NEWSLETTER

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Observatory telescope at Dyffryn Gardens for Stargazing LIVE

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Editorial John Richards

Now, is without doubt an exciting time to be interested in astronomy and spaceflight. We have a Brit orbiting above us in the ISS, and the discovery of gravitational waves, with the the help of astronomers from Cardiff University, has made headlines all around the World. On a Society front, your committee is busy building an exciting program of talks for our 42nd year, and we will release details of our varied program very soon. The committee is also working very hard on acquiring charity registration, and to continue to place the society in the forefront of UK astronomical societies. So watch this space. Hopefully, you will enjoy this, the first newsletter of 2016. I'm back with articles about spaceflight history, and also a more up to date summary. Phil Wallace writes about intriguing solutions writers create to overcome the vastness of space. Kayleigh continues to follow the escapades of our 'Brits in Space' and Hugh gives us his highlights of the night sky in his quarterly review of the heavens.

As many of you are no doubt aware, Dave, our secretary for 40 years, has sadly decided to leave the committee. He, along with Bob Owens was the driving force in the initial creation of the Society, and has been instrumental in making CAS what it is today. Dave will be missed by the committee, and the Society more generally, but I wanted to take this opportunity to thank Dave for his tremendous efforts over the last 40 years, and wish him the very best in the future.

Wishing you clear and dark skies - John

Contact Details

Have you changed your email address or other contact details recently? If so, you could be missing out on receiving important Society information. Please keep us up to date with any changes. Send your revised details to either our Membership Secretary (membership.secretary@cardiff-astronomical-society.co.uk) or Secretary (secretary@cardiff-astronomical-society.co.uk).

Visit CAS on the web @

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As a CAS member you can use the Members Area of the web site to view Society handbooks, committee minutes,newsletters and other Society material of note.

CAS is now on twitter, to follow us, follow **CardiffAS**

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BEHIND THE SCENES FOR STARGAZING LIVE!

The preparation for this began in November when a twitter feed confirmed there would be another Stargazing Live series and the probable transmission dates. Then it was a flurry of emails to Dyffryn Gardens, the National Museum to arrange our stand on January 16th and the BBC to obtain 'official' approval for our star party around the observatory on 14th January. Without this we would not have any publicity via the BBC SGL web site.

Next day the BBC banner went up on the fence by the Dyffryn Gardens café, and before I had much time to turn around and draw breath, Dyffryn emailed to say they had already taken over 300 bookings! So I don't think public interest in astronomy is going to fade anytime soon.

The CAS star party took place under clear skies and excellent viewing conditions (take note Brian Cox and Lucie Green) and there were many WOWs and 'awesome' as a big CAS team manned a range of telescope and binoculars, Made in Cardiff filmed and Alan Stephens controlled the observatory telescope. In case of cloudy skies, the Cory Centre was full with stands of merchandise, junior activities table and a virtual sky tour using Stellarium software.

There did seem to be a huge number of people all looking through telescopes, listening to naked eye tours of the

night sky, and many asking ‘When are you doing this event again? !!

The CAS team packed up late, hoarse, tired but happy having enjoyed themselves and running the event. Yes, we did look silly in hi viz jackets with red light attachment – why not join in on these occasions and have some fun whilst looking up? Experience is not important, you will be looked after, and it does help to have some beginners for the public to talk to, it demonstrates that we all start as beginners.

Then we had to do it all over again and be at the steps of the National Museum at 8:30 am on the Saturday morning. This was the Museum’s SGL event for which we had several stands, a range of telescopes on display, merchandise, help for people to get started and junior activities for the young and not so young. Over two thousand came through the door so yes, it’s fair to say we weren’t bored and looking for things to do. Always something to remember, this time it was the bridal party and large number of guests all in full regalia trooping around the scopes and stands on their way to a function room, and also the muffins Kayleigh treated us to. She and Owen Cornelius work hard at all these events to put on very good educational activities for the large number of juniors that come to our stands. And who needs Brian Cox when we have Spencer dressed as Darth Vader? Very popular for photographs.

The SGL emphasis was on Tim Peake and the International Space Station. With the Techniquest event for his launch last December and SGL week, I think the CAS team are all now Tim Peak’ed out!

Many thanks to all those who have helped in the preparation for SGL, during the week itself and contributed with ideas and hard work. It is a TEAM effort and seemed enjoyable for all.

Theresa Cooper

The Bill Sutherland Award Martin Chick

This award was set up in memory of Bill Sutherland an early member of CAS, who passed away in 1990. It is awarded each year at the AGM, to a CAS member who has shown outstanding enthusiasm for astronomy and the Society.

Work for the award can be of any astronomical or Society nature and may include (but not exclusively) things like observational drawings, photographs, CCD images, newsletter articles, talks given to the Society and promotion of the Society etc.

Obviously some work comes to the attention of the awarding committee automatically (such as a newsletter article), other work by its nature may need to brought to the attention of the awarding committee by it author (e.g. photographs).

Remember we are not necessarily looking for technical excellence but rather enthusiasm for astronomy and the Cardiff Astronomical Society, so why not enter your work for consideration for this award.

Last year the award was presented to Hugh Lang. Hugh is a long standing member of the society, and was an active member of the group using the public observatory at Penylan. Hugh has held a number of positions on the committee over the years and has been a very active and dedicated supporter of the society.

So, get your thinking caps on, and If you'd like to nominate yourself or someone else for this award, send an email to BSA@cardiff-astronomical-society.co.uk stating who you are nominating and the reason for the nomination. If appropriate you can attach samples of work to the email.

Ever have the urge to write? The Cardiff Astronomical Society is looking for articles for future editions of the newsletter. It can be on any aspect of astronomy, spaceflight or even science fiction. As long as it relates to some aspect of astronomy, I'd love to read your articles, and so would other members of the Society. Recently we've had great articles about debunking the debunkers who claim the Moon landings never happened, how to take amazing pictures with your telescope, space stamps, solar eclipse cruises and how various committee members started their astronomical journey. Articles don't need to be huge, but I'd really like to hear from you if you feel you have a story to tell.

Interested? Why not pen your initial idea on an email and send it to me, the Editor at **Publications.Officer@cardiff-astronomical-society.co.uk,** and you could see your article in print before you can say "Tim Peake's in the airlock"

Publication Dates

The CAS newsletter is published at the first Society meeting of September, December, March & June. The deadline for submissions is 4 weeks before the publication date, and is 7th June for issue 175.

FREE ASTRONOMY MAGAZINE

Our friends at Astro Publishing have provided us a link to their latest **FREE** bi-monthly astronomy magazine. Articles in the latest edition include stunning images of the New Horizons flyby of Pluto, how scientists are dealing with the incredible diversity of exoplanet atmospheres, LISA Pathfinder, and zombie stars (yes, zombies are everywhere these days it seems) The link for the magazine is:

http://www.astropublishing.com/FAM-1-2016/index.html

The Night Sky End Feb - June

Hugh Lang

The planets

Mercury is generally a difficult planet to locate being so close to the Sun and is only ever seen in morning or evening twilight skies, and as such is easily overlooked. Less than 25 percent of observers have actually bothered to attempt an observation of the planet, which is a real shame! However readers, you will get two fine opportunities to see Mercury in the next few months and it will be well worth the effort. Mercury starts off poorly placed through February, and remains so until the end of March. The first opportunity for you locate and observe this illusive planet will occur during the first half of April's twilight sky when Mercury reaches its greatest elongation (E 20 deg) on the 18th of the month. The planet will be well placed and quite bright (April 1st Mag -1.5, fading to Mag -0.5 by April 21st) in the twilight evening sky. If you look just North of due West at around 21:00 hrs BST (Or 20:00hrs UT) from April 8th you can use a 2% waxing moon which will be placed about 13 moon diameters (that's 6.5 degrees) due West of the planet to help locate it, and then once found, you can then follow the planet every clear evening as it rises ever higher in the sky until the 20th April when the planet starts to move back towards the Sun as seen from our view point, becoming lost again in the Sun's glare. However a second opportunity to observe Mercury, this time in transit of the Sun occurs on May 9th. Being in transit it's ideally placed for northern observers. First contact occurs at around 11:26 UT, mid transit is at 14:56 UT and the end of transit occurs at 18:40 UT. Just look for a 12 second of arc disk slowly moving across the face of the Sun. Be careful not to confuse it with any sunspots though. Mercury then goes on to reach it's greatest West elongation (West 24 deg at approx mag 0.0) by the 5th of June, but unfortunately is unfavourably positioned in the morning twilight sky for us northern observers.

At the end of February **Venus** a morning object, magnitude -3.9 and diameter 11.5 seconds of arc. It can be found low in the South

East, is now moving back into the Sun's twilight and becoming ever more poorly placed throughout March, To all intents the planet is difficult to observe during April becoming unobservable during May. Venus then reaches superior conjunction with the Sun on the 6th of June before re-appearing into the evening sky. More about this planet will be found in the next newsletter.

This is a good year for people wishing to observe the planet **Mars**. At the end of February the planet is a distinctive ochre red colour at visual magnitude 0.8. Diameter 6.6 seconds of arc, found moving eastward through the constellation of Libra. On the 13th of March Mars then moves into and through the constellation of Scorpius, ever slowly brightening and increasing in angular diameter. By the end of the month the planet will be at magniteude -0.2 and have an apparent diameter of about 12 seconds arc. By April Mars will have crossed briefly into the constellation of Ophiuchus, now at magnitude 0.5 and apparent diameter of 11.8 seconds of arc; and is found rising in the East around 22:30 UT. By the 17th of April the planet is stationary and then proceeds to start its journey back (to retrograde) into Scorpius; now at magnitude -1.2 at some 14.6 arc seconds in diameter. Mars then reaches opposition on the 22nd May, so it will be observable all night. The planet is actually closest to the Earth on the 30th May, it's distance from Earth will be 0.5 AU,that's 4.2 light minutes away. Its magnitude will be around -2.1 and its visual diameter 19 seconds of arc. The north pole of the planet will be tilted some 12 degrees towards Earth. At position angle 37 degrees. Unfortunately the planet will be quite low in the southern skies as seen from the U.K., but it's still the best month for imaging this planet using either video or CCD camera's. Failing that you'll have to wait until 2019 for the next Martian opposition!

For the period covered by this article **Jupiter** is retrograding amongst the stars of the constellation of Leo the Lion. At the end of February the planet rises in the East in the mid-late evening now at visual magnitude -2.4 with an apparent visual diameter of 42.5 seconds of arc. Jupiter will be in close conjunction with the moon on the 24thof February. On the 8th March the planet will be at opposition. So the planet will rise at sunset and be up all night! Jupiter will have

increased in brightness and size slightly (visual magnitude -2.5 and have an angular diameter of 44 seconds of arc and will remain close to these parameters all month.) So it's a good time to get out the telescopes and observe it! Its distance from Earth at opposition will be 4.4 AU, that's some 36 light minutes away. It's well placed for northern observers as its declination is north of the equator all year. Jupiter will be in close conjunction with the Moon on the 18th. After opposition the planet starts to retrograde though Leo. By the end of April its visual magnitude is -2.3 and 41.9 seconds of arc. By the 9th of May Jupiter will complete its retrograde loop while still in Leo. By the end of June the planet will be found in the western sky still easily located at magnitude -1.9 and apparent visual diameter of 35.2 seconds of arc now setting just after midnight.

Saturn is currently residing amongst the stars of Ophiuchus and remains so until next September. At the end of February its visual magnitude 0.5 and angular diameter 16.3 second of arc. However the planet resides at 21 degrees south of the celestial equator so it never really rises high enough to clear the 'atmospheric murk' for observers in the Northern hemisphere. By mid March Saturn will rise in the East around midnight. On the 25th March Saturn is stationary, and then begins to retrograde through Ophiuchus. By mid April the planet will rise around late evening, increasing in size and brightness very slightly, the planet reaching its highest point on the northern sky this month so the best time to observe this planet will be around midnight during the months of April and May. On June 3rd Saturn reaches opposition, so will be observable through out the night at visual magnitude 0.3 and angular size 18.4 seconds of arc. The planet will be 9.01 AU from Earth, that's 75 light minutes away. The North side of the ring system will be tilted toward Earth at an angle of 26.1 degrees with the ring system sporting an angular diameter of some 42 seconds of arc so it's well worth the effort of observing.

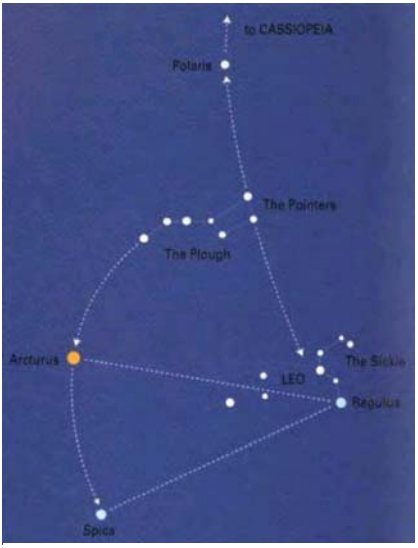
Uranus situated in the constellation of Pisces for the period covered by this article, and at the end of February can be located low in the western sky at magnitude +5.9 and angular diameter 3.3 seconds of arc. These values don't change for the next few months. By mid March the planet vanishes into the twilight sky. On the 9th

March Uranus will be in conjunction with the Sun. The Planet reappears in the morning twilight sky during late May, but won't be observable until early June.

Neptune is in conjunction with the Sun on the 28th February and will reappear in the eastern dawn sky in the constellation of Aquarius. However the angle of the ecliptic favours observers in the Southern hemisphere and so wont be an easy object to locate until early July, even then at magnitude +7.8 and angular diameter of around 2.3 seconds of arc it will be only detectable with a small telescope or binoculars.

The Night Sky

At the end of February the water constellations of **Cetus**, the whale, **Pisces** the fish, together with **Aries** the Ram are setting into the Western twilight sky to be replaced by Leo the lion now slowly making its reappearance in the eastern evening twilight sky also been perused by **Virgo**, **Bootes** and **Coma Borealis**. **Orion** is still prominent in south with Sirius scorching a hole in the celestial sphere due South. Above and slightly to the east of Orion lies the constellation of **Gemini** the twins and **Castor and Pollux** can easily be discerned in a light polluted sky. To the east of Gemini lies **Cancer** the Crab, a nice cluster of stars known as the Beehive or M44 can be located mid point of Castor and Regulus or Alpha Leonis. Situated below Gemini and Cancer is the constellation of **Canis minor**, a small constellation designating one of the two hunting dogs but contains a distinctive star by the name of **Procyon**, this star been one of the three stars of the asterism known as the Winter triangle, the other two stars being Betelgeuse and Sirius. The constellation of Monoceros also resides in this part of the sky, and is home to the Helix nebula, this object is large and very diffuse, not easy to see visually but a nice object for CCD imaging. As we move into the month of March Orion slips towards the southwest horizon and **Leo** takes its place. Overhead the distinctive shape of the **Plough asterism** is situated. Using the two stars in the Pan closest to the line of stars forming its handle it will point the way to Regulus the brightest star in Leo. Below Leo, the largest of the 88 constellations, **Hydra** the snake can be located



Plough Asterism Image by Steve Souther

along with the **Sextant**, **Crater** and **Corvus** the crow. Above, and to the East of the tail of Leo can be found Coma Berenices a faint grouping of stars also known as Berenices hair. In the North East the brilliant orange star **Arcturus** in the constellation of Bootes is making its presence known. On March 21st at midnight the Sun crosses from South to North on the elliptical plane at RA (Right Ascension) 00:00:00 marking the Vernal equinox. (Due south at this time we are looking at RA 12:00:00 which is situated between the tail end of Leo and Coma Berenices.) As we move through April, **Virgo** will be on the south meridian close to midnight. Above the head of Virgo is placed Coma Berenices. Between these 2 constellations is an area known as the realm of the Galaxies. It's a deep sky observer's delight with 17 Messier galaxies to observe! These are the brightest objects in the Virgo cluster of Galaxies and there are hundreds more, though you will need a reasonably sized telescope to see some of them. Towards the East, **Hercules** has appeared above the horizon, while in the North east the distinctive white blue star **Vega** in the constellation of the **Lyre** has appeared. **Ophiuchus** and **Libra** the scales are appearing in the south east. By the middle of May the bright star Arcturus will be due south while Cancer and Gemini will be setting. Towards the East, Aquila will start to appear. **Cygnus** the swan has just risen. Towards the North east the asterism known as the summer triangle can be located while in the South, the tail of **Scorpius** with the bright red star Antares can just be seen above the murky horizon. Moving into June the constellation of Ophiuchus will be placed due south. Leo will be setting in the west. Sagittarius with the asterism of the teapot is rising low in the South East. In the east **Pegasus** is starting to appear. **Delphinus** the dolphin and **Equuleus** the horse have made an appearance, while in the North East **Andromeda** is making its return to the night sky.

Spaceflight Roundup John Richards

I'm not sure if you've heard the news, but Tim Peake has been successfully launched to the International Space Station! On the

15th December, Tim, along with Russian Yuri Malenchenko and American Tim Kopra were launched from the Baikonur Cosmodrome in Kazakhstan. There was, as you can imagine, extensive UK media interest in the story. They even had me on the radio talking about it! Tim's unabashed aim has been to promote **STEM** (Science, Technology, Engineering and Mathematics), and to inspire our youth to become interested in space. He has already conducted interviews with UK schools,and asked UK students to send him computer code he will run on the ISS, on two specially commissioned, British built, Raspberry Pi computers. Amoung other tasks he has undertaken has been,along with Tim Kopra, his 1st spacewalk, to replace a failed voltage regulator.

Tim Peake 'takes a space selfie'

The spacewalk was terminated early, after 4 hours 43 minutes, when Tim Kopra noticed a build up of cold water in his spacesuit. 'Cold water' implies the leak has been exposed to space. In a similar incident, Luca Parmitano reported a large amount of water leaking into his suit during a spacewalk in 2013. Subsequent reports suggest that the suit Tim Kopra was wearing was in fact the same one worn by Luca in 2013. **SpaceX** engineers gave owner, Elon Musk, an early Christmas present when they managed, for the first time, to land the first stage of a Falcon 9 rocket for a soft landing on Earth. The landing, at “Landing Site 1” at Florida's Cape Canaveral Air Force Station occurred roughly 10 minutes after launch of the rocket that successfully carried 11 communications satellites into space. Previous unsuccessful attempts had tried landings on a unmanned barge, but this landing occurred not far from the launch site, and excited local residents witnessed the thrusters firing as the first stage came into land. This was the first landing of an orbital rocket. The Blue Origin landing referenced in the last issue was of a sub orbital vehicle. Blue Origin, then “upped the ante” in early 2016, by relaunching the same sub orbital rocket it launched and returned to Earth in November last year. Another launch by SpaceX in late January failed in its attempt to land the first stage on a barge in the Pacific Ocean. The landing of the 1st stage touched down safely, then as it settled on the barge, one of the support legs on the rocket buckled , and the rocket toppled over and exploded. The hope is that by reusing expensive rocket componets, the cost of getting into orbit, will be greatly reduced. Early February saw the successful installation of the last of the hexagonal mirrors for the **James Webb Space Telescope**. In an exceptionally delicate operation, NASA's engineers at the Goddard Space Flight Centre,have spent the last few months installing each mirror, around 1.3 metres across. Once deployed in space, the 18 primary mirrors will work together as 1 6.5 metre mirror. **NASA** has awarded the 2nd batch of contracts to companies aiming to

launch resupply missions to the International Space Station between 2019 and 2024 when current ISS operations will cease. As well as established outfits like SpaceX, who fly the Falcon 9 rocket, and Orbital ATK who fly the Cygnus, a new player has emerged. The Sierra Neveda Corporation has now been guaranteed at least 6 cargo resupply mission flying its **Dream Chaser** 'mini space shuttle' design. The 1st orbital test flight of the Dream Chaser is scheduled to occur in late 2016, launching from Kennedy Space Centre on top of an Atlas V rocket. **Virgin Galactic** unveiled the NEW SpaceShip Two on 19th February, less than 18 months after the ill-fated flight that killed its co-pilot and seriously injured the pilot. The new craft, is called **VSS Unity**, and was named by Professor Stephen Hawking. The largest change in the design from its predecessor, is the creation of an 'inhibitor' to prevent the premature activation of the braking system. The US National Transportation Safety Board (NTSB) concluded the accident was caused by the early activation of the breaking system by the co-pilot, causing the ship to disintegrate above the Californian desert in late 2014. Virgin Galactic will now start testing of the vehicle. This will be consist of initial ground tests, followed by glide tests from 8 miles. The final phase of testing will be rocket powered flights when craft & crew will experience weightlessness. ESA launched its **LISA Pathfinder** mission on 3rd December. Launched from French Guinea, it is hoped that the mission will prove the feasibility of having probes HUNDREDS of kilometres apart to assist in the detection of gravational waves, leading to a space based gravitational wave observatory being launched by the mid 2030's. ESA reported in mid February, the two cubes housed inside LISA Pathfinder were left to move under the effect of gravity alone. A **Cygnus** resupply successfully launched to the ISS. The space craft, with enhanced fuel cells, solar arrays and an increased payload capacity, carried 3 tonnes of cargo, including crew supplies and specially modified Raspberry Pi computers (see right) that Tim Peake will use while in space. On the 19th February, the Cygnus was released from the station, carrying 1 1/2 tonnes of trash and burnt up in Earth's atmosphere.

Astro-Pi's

SF's Answer to Relativity Phil Wallace

Relativity is a real pain for science fiction (hereafter referred to as SF, not sci-fi like those pesky Americans would say). Even going as fast as possible travelling to the stars would take decades or centuries. With no possibility of reprieve or parole interstellar travel looks doomed.

But wait…this is SF! We don't need to let those pesky laws of physics hamper our fun. So SF writers have come up with a bewildering array of solutions to the lightspeed barrier. Warp engines, hyperdrives, slipstream portals, wormholes and jump gates are scattered across science fiction almost as liberally as the planet-killing weapons of my previous articles. So let's have a look at some of the more popular FTL (faster than light) methods.

Warp Engines: A staple of Star Trek since its very beginning, warp engines are in fact physically possible. Or rather, *actual* warp engines are possible, Star Trek warp engines are not. The engines of the USS *Enterprise* work by forming a "bubble" of spacetime around the ship that is "submerged" into subspace; a strange netherworld existing "beneath" our own space-time. This bubble is then made to move at great speeds in a realm where there is no speed limit. Fanciful, crazy, impossible.

The "real" warp drive was worked out mathematically by Miguel Alcubierre and suggests that a large enough mass in front of the ship and a corresponding negative mass behind the ship, all moving, would allow the ship to "surf" the wave of space-time. So the ship itself is at relative rest, it's just riding a wave that happens to be moving at near-lightspeed. Relativity is avoided and causality is maintained as long as the starship cannot communicate with the universe while moving.

You may have noticed that little stumbling-block; "negative mass." Negative mass, or exotic matter, is physically possible (that is to say, the laws of physics as we understand them do not *dis*allow it)

and may have been experimentally observed in the Cassimir Effect. However, Alcubierre calculated you would need at least 10^{19} kg of exotic mater for the system to work. That's about the mass of Mars' moon Deimos. Yeah, not likely. Plus the difficulty of making this whole apparatus move without touching it.

Hyperdrive: An incredibly common method of FTL is the wonderfully generic hyperdrive. Most commonly it carries the starship into another of those alternate space-times called hyperspace, this time it is "above" our universe, so it (apparently) has a much higher energy and no speed limit and no relativity either. Hence, starships can accelerate indefinitely without its mass increasing as that annoying Einstein predicted. Hyperspace turns up throughout sci-fi, from Star Wars to Stargate to Babylon 5 to Homeworld and on. Even my own SF works feature starships powered by hyperdrives.

As with exotic matter, the laws of physics do not denounce hyperspace, but the fact that we have no idea how to reach a higher dimension does not bode well for the idea of a hyperdrive.

Space Folding "Jump" Drives: Found in newer works such as the re-imagined Battlestar Galactica, space folding jump drives (or jump drives for short) function very differently from warp engines or hyperdrives. They allow a starship to disappear from one location and appear near-instantaneously in another, much more distant location. This could get complicated, so I'll explain the basics:

Suppose space-time is a flat sheet of paper and your starship is a neat little drawing at one corner. You want to reach a destination at the far corner of the sheet. You could fly straight across, or you could be rather clever and fold the sheet of paper so that the two opposite corners are right next to each other. Then you just hop across the gap and boom, from an observer's point of view you have jumped across a huge distance. So, we take a short cut across two-dimensional space by folding it and hopping across the third dimension. Now add another dimension to the drawing at the

2D sheet becomes a 3D cube and the air you jumped across becomes….well no one has any idea, but it's presumably that damn hyperspace again.

Jump drives are very distinct from other FTL engines. For one, they function in a series of "hops" rather than a continuous flight. Second, many universes contend that jump drives can't be used for FTL communication except via courier. This allows for lots of dramatic potential which writers just love.

Wormholes and Stargates Finally we come to wormholes as a means of travel. These tend to crop up in "harder" SF universes; to allow FTL travel while keeping technology plausible. Normally there is a pre-existing network of wormholes, either naturally occurring (very conveniently) or left behind by some long-lost species. Wormholes are regions of space-time that take shortcuts across or through higher dimensions; they are like bridges across the space around the sheet of paper described above.

Travelling through a wormhole is just like travelling through space so relativity can still be present. Several stories allow wormholes to connect different points in time as well as points in space, allowing for some interesting "apparent" FTL. One instance involved massive sleeper ships flying out to wormholes over many centuries, travelling through a wormhole to the past then continuing the journey. The ship still takes hundreds or thousands of years to arrive, but from the observer's viewpoint it only takes a few weeks.

Finally, we have perhaps the ultimate in wormhole travel; the eponymous Stargates. Large superconducting rings that connect to each other via artificial, stable wormholes, they allow interstellar and intergalactic travel in a matter of seconds. If enough power is available it can take you billions of light years across the universe.

Stargates represent an interesting type of FTL; it's only useable on personal scales. It can carry people, small vehicles and cargo but it totally useless for starships. This is of course highly convenient for an SF series since it can focus on small groups of characters. This is naturally something the Stargate's builders did intentionally.

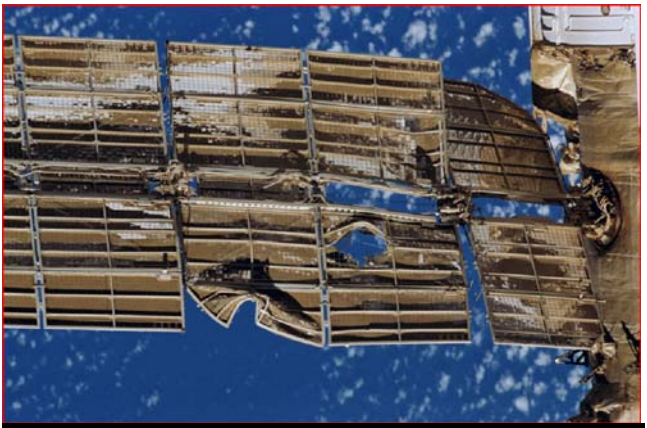
From 'New Hope' to New Horizons (part 3)

Valentine's Day **1996** saw the maiden flight of the **Chinese Long March** 3 rocket. It was designed to put satellites into geo-synchronous Earth orbit, as China was keen to capture a slice of the blossoming 'telecommunications sector'. Having flown more than 30 missions since, this was not a successful start for the Long March 3. Two seconds after launch, and just after it has climbed above the launch tower, the rocket veered of course, eventually destroying a nearby town, killing at least 6 people. Three days later saw the launch of the **NEAR** (Near Earth Asteroid Rendezvous) Shoemaker mission. The mission, launched from Cape Canaveral, was the first mission to orbit and successfully land on an asteroid, when in February 2001, it landed on 433 Eros, having earlier made a flyby of 253 Mathilde in 1997. June 4th saw the maiden launch of the **Ariane 5G** rocket launched from French Guinea. Unfortunately, along with its Chinese counterpart the rocket flew off course and self-destructed 37 seconds after lift off. In orbit, Hubble took the 2nd of its now famous 'Deep field' images. HDF-S (**Hubble Deep Field South**) was taken to assess if the area selected for the first Deep Field image, containing millions of galaxies, was a fluke, and did not represent the Universe as a whole. It was pointed to an anonymous area in the Southern sky, and was a culmination of a 10 day long observation. The second deep image did in fact prove the Universe appears to be filled with almost countless galaxies, in whichever direction you look. After some 'shake down' tests the latter half of 2006 saw the first flybys by the Galileo probe of the largest Jovian Moons Ganymede, Callisto and Europa.

February **1997** saw the launch of the Space Shuttle **Discovery** and a 10 day service mission, the 2nd, to service the **Hubble Space Telescope**. Astronauts Steve Smith, Mark Lee, Gregory Harbaugh and Joseph Tanner spent a total of more than 33 hours, and 5 spacewalks installing **NICMOS** (Near Infrared and Multi Object Spectrometer) and the **STIS** (Space Telescope Imaging Spectrograph). These new devices, using technologies and techniques not available in the original design of Hubble, replaced the Goddard High Resolution Spectrograph, and the Faint Object

Spectrograph, and would allow Hubble to see even deeper into the early Universe, where light is shifted to ever longer parts of the infrared spectrum.

Disaster almost ensued in June when an unmanned Progress resupply vessel, collided with the MIR space station, damaging the station's solar arrays (vital for power generation), and puncturing the hull of the Specktr module, depressurising it, and exposing it to the vacuum of space. Aboard at the time were Vasily Tsibliyev, Aleksandr Lazutkin and British born American, Michael Foale. It was only the rapid reaction of the crew on board, that prevented them having to evacuate the station, though the actions that day had ramifications for a long while to come, and most likely contributed to MIR's eventual de-orbit 4 years later. The 4th July saw the **Mars Pathfinder** land on the red planet. The probe landed, or bounced, into Ares Vallis, with the use of parachutes and a giant system of airbags that protected the craft upon impact. Weighing only 23 pounds, the mission returned more than 17,000 images and greatly enhanced our capabilities in terms small robotic rovers, blazing a trail for what was to come. **Takao Doi** became the 1st Japanese astronaut to conduct a spacewalk, when he flew aboard **STS-87**. His spacewalks involved demonstrating techniques that would be employed in future maintenance operations on the International Space Station (**ISS**). Mid October saw the launch of the **Cassini** probe to Saturn. Consisting of 2 probes ,the main Cassini Probe weighing almost 7.6 tonnes and the Huygens probe due to land on Saturn's largest moon Titan, the probe caused a certain amount of controversy when it was revealed that the power source would contain a radio isotopic thermoelectric



Damage sustained to Mir solar panels in 1997

generator. While NOT a nuclear reactor in space, NASA were certainly launching a pellet of radioactive plutonium into space, and a failure of the Titan rocket carrying Cassini would have sprayed radioactive contamination over potentially a wide area. Prior to the launch 27 people were arrested, and activists even tried to get the launch cancelled. Thankfully, this didn't happen and Cassini and Huygens successfully started their 7 year journey to the planet Saturn. Brazil attempted the maiden flight of its **VLS-1** rocket, carrying a low Earth orbiting satellite. Unfortunately, the mission failed, emphasising again that getting to space, even low Earth orbit, is hard.

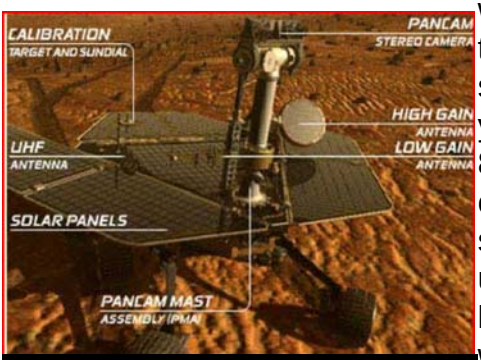
1998 saw the implications of last year's Proton collision with **MIR** continue to occupy the cosmonauts aboard the station. They spend almost the entire year and 9 spacewalks repairing the damaged station, paying particular attention to the depressurised Specktr module. In happier news for the Russians, they successfully launched the 1st **ISS module** into space. The **Zarya** control module was launched on 20th November, and provided electrical power, storage, propulsion and guidance during the early years of assembly. This was followed by the adding of the US Unity module a month later by the Space Shuttle Endeavour. Earlier in October, and after a gap of more than 36 years, former Mercury Astronaut **John Glenn**, at 77 years old, became the oldest man to fly in space. He flew as a payload specialist on Shuttle mission **STS-95**, and assisted in the medical experiments related to the effect of weightlessness on the human body. The mission also focused on preparatory tests for the next Hubble servicing mission.

1999 saw the unexpected failure of the 4th of 6 gyroscopes aboard the **Hubble Space Telescope**. This meant additional work for the space shuttle astronauts, split the servicing mission in 2 (the 2nd to be completed by another flight), and brought the servicing mission forward. As well as replacing the gyroscope module, a new faster computer, 20 times faster, with 6 times more memory was installed. Also a solid state recorder was installed, with 10 times the data volume of the previous device. Finally, a new more powerful S band transmitter was added. To lessen the temperature differentials

within the telescope, the outer layers of thermal protection were replaced. July saw the launch of **STS-93**, carrying the **Chandra X-Ray satellite**. It is the 3rd of NASA's GREAT Observatories, and is designed to observe X-rays from high energy regions of the universe, such as black holes, quasars and hot gas surrounding remnants of exploded stars. Chandra's elliptical orbit ranges from around 10,000 to 82,650 miles from Earth. It's still in operation, and has helped scientists discover a new type of black hole, X ray radiating black holes, and has offered the most direct evidence yet of the existence of 'Dark Matter'. An embarrassed NASA had to admit that the reason for the failure of the **Mars Climate orbiter** was a mix up between scientists taking measurements in inches & centimetres. Whoops!!

The year **2000** started with the **NEAR Shoemaker** spacecraft entering orbit around asteroid 433 Eros. It was the 1st of the near Earth asteroids to be discovered in 1898 and is a potato shaped object around 20 x 8 miles. In total, NEAR took more than 160,000 photos. The myriad instruments on the spacecraft estimated the gravity field of the asteroid, determined its mass and density, and showed that even small objects can provide fascinating insights into the Solar System. At the end of the mission the following year the probe actually landed on the asteroid. April marked the final manned mission to the **MIR** space station. The mission, Mir E0-28, was an effort by MirCorp to refurbish and privatise the ageing space station. Unfortunately additional funding was not forthcoming, and this led ultimately to it being de-orbited within a year. **STS-92** became, bizarrely the 100th flight of the US space shuttle. The mission lasting almost 13 days was primarily involved in ISS construction. This led, in October, to **Expedition 1**, the 1st permanent crew of the ISS. Aboard **Soyuz TM-31** were Russians Yuri Gidzenko, Sergei Krikalev and American William Shepherd. 2000 also saw the maiden flight of the **Progress M-1** resupply spacecraft. The vehicle was optimised for the transportation of fuel rather than pressurised cargo. To close out the year, on December 30th , the Cassini made a flyby of Jupiter on the way to its ultimate destination, Saturn.

2001 starts with a bang when In January China launches the **Shenzhou** orbital module on its second unmanned test flight. Aboard the re-entry were a monkey, a dog and a rabbit. What they thought about the launch is unknown, Subsequent launches also occurred in March and December. The Russian Space Station **MIR** was de-orbited in March after more that 5,500 days in orbit. Launched in modules, the core module was launched in 1986, and was prior to the construction of the ISS, the largest man made structure in space. During its 15 years in space it has completed 86,000 orbits and was the 1st continuously inhabited research station in orbit. The Russians used the station to measure the long term effects of weightlessness on the human body, and cosmonauts who visited there still hold many of the records for the longest duration missions in space history. The decision to de-orbit the station was primarily made for 2 reasons. Firstly, the Proton collision in 1997 had rendered the station compromised, even after the repairs, and secondly the Russians could not afford to maintain the ageing station, at a time when work was soon to start in earnest on the International Space Station. April 28th saw **Dennis Tito** become the 1st space tourist, by paying $20 million to spend nearly 8 days aboard the ISS. He was ferried to the station on a Russian Soyuz rocket. US astronauts **Susan Helms** and **Jim Vass** set a new record, that still exists to this day, when they spend 8 hours and 56 minutes installing the Leonardo module on the ISS. This was an intensive time in orbit, with a total of 18 spacewalks, totalling 100 hours in 2001 alone. June saw the launch of the **Wilkinson Microwave Anisotrophy Probe** (WMAP) to measure tiny temperature differences of the Cosmic Microwave Background. It also helped in assigning percentages to the component parts of the Universe (matter, dark matter and dark energy) as we understand them today. While it ceased operation in



Opportunity rover, showing some instruments

2010, its impact on cosmological research cannot be doubted. The three most highly cited physics and astronomy papers published in the new millennium are WMAP scientific papers. August saw the launch of NASA's **Genesis** mission to collect a sample of solar wind and return it to Earth for analysis. Its aim was to build a repository of solar matter, like that of the Moon rocks returned during the Apollo era, to be studied by solar scientists around the world.

March **2002** saw the 2nd part of the 3rd **Hubble** servicing mission. Due to the failure of the gyroscopes in 1999, the 3rd servicing mission was split into 2 missions. This was the 2nd of these. The main task was to install a new instrument that doubled Hubble's field of view, and to collect data 10 times faster. Also a improved power supply and cooling system were installed, which allowed the Near Infrared Camera to operate again. Finally, one of the reaction wheel assemblies, used to steer the telescope was also replaced. In all, 5 spacewalks wee conducted, 2 teams of 2 astronauts and almost 36 hours of spacewalks, spread over 4 days. October saw the launch of the European **Integral** mission (International Gamma-Ray Astrophysics Laboratory) to observe the most energetic radiation in the Universe. It has 4 instruments on board including spectrometer, imagers, and x-ray and optical monitors, and has detected gamma-ray bursts, including the closest and faintest ever recorded. The mission is still continuing, and is currently due to end in December 2018.

2003 was unfortunately dominated by tragedy when the Space Shuttle **Columbia** disintegrated during re-entry killing all 7 astronauts on board. During the launch, a suitcase sized piece of foam from the Shuttle's external tank impacted the left wing of the space shuttle. There was a feeling among some NASA engineers that this

damage could potentially effect the structural integrity of the vessel. NASA managers didn't seem to heed these warnings. In subsequent testimony to the Columbia Accident Investigation Board, it was reported that NASA had the capability to either assess the damage themselves, or for others (Department of Defence) to do so on their behalf, and **actively** chose not to do so. Therefore, when the crew donned their helmets and prepared for re-entry on 1st February 2003, they were unaware of their possible fate. The space shuttle Columbia burnt up in the atmosphere travelling from New Mexico into Texas. It was travelling at mach 19.5 at an altitude of 210,000 feet.

Remnants of the Space Shuttle Columbia

Debris was spread over 3 states; Texas, Louisiana and Arkansas. There were obviously no survivors. The shuttle was grounded for more than 2 years. During late April, **GALEX**, an ultraviolet space telescope was launched, interestingly from an air-launched rocket Pegasus rocket, as its weighed only 277 kg. The aim of this mission was to show how galaxies evolve and change over their immense lifetimes. May saw the launch of Japanese mission to return a sample of an asteroid to Earth. The probe spent more than 2 years, chasing the asteroid, 25143 Hotokawa before returning to Earth in 2010. June saw the Russians launch the **European Mars Express** probe, ESA's first visit to another planet. It arrived at the Planet in only 6 months, due mainly to the relative closeness of the 2 planets. Mars Express also carried a lander probe, **Beagle 2.** Unfortunately, after being released on Christmas Day 2003, Beagle 2 was never heard from again. Recent evidence suggests it crashed into the Martian surface. Mars Express though soldiers on, offering high resolution images of the Martian surface, increasing understanding of the atmosphere, and information about the sub-surface and interior of the planet. At the time of writing, the mission has received 6 extensions, and is scheduled to operate until the end of 2016.

June and July saw Mars again the destination of choice for NASA, when they sent the **Spirit** and **Opportunity** probes to our closest neighbour. Both probes arrived on the Martian surface in early 2004, and while contact was lost to Spirit in 2010, Opportunity has motored along to cover over 25 miles in its 12 year journey around the Red Planet. It has provided evidence that while dry and arid now, in its past Mars was a wet world, potentially capable of sustaining life. August saw NASA launch the **Spitzer** Infrared Space Telescope, the 4th, and last of the GREAT NASA OBSERVATORIES program to image all major electromagnetic bands from space. The Chinese entered the manned spaceflight business when they launched **Yang Liwei** aboard **Shenjhou 5** on a 21 hour, 14 orbit test flight. While Yang described the ascent, as "very uncomfortable", and the landing as "heavy", the flight was obviously heralded a great success by the Chinese.

March **2004** saw the launch of the ESA probe **Rosetta** and its small companion Philae to comet (deep breath now!) **67p /Churyumov-Gerasimenko.** Their mission was to orbit and land on a comet, thought to be virtually unchanged since the dawn of the Solar System. As we've seen over the last 18 months, the mission has been a huge success, in its stated aims, but also showing ESA as a major force in innovative space missions, that grab the public interest. While contact with **Philae** has been lost, Rosetta still orbits the comet returning fascinating images and data.

The Space Exploration Team became the first amateur organisation to launch a rocket into space, when their **GOFAST** rocket reached an altitude of 72 miles when it was launched in May. The commercial, or non-governmental race to space heated up further, when in June, the maiden flight of **SpaceShipOne** flew. Carrying Mike Melville, it was the 1st privately funded manned spaceflight. It was fighting for the **Ansari X prize** for suborbital flight; a prize awarded to the company who design a spaceship capable of carrying up to 3 passengers above 62.5 miles, twice in 2 weeks. In October, this was achieved when SpaceShipOne carrying Brian Bennie, completed the second flight, after Mike Melville reached the same height earlier on 29th September. The

*The Space Exploration team displaying their **GOFAST** rocket*

prize? $10 million, not bad, though its estimated more than 10 times that amount had been invested in this aspect of the burgeoning 'commercial space' industry.


Mike Melville celebrates on top of SpaceShip One

Earlier in the year, and and after a journey of almost 7 years, the NASA **Cassini** probe arrived at the planet Saturn. It carries with it the Huygens probe, that was released and landed on Saturn's largest moon, Titan. It was humanity's first successful attempt to land a probe on another world in the outer Solar System. While it was slowly descending to the surface, it revealed many features we'd recognise on Earth, lakes, river, tributaries. But none of these were created by water, its far too cold. These features were formed by liquid hydrocarbons etching their mark on the world, as water does on the Earth. Once it landed, Huygens continued to transmit for another 72 minutes before contact was lost as its parent craft, Cassini, dipped below the horizon. Cassini itself, has offered us a wealth of new discoveries including exquisite views of the ring systems of Saturn, views of some of the most powerful auroras in the Solar System, and of course the venting of organic material into space from an ocean under the southern region of Enceladus, with the tantalising glimmer of what that might mean for the possibilities of life in the

Universe. September saw the launch of **SMART-1** (Small Missions for Advanced Research in Technology) a Swedish designed ESA probe to orbit the Moon. Surprisingly, this was the first ESA mission to do this. Its primary mission was to test an ion propulsion engine, and to extend ESA's capabilities in the area of micro satellites; offering high scientific return for relatively low cost. After a 3 year mission, SMART-1 was deliberately crashed into the lunar surface. George Bush announced that at the end of its mission to complete construction of the International Space Station, the American Space Shuttle fleet would be mothballed. The beautiful, but flawed craft had become too expensive, both in terms of cost, and human lives to continue. The final flight was scheduled for 2010. In light of this, NASA administrator Sean O'Keefe announced the decision to cancel the final Hubble servicing mission. An uproar ensued. As if to emphasise the impending loss, in June **NASA** released a new deep field photograph, the 'Ultra Deep Field' (UDF) image. Showing an estimated 10,000 galaxies, the image combined for the 1st time observations of visual, ultraviolet and infrared light. The image taken was of an area of sky 1/10th of the angular diameter of the full Moon as viewed from Earth, and showed galaxies up to 13 billion light years away.

Early in January 2005 the **Deep Impact** probe was launched. It aim to launch a projectile at comet Tempel 1, to help determine the composition of the comet's nucleus. The impact occurred on July 4th

The Space Shuttle again returns to flight. Based on the findings of the Columbia disaster, the cameras on the launch pad are upgraded and greatly increased in number. Cameras are placed on almost every imaginable structure, including the orbiter itself. This has made for some amazing video since 2005. During the launch a piece of foam is seen breaking off the external tank and impacting the orbiter. This was the issue that caused the Columbia disaster. As the Shuttle approached the Space station, it performed its first ever pitch and roll manoeuvre to allow crew aboard the station, and technicians on the ground a visual inspection of the state of the thermal tiles protecting the shuttle. Damage was spotted and a decision made to conduct spacewalks to assess, and if possible

repair any damage. Stephen Robinson successfully removed protruding gaps fillers on **Discovery**'s heat shield. A damaged thermal blanket was also spotted, but was considered non critical for reentry and was left. Thankfully, Discovery landed without major incident. Once Discovery landed, it was decided to ground the shuttle fleet again while the external tank was redesigned. It did not fly for another year. NASA appointed a new Administrator when Dr. **Michael D. Griffin** replaced Sean O'Keefe. He had stated in his confirmation hearing that he would reassess the Agency's decision to cancel the last Hubble servicing mission. The tide was turning against the initial decision. In a report entitled "Assessment of Options for Extending the Life of the Hubble Space Telescope: Final Report", The National Academy of Sciences concluded that:

"*Given the intrinsic value of a serviced Hubble, and the high likelihood of success for a shuttle servicing mission, the committee judges that such a mission is worth the risk*."

Griffin reversed the decision and agreed to allow 1 more servicing mission to the Hubble, with conditions. The **Mars Reconnaissance Orbiter** was launched by NASA in August. It's primary mission was to map the Martian surface, and study its climate. It was used in the selection of the landing site for the Phoenix Lander, and has also been used to locate liquid water on various points on Mars, both in polar regions and underground. The orbiter is still in operation around Mars, and has transmitted 260 terrabits of information back to Earth. To put this into context, that around 4,000 moderately sized USB memory sticks!! The final astronomical launch of note in 2005, was that of the ESA **Venus Express** probe, launched aboard a Soyuz rocket in November. Its primary mission was to map the Venusian atmosphere on a global level. One of the most interesting findings was the discovery of a frigid layer of the atmosphere, much colder than the corresponding area within the Earth's atmosphere, so cold in fact that snow could exist. Evidence of recent volcanic activity has also been found, a high level ozone layer, and a virtual absence of a magnetic field. At the end of the mission in late 2015, the probe burnt up in the Venusian atmosphere.

The final part of this series will cover the period 2006-2015

Up-coming CAS Public Events

Date	Time	Event	Venue
9th May	5:30pm - 7:30pm	Transit of Mercury	National Museum of Wales

For further details of the events we are organising for the transit, please visit the web site

CAS Lectures March to May

Date	Title	Lecturer
3rd Mar	From Holmdale to Planck:How the Cosmic Microwave Background has improved our understanding of the Universe	Dr Rhodri Evans,Cardiff University
17th Mar	William & Caroline Herschel:An 18th Century Cosmic Partnership	Jonathan Hall,Bath
31st Mar	Deep Sky Observing	Callum Potter,Tewkesbury Glos
14th April	Annual General Meeting	Cardiff Astronomical Society
28th April	Astronomical Imaging with Bridge Cameras	Dr Steve Wainwright,Swansea Astronomical Society
12th May	The Closest & Brightest Radio Galaxies	Prof Mark Birkinshaw,Bristol University
26th May	The Winter Star Party:All Night Observing from 26 Degrees North	Mark Radice,Salisbury

Observing Sessions

Date	Day	Time	Venue
4th or 5th Mar.	Fri or Sat	20:00 GMT	Dyffryn Gardens
11th or 12th Mar.	Fri or Sat	20:00 GMT	Mountain View Ranch
8th or 9th April	Fri or Sat	20:30 - 00:00 BST	Dyffryn Gardens
15th or 16th April	Fri or Sat	21:00 - 00:00 BST	Mountain View Ranch
6th or 7th May.	Fri or Sat	20:00 GMT	Dyffryn Gardens
27th or28th May	Fri or Sat	20:00 GMT	Mountain View Ranch

NOTE:- Where two dates are given we will attempt to hold the session on the first date, weather permitting, otherwise we will try again on the subsequent date. All dates are subject to weather conditions. For confirmation of any session please check on the CAS Web site or the CAS Observing line. 07817 723 883 for more information.

Almanac Compiled by John Richards

Sun Rise/Set & Twilight

Date	Astronomical Twilight Begins	Sun Rise	Sun Set	Astronomical Twilight Ends
1st March	05:06	06:57	17:52	19:43
08th March	04:51	06:42	18:04	19:55
15th March	04:34	06:26	18:16	20:08
22nd March	04:16	06:10	18:28	20:22
29th March	03:57	05:54	18:40	20:37
1st April	03:49	05:47	18:45	20:43
8th April	03:29	05:32	18:57	21:00
15th April	03:07	05:16	19:08	21:17
22nd April	02:45	05:02	19:20	21:36
29th April	02:22	04:48	19:31	21:57
1st May	02:15	04:44	19:35	22:04
8th May	01:48	04:31	19:46	22:29
15th May	01:17	04:20	19:57	23:00
22nd May	00:24	04:11	20:07	23:53
29th May	--:--	04:03	20:16	--:--

Meteor Showers

Date	Meteor Shower	RA	DEC	ZHR
12/04/16	**Virginids**	**14h04m**	**-9°**	**5**
22/04/16	**Lyrids**	**18h08m**	**32°**	**12**
28/04/16	**Alpha-Scorpiids**	**16h32m**	**-24°**	**5**
05/05/16	**Eta-Aquarids**	**22h20m**	**-1°**	**35**
13/05/16	**Alpha-Scorpiids**	**16h04m**	**-24°**	**5**

Star Parties and Observers Club Meetings

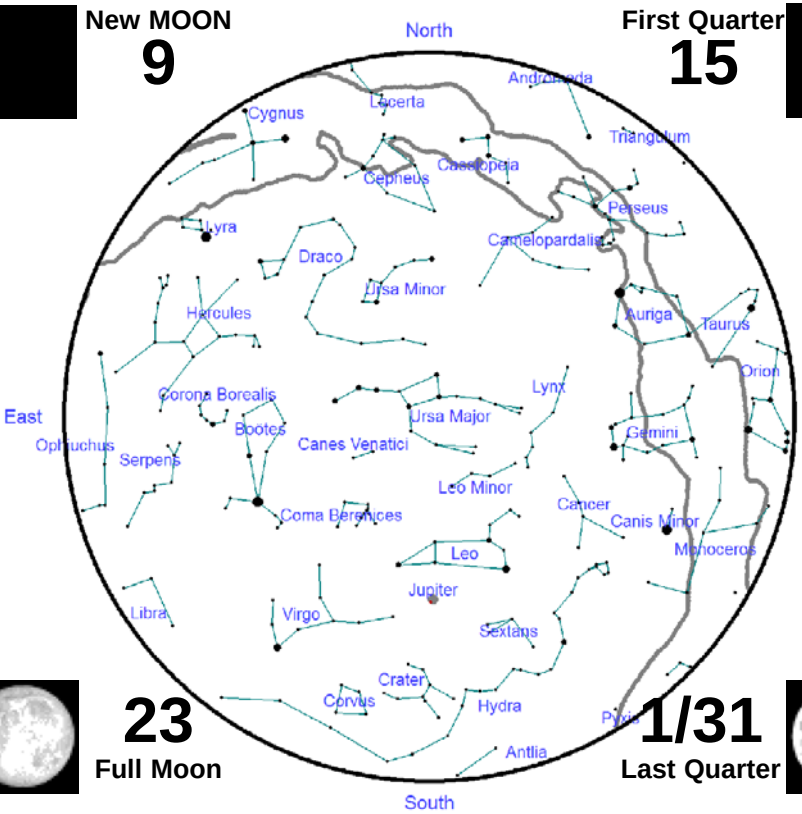
Date	Day	Time	Venue
08/03/16	Tuesday	19:30 - 22:30 GMT	Dyffryn Gardens
05/04/16	Tuesday	19:30 - 22:30 GMT	Dyffryn Gardens
03/05/16	Tuesday	19:30 - 22:30 GMT	Dyffryn Gardens

We always hope for clear skies,but the Star Party will go ahead as planned, regardless of the weather, and are held at Dyffryn Gardens unless otherwise stated.

Almanac March

New MOON
9

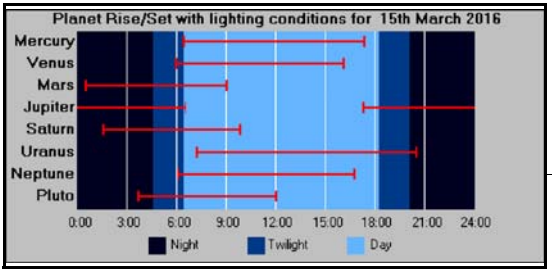
First Quarter
15



23
Full Moon

1/31
Last Quarter

	Constellation	R.A	Dec	Rises	Sets	Mag.
Mercury	Aquarius	23h14m07s	-07°09'12"	06:25	17:18	-1.0
Venus	Aquarius	22h22m08s	-11°24'28"	05:56	16:04	-3.9
Mars	Scorpius	16h04m59s	-19°36'58"	00:27	09:01	-0.1
Jupiter	Leo	11h16m10s	+06°18'56"	17:17	06:30	-2.5
Saturn	Ophiuchus	17h01m55s	-21°00'21"	01:32	09:48	+0.4
Uranus	Pisces	01h11m04s	+06°53'20"	07:11	20:26	+5.9
Neptune	Aquarius	22h54m15s	-07°54'46"	06:09	16:54	+8.0
Pluto (Dwarf)	Sagittarius	19h19m32s	-21°13'27"	03:51	12:04	+14.3



Planet Events

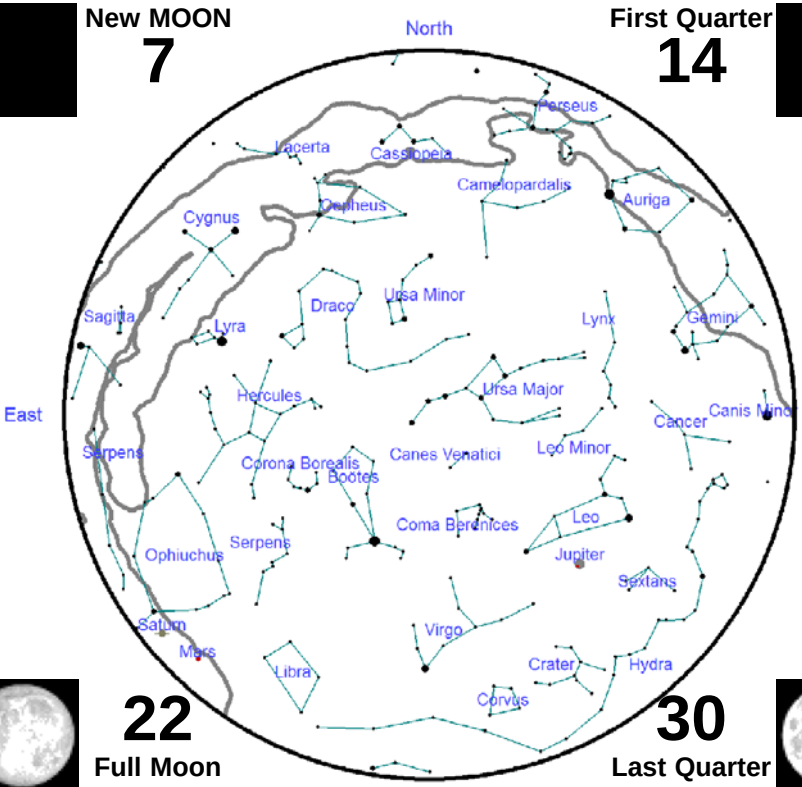
8th Jupiter at Opposition.
20th Venus at Aphelion (0.73 A.U.).
23rd Mercury at Superior Conjunction

The data presented here is for the 15th March. Positional data is at 00:00 GMT/UT

Almanac April

New MOON
7

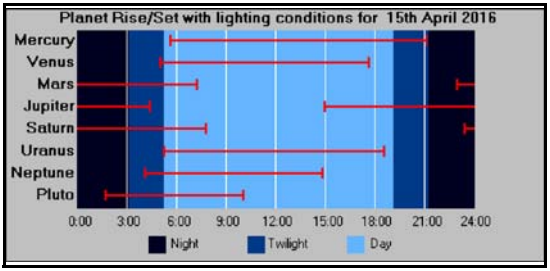
First Quarter
14



22
Full Moon

30
Last Quarter

	Constellation	R.A	Dec	Rises	Sets	Mag.
Mercury	Aries	02h45m46s	+18°32'49"	05:38	21:03	-0.3
Venus	Pisces	00h44m32s	+03°10'32"	05:01	17:38	-3.9
Mars	Ophiuchus	16h28m55s	-21°16'06"	22:55	07:12	-1.0
Jupiter	Leo	11h03m54s	+07°33'22"	14:57	04:22	-2.4
Saturn	Ophiuchus	17h00m11s	-20°55'30"	23:24	07:46	+0.3
Uranus	Pisces	01h17m33s	+07°32'59"	05:12	18:34	+5.9
Neptune	Aquarius	22h54m24s	-07°53'55"	04:07	14:53	+8.0
Pluto (Dwarf)	Sagittarius	19h19m38s	-21°13'21"	01:49	10:03	+14.3



Planet Events

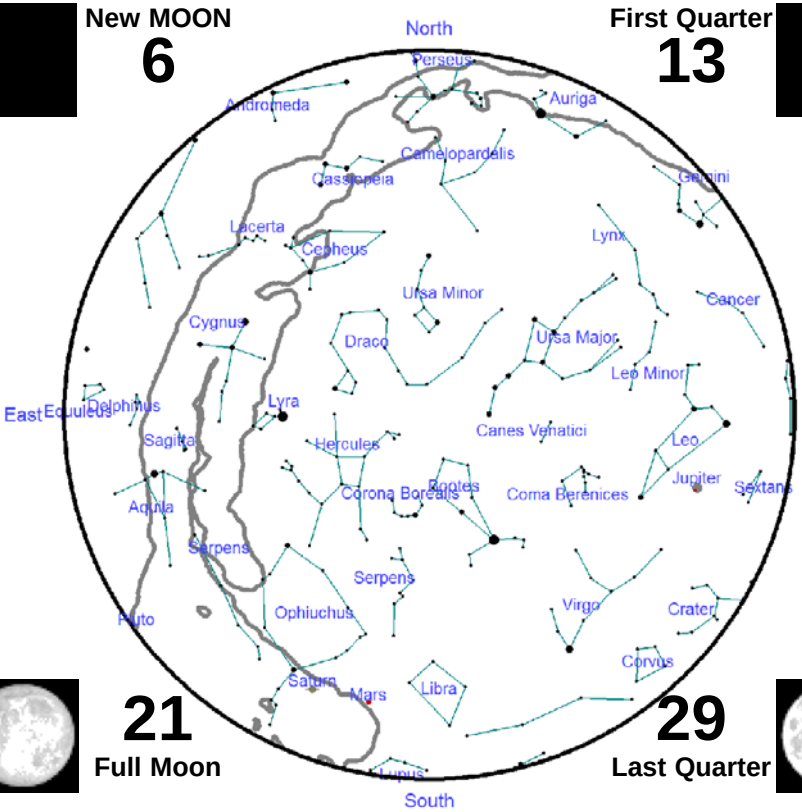
5th Mercury at Perihelion (0.31 A.U.).
9th Uranus at Conjunction.

The data presented here is for the 15th April positional data is at 00:00 GMT/UT

Almanac May

New MOON
6

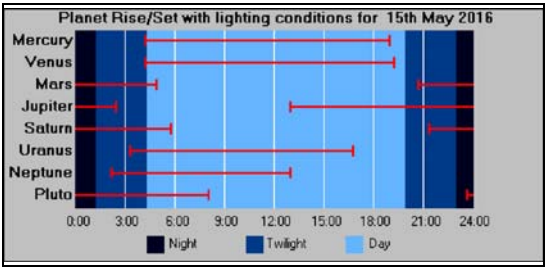
First Quarter
13



21
Full Moon

29
Last Quarter

	Constellation	R.A	Dec	Rises	Sets	Mag.
Mercury	Aries	02h57m24s	+15°10'31"	04:12	18:57	+4.1
Venus	Aries	03h04m54s	+16°29'03"	04:12	19:12	-3.9
Mars	Scorpius	16h08m35s	-21°45'16"	20:40	04:51	-1.9
Jupiter	Leo	11h00m32s	+07°48'11"	12:54	02:22	-2.2
Saturn	Ophiuchus	16h53m34s	-20°43'54"	21:18	05:42	+0.2
Uranus	Pisces	01h23m41s	+08°09'32"	03:17	16:45	+5.9
Neptune	Aquarius	22h54m32s	-07°53'03"	02:09	12:55	+8.0
Pluto (Dwarf)	Sagittarius	19h19m43s	-21°13'14"	23:47	08:05	+14.3



Planet Events

9th Mercury at Inferior Conjunction.
19th Mercury at Aphelion (0.47 A.U.).
22nd Mars at Opposition.

The data presented here is for the 15th May, positional data is at 00:00 GMT/UT

“This is Major Tim to Ground Control. I’m stepping through the door, and I’m floating in a most peculiar way, and the stars look very different today…”

Tim Peake’s mission on board the ISS is well underway, we have seen his interviews on TV, watched his space walk, read his blog, and interacted with him via social media. But there are two other British Astronauts on board the ISS that you may not know about.

Now at this point you maybe thinking “Huh!? what is she on about?” but keep reading as I introduce you to two very special astronauts.

Meet **Ed** and **Izzy**, 2 Raspberry Pi computers. OK, so you got me there, they aren’t humans, but they aren’t just two ordinary Raspberry Pi’s either. Ed and Izzy were handpicked by Tim to join him on his mission. They will be helping Tim conduct various experiments while he is on board the ISS. Ed and Izzy will be the first Raspberry Pi’s to go into space and live on board the ISS, but what makes them extra special is that the experiments they will be conducting were coded by school children from across the UK.

Before we take a look at these experiments and how you can get involved, let me tell you a bit more about Ed and Izzy. Ed and Izzy were born in the UK, at the Sony UK Technology Centre in

Pencoed. They were named after the real-life friendship between Sir Isaac Newton (Izzy) and Edmond Halley (Ed), which resulted in the publication of the famous 17th-century physics book, Principia Mathematica, after which Tim's mission is named. Little did they know, that thanks to the collaboration between the Raspberry Pi Foundation & ESA (European Space Agency), their lives were going to change forever.

Just like Tim, Ed and Izzy had to complete a series of tests that would prepare them for their mission. Their training was specifically designed to test their strength and speed, as they would be conducting important experiments and using special sensors in a zero gravity environment. Like real-life astronauts they were also given their very own space suits, which were tailored to their specific needs and would help them survive the environment on board the ISS. They even have their own mission patch and Twitter pages!

Ed and Izzy were given a special sensor board, a Raspberry Pi peripheral called the Sense HAT. This can measure the environment inside the ISS, detecting how the station is moving through space, and measuring the Earth's magnetic field. They were also given cameras, Ed's would detect visible light and Izzy's would detect infrared light. Ed and Izzy will stay on board the ISS until 2022. Follow Ed (@astro_pi_vis) and Izzy on Titter for regular updates on their mission.

What would you do with a piece of equipment like the Sense HAT? Look for cosmic rays? Make a time-lapse of the Earth through a hatch window? Maybe just give Tim games to play? This was the premise of the 2015 Astro Pi student competition which produced seven winning teams. Their experiments are in the form of Python programs, written and tested by the school pupils using their own Sense HAT boards and Raspberry Pis. The winning programs, now part of the Astro Pi payload, blasted off from Cape Canaveral Air Force Base in Florida back in December and arrived at the ISS a few days before Tim. They range from fun reaction time games to serious science experiments looking at space radiation. During his mission Tim will deploy the Astro Pis inside the European Columbus module and run each of the student programs in sequence. Finally, the results will be downloaded back to Earth, returned to the students that took part, and made available online for everyone to see.

2016 Coding Challenges

The Raspberry Pi Foundation have announced that they are running a new set of coding challenges for the Astro Pi mission! To take part visit the **astro-pi.org** website, pick one of the two challenges available, read through what's required, then write code to carry out the task.

You have until the 31st of March 2016 to submit your code. Good luck!