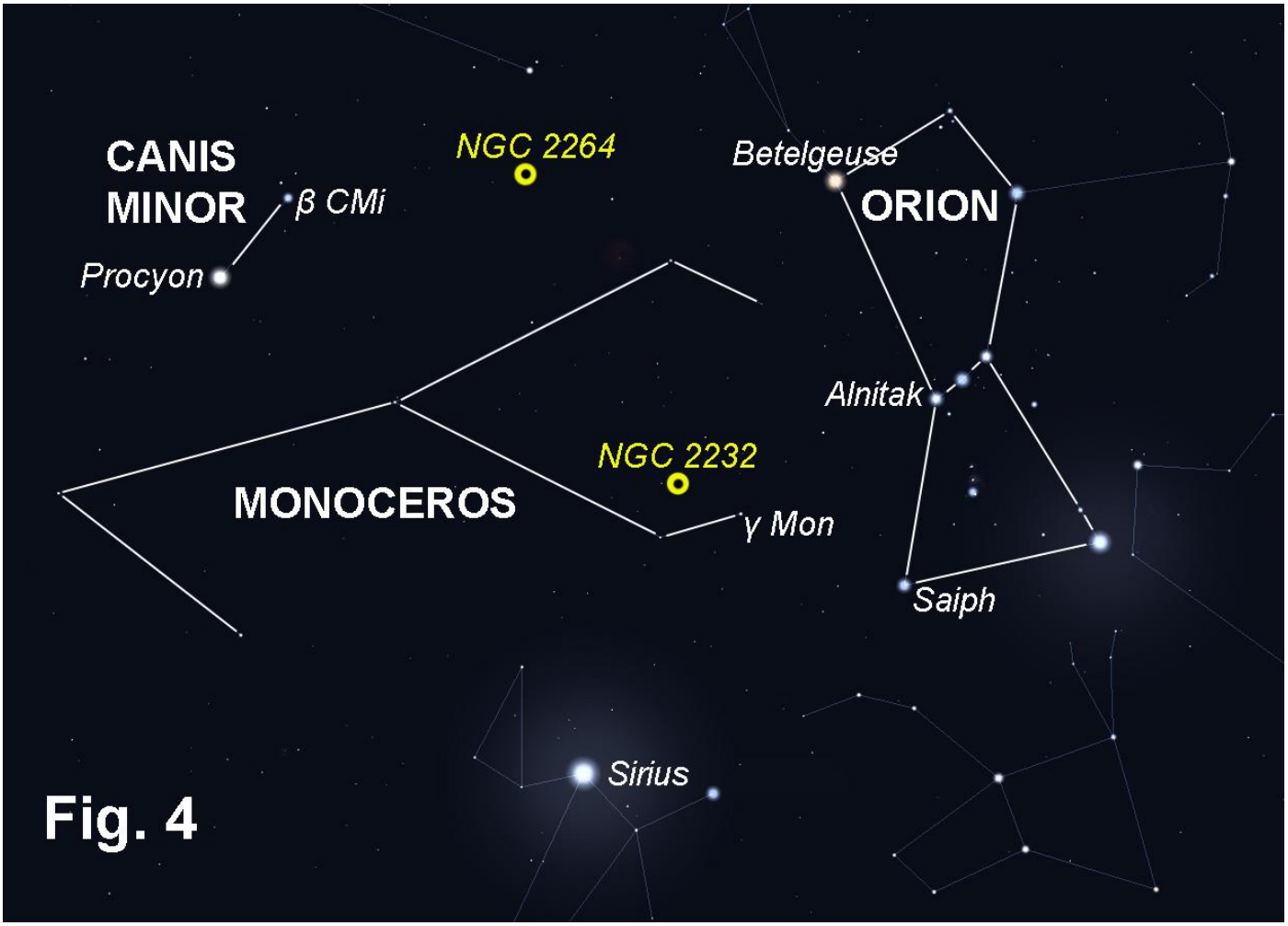
In the east, at this time of year, the ecliptic makes an angle of around 60° with the horizon compared with 20° six months later. This means that the planet Jupiter has reached an altitude of 50° at our time of viewing in February.
Spica and almost all of Virgo have risen, as has Arcturus the brightest star in Boötes, the herdsman. Immediately north of Arcturus lies M3 (NGC5272) which is possibly the second finest globular cluster visible from the UK. At magnitude 6.3 it is at the absolute limit of naked eye visibility, although binoculars will easily show it, whilst apertures of around 110mm will resolve it comfortably. Corona Borealis, containing the two interesting variables R and T CrB, is now clear of the horizon. R CrB is an orange supergiant that

undergoes sudden and unpredictable magnitude changes whilst T CrB is a recurrent nova that in common with others of this type, is a binary system.

What Objects Can I Look For This Month?

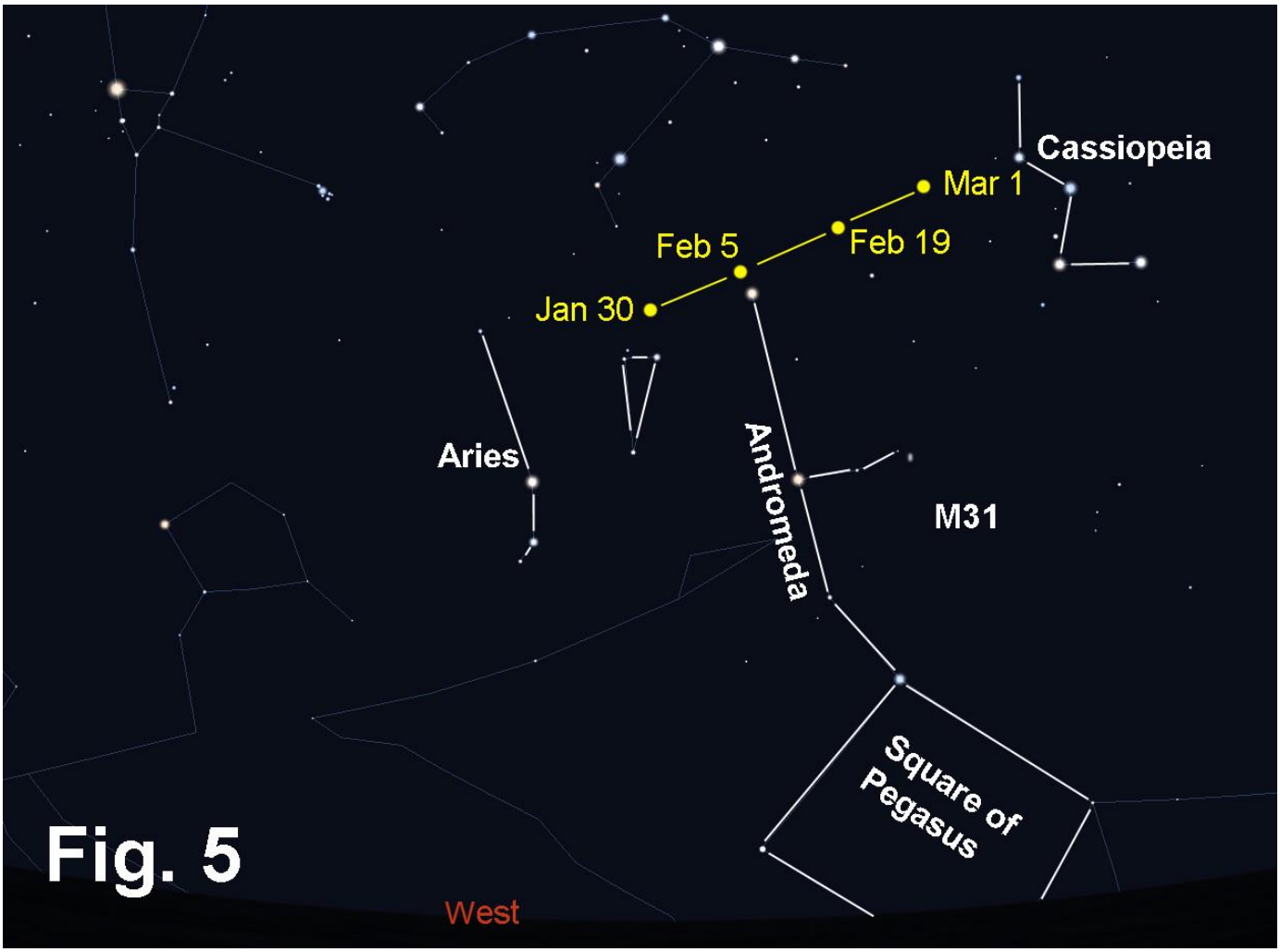
1. NGC 2264 at magnitude +3.9 is an open cluster sometimes referred to as the Christmas Tree, although I've never been able to appreciate the likeness. It is visible to the naked eye despite it being around 2,500 light years distant. The cluster lies midway on a line between Betelgeuse and beta (β) Canis Majoris and fractionally north of that line.

2. NGC 2232 is an easy binocular open cluster centred on the star 10 Monocerotis. There are thought to be 20 members in the group. The three stars Alnitak, Saiph and gamma (γ) Monocerotis form an equilateral triangle with the cluster a little to the east of the latter.



Comets

Comet 2014 Q2 (Lovejoy) is still visible towards the west and at a very respectable altitude in the early evening. Its magnitude is now on the wane but binoculars will still show it although I think only the nucleus will be visible. The tail will be best seen by imaging with exposures of 30 seconds or more at ISO settings of 6400 or 12800. Fig 5 gives its position, whilst the table below gives magnitude estimates for this month.



Feb	Mag		Feb	Mag		Feb	Mag
1st	5.1		15th	5.9		28th	6.7
5th	5.4		20th	6.2			
10th	5.6		25th	6.5			

DSLR Evening

Following the success of our last imaging session at Ashdown Forest, we plan for another to take place later this month. Before that, John Lutkin will give a short presentation at the regular meeting on February 18th when he will talk about the basic steps that need to be taken to secure good quality digital images.

The following evening, Thursday 19th February, we hope to meet on Ashdown Forest to secure some images of a chosen area of the night sky. If the 19th is cloudy then we will use the 20th and 21st as backups.

Providing one of these evenings is a success weather wise, we will then arrange an evening when we can meet up to manipulate and process our images under the expert guidance of Ian King who has very kindly offered his assistance. He will be leading us through some of the techniques within Maxim DL and Photoshop.

If you wish to take part in the Ashdown Forest imaging evening, please let me know using the e-mail address at the end of this Newsletter.

Brian Mills

NASA SPACEPLACE

Minor mergers have massive consequences for black holes

By Dr. Ethan Siegel

When you think of our sun, the nearest star to our world, you think of an isolated entity, with more than four light years separating it from its next nearest neighbour. But it wasn't always so: billions of years ago, when our sun was first created, it very likely formed in concert with thousands of other stars, when a giant molecular cloud containing perhaps a million times the mass of our solar system collapsed. While the vast majority of stars that the universe forms—some ninety-five percent—are the mass of our sun or smaller, a rare but significant fraction are ultra-massive, containing tens or even hundreds of times the mass our star contains. When these stars run out of fuel in their cores, they explode in a fantastic Type II supernova, where the star's core collapses. In the most massive cases, this forms a black hole.

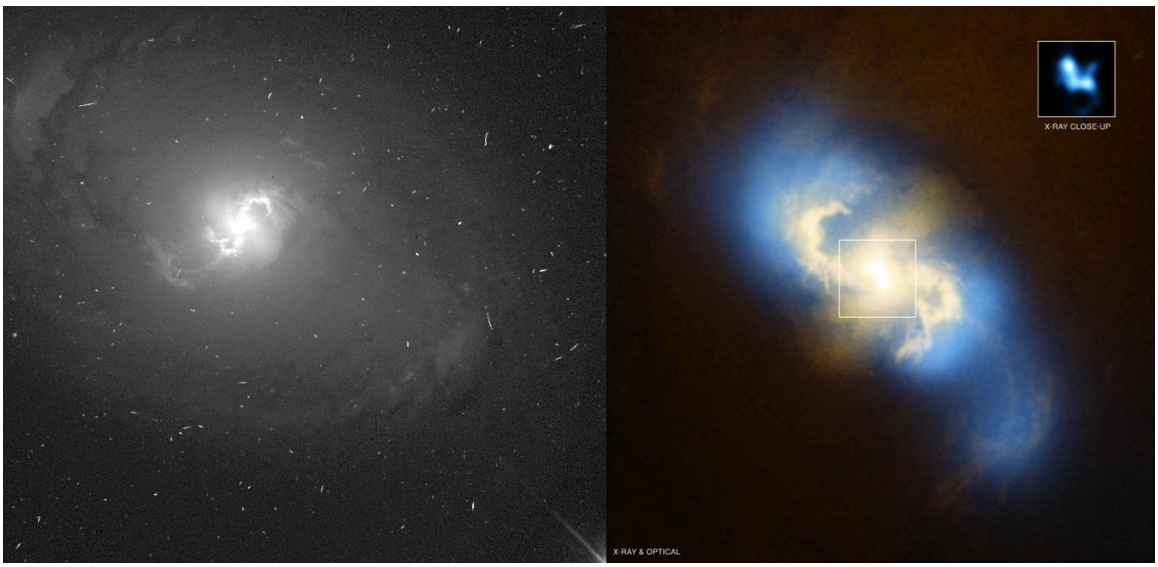
Over time, many generations of stars—and hence, many black holes—form, with the majority eventually migrating towards the centres of their host galaxies and merging together. Our own galaxy, the Milky Way, houses a super massive black hole that weighs

in at about four million solar masses, while our big sister, Andromeda, has one nearly twenty times as massive. But even relatively isolated galaxies didn't simply form from the monolithic collapse of an isolated clump of matter, but by hierarchical mergers of smaller galaxies over tremendous timescales. If galaxies with large amounts of stars all have black holes at their centres, then we should be able to see some fraction of Milky Way-sized galaxies with not just one, but *multiple* super massive black holes at their centre!

It was only in the early 2000s that NASA's Chandra X-ray Observatory was able to find the first binary super massive black hole in a galaxy, and that was in an ultra-luminous galaxy with a double core. Many other examples were discovered since, but for a decade they were all in ultra-massive, active galaxies. That all changed in 2011, with the discovery of two active, massive black holes at the centre of the regular spiral galaxy NGC 3393, a galaxy that must have undergone only minor mergers no less than a billion years ago, where the black hole pair is separated by only 490 light years! It's only in the cores of active, X-ray emitting galaxies that we can detect binary black holes like this. Examples like NGC 3393 and IC 4970 are not only confirming our picture of galaxy growth and formation, but are teaching us that super massive relics from ancient, minor mergers might persist as standalone entities for longer than we ever thought!

Check out some cool images and artist reconstructions of black holes from Chandra:
http://chandra.harvard.edu/photo/category/blackholes.html

Kids can learn all about Black Holes from this cool animation at NASA's Space Place
http://spaceplace.nasa.gov/black-holes.



Images credit: NGC 3393 in the optical (L) by M. Malkan (UCLA), HST, NASA (L); NGC 3393 in the X-ray and optical (R), composite by NASA / CXC / SAO / G. Fabbiano et al. (X-ray) and NASA/STScI (optical).

CONTACTS

General email address to contact the Committee
wadhurstastro@gmail.com

Chairman John Vale-Taylor

Secretary & Events Phil Berry 01892 783544

Treasurer Mike Wyles

Editor Geoff Rathbone 01959 524727

Director of Observations Brian Mills 01732 832691 email: BRIAN@wkrcc.co.uk

Committee Members Paul Treadaway
Jim Cooper
John Lutkin
Eric Gibson
John Wayte

Wadhurst Astronomical Society website:
www.wadhurstastro.co.uk
SAGAS web-sitewww.sagasonline.org.uk

Any material for inclusion in the March 2015 Newsletter should be with the Editor by February 26th 2015