Federation of Astronomical Societies

Editor: Michael Bryce

Newsletter

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Note: The FAS Council Reserves the Right to publish articles, events and reports submitted to the FAS Newsletter

Cover Image "Markarian's Chain" by Mark Hardaker FRAS: Fordingbridge Astronomers (fordingbridgeastro.org.uk)

President
Dr Paul A Daniels
Hon. Member of Guildford AS
Rose Hill
High Green, Bradenham
Thetford, Norfolk
IP25 7RD
president@fedastro.org.uk
07802 324 697

Treasurer
Pat McEvoy
Hampshire Astronomical Group
17 Severn Close
Paulsgrove
Portsmouth
PO6 4BB
treasurer@fedastro.org.uk

Secretary
Richard Stebbing
Guildford AS
secretary@fedastro.org.uk
01372 750 644

Editor
Michael Bryce
Carolian AS & Bromsgrove AS
49 Cortland Way
Stourport-on-Severn
Worcestershire
DY13 8NZ
newsletter@fedastro.org.uk
07821 896 304

President's Spot: Dr Paul A. Daniels FRAS

You may recall from the last President's Spot (Newsletter #132) that I looked at Dyson Spheres, considered their practicality and concluded that the energy costs of building them far outweighed any advantages though a Ringworld might be feasible for a sufficiently advanced civilisation. I also posed the question…

What are Space Elevators?

Imagine you could take a ride into space on an elevator (that's American for a *lift*): first floor children's toys, second floor men's clothing, …, six millionth floor for the international space elevator observation platform! Well, it's not quite the same – unlike the lifts in John Spencer or Marks & Lewis (other tortured shop names are available) these lifts would be more like boxes that crawled up and down a special, super-strength, vertical cable using electric motors powered using either solar energy or from a directed laser beam on the ground instead of a steel cable lifting and lowering the lift.

There would be no more need for expensive, polluting and risky rocket technology to ferry people and materials to space. But I'm getting ahead of myself…

The idea of a space elevator was first conceived in 1895 by the Russian scientist and philosopher Konstantin Tsiolkovsky (better known as one of the pioneers of modern rocketry) who was inspired by the 330 m height of the Eiffel Tower completed only six years earlier and, perhaps, the story of the biblical Tower of Babel intended to reach up into heaven. He considered a tower at the Earth's equator reaching from the ground up to geostationary orbit (GSO) altitude. A GSO is at an altitude of approximately 35,786 km where an orbiting body (*i.e.* gravitational pull equalling centrifugal force) moves around the Earth at the same rate that the Earth rotates on its axis and so stays above the same longitude on the equator.

The flaw in Tsiolkovsky's idea is that the tower is a structure in *compression* and, if you add up the effective weight of the parts of the tower at each altitude, the total downward force at the base of the tower would exceed the compressive strength of all known materials. In other words, the tower would easily collapse under its own weight. A back-of-the-envelope calculation (large envelope, small writing!) shows that the weight of such a tower with a density of 1,000 kgm^{-3} (that of water) would exert a pressure on the ground beneath the tower of ~48 GPa (1 Giga Pascal = 10^9 Nm^{-2}). Denser materials would proportionately increase this pressure – a tower made of High Carbon Steel (density 8,260 kgm^{-3}), for example, would exert ~400 GPa but the compressive yield strength of such steel is only about 3 GPa so the foot of the tower would quickly crumple!

However, compressive strength and tensile strength (pulling on a material) are not the same: typically the latter is higher than the former and, in 1960, this led to Russian engineer Yuri Artsutanov conceiving a design[1] for a more potentially workable space elevator using a structure under tension. He replaced Tsiolkovsky's tower with a cable but extending that cable up past the GSO altitude to, say, 100,000 km and then attaching a high-mass counterweight to keep the cable taut.

The cable remains taut because the counterweight is being forced to rotate faster than the orbital period for the counterweight's altitude so the centrifugal force exceeds the gravitational pull and pulls on the cable keeping it taut. The further upwards from the GSO you travel the less cable there is above you pulling outwards and so the tension in the cable decreases away from the GSO. Similarly, the cable below the GSO is essentially suspended from the GSO altitude with less weight of cable hanging below you as you approach the Earth's surface so the tension in the cable also decreases as you move downwards from the GSO. In consequence, the tension at the lower and upper ends of the cable is zero and is a maximum at the GSO altitude.

In order to maximise the strength of the

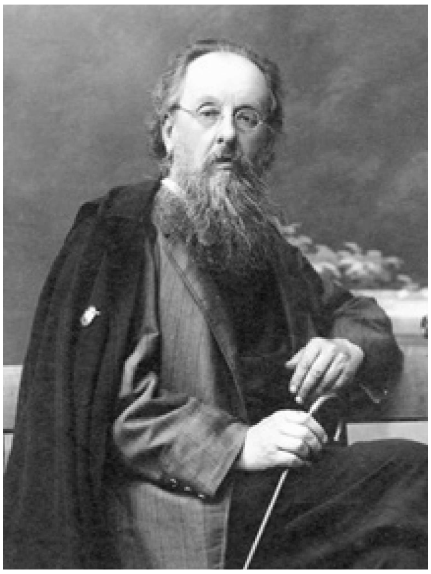

***Figure 1** Konstantin Tsiolkovsky in 1924*

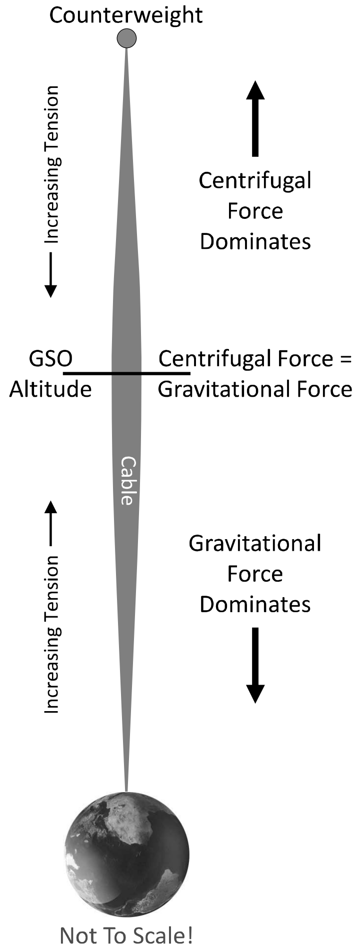

***Figure 2** Schematic of the space elevator (not to scale).*

cable for a minimum total weight of cable it should, optimally, be thicker at the GSO point, where the tension is greatest, and tapered towards the lower and upper ends so that it's thin enough to reduce cable mass but still strong enough to support the elevator. Figure 2 exaggerates the thickness of the cable which, most practically, would be a woven ribbon rather than having a circular cross-section and would be just millimetres thick at the extremes and a few centimetres thick at the GSO. The cable would also likely be a heterogeneous mix of fibres woven to allow it to conduct electrical power as well as provide the core strength to support the structure and elevator.

P. K. Aravind has suggested[2] that space platforms be built at both the GSO and counterweight end of the cable so that space vehicles can be constructed there from raw materials or components ferried up from the Earth's surface. A spacecraft released from the GSO could very easily enter a useful geosynchronous orbit and a spacecraft launched from the station at the end of the cable would have an excess velocity and so would be useful for missions that need to escape Earth's gravity, *e.g.* missions to the Moon or Mars or journeys to outer parts of the solar system such as Jupiter.

Another suggestion is that the counterweight be a manufacturing plant using raw materials from captured asteroids so that those materials (or the manufactured components) don't have to lifted from the surface of the Earth. Such a concept would provide a mostly space-based infrastructure to allow us to simplify travel to the Moon, Mars and beyond – imagine if a spacecraft used to travel to Enceladus had been entirely built in space and had never touched the surface of the Earth!

Other forms of space elevator have been envisioned[3] including elevators on a looped cable (similar to a Paternoster lift) and shorter versions designed to service low-Earth orbit (LEO). The latter, LEO, version would be 2,000-4,000 km tall with the centre of mass at 1,000-2,000 km altitude and a moving lower platform at 150 km altitude (circumnavigating the Earth every 105-127 mins and moving at ~25,000 kmh^{-1}). The moving platform would have to be loaded from a hypersonic space plane such as those designed by Reaction Engines.

Material	Density ρ kgm^{-3})	Max Tensile Stress T (GPa)	Taper Ratio
Steel	7900	5.0	1.6×10^{33}
Kevlar	1440	3.6	2.5×10^{8}
Carbon Nanotubes	1300	130	1.6

***Figure 3** Tensile strength of various materials. From Aravind[2].*

As you might expect, advanced materials would be required to construct the space elevator's cable. Even steel cables with the highest known tensile strength wouldn't have a high enough tensile strength to density ratio to make their use practical. The only material that's a candidate for the space elevator cable is carbon nanotubes. The table in Figure 3 shows the relative densities, tensile strengths and taper ratios of Steel, Kevlar and Carbon Nanotubes. The taper ratio is the cross-sectional area of the thickest part of the cable at GSO divided by the thinnest part of the cable at ground level and takes into account both the density and tensile strength of the material used. Steel and Kevlar are clearly unsuitable because a cable made from them (and also strong enough at ground level to support a usefully-sized elevator) would be immensely thick at GSO! Carbon nanotubes, however, hold more promise; the cable would only need to be 1.6 times the ground cross-sectional area at GSO.

So, is that it? Does that solve the materials problem? Well, no it doesn't because the cable would need to be several tens of thousands of kilometres long and currently the longest single carbon nanotube that's been manufactured is about 50 cm long and the longest 'forest' of nanotubes is just 14 cm long[4]. The technology that produces carbon nanotubes needs to improve the length grown *whilst still maintaining their strength*. If that can be done then it may be possible to weave a suitable cable.

There is some work being done to produce graphene sheets which would have superior strength compared with carbon nanotubes but that R&D is still in the very early stages.

A problem common to both carbon nanotubes and graphene is that their strength comes from the regular structure of carbon atoms and any defect in that structure of atoms would be likely to grow if it were stressed. This would lead to fraying of the carbon nanotubes or graphene that could potentially and rapidly lead to catastrophic failure of the space elevator cable with total loss of investment, disruption to the space-based industry and possible loss of life.

The risk to life is partly on Earth with material falling from the sky but also of those on any space platforms at the GSO or counterweight positions. Depending on the exact location of the break and mass of the counterweight, the GSO platform would either fall to Earth, enter an eccentric Earth orbit or move away from the Earth on an escape trajectory that would make rescue of personnel extremely difficult. Wherever the break, the counterweight platform would be more likely to follow an escape trajectory.

This doesn't mean that we're barking up completely the wrong tree looking at carbon nanotubes as the materials solution to the problem but that there needs to be *a lot* more R&D on that approach and very careful attention paid to the design of the cable.

So, we have the concept of a completed, working space elevator and some nice diagrams showing the various versions available but it must have occurred to you by now – how would you build it? You can't start from the ground up because the cable would be too flexible and floppy and you can't start from the counterweight location because it would have nothing to hold it near Earth whilst construction was underway. The solution is to start at a pre-constructed platform at the GSO altitude and unspool the cable both outwards and downwards symmetrically away from the GSO at the same time so that the centre of mass remains at the GSO. There are more than a few complications with this approach of course (!); as the cable is lowered towards the Earth, for example, atmospheric drag means it wouldn't be vertical and then would come the problem of getting the fragile, flapping loose end of the cable down to the Earth's surface.

I mentioned above the risks that could occur due to failure of the material making up the cable but there's a whole catalogue of other potential problems:

(a) A major meteoroid strike could cause damage to a large number of adjacent cable fibres and cause the cable to fail.
(b) Over time micrometeoroid strikes could abrade the cable and weaken it below a safe-use level.
(c) Orbital debris could collide with the cable and either weaken it or cause it to fail.
(d) Erosion of the cable by upper-atmospheric atomic oxygen and sulphuric acid aerosols as well as solar UV radiation might eventually degrade the cable's strength.
(e) Atmospheric drag would apply additional tension to the cable and such drag would increase at a time of high solar activity.
(f) Extreme weather could stress the cable and repeated lightning strikes might cause it to eventually fail.
(g) Tidal stresses induced by the Sun and Moon might affect the cable.
(h) The dynamics of the cable would need to be carefully monitored. Any taut string is liable to develop oscillations and, if large enough, these could destroy the cable. An orbital debris impact, colliding space vehicle or, more subtly, an ill-judged resonant sequence of elevator car movements could induce an oscillation.
(i) As the elevator cars move up the cable from the ground they go from a lateral velocity of <Circumference of Earth>/<1 Day> (=1,670 kmh^{-1}) to <Circumference of GSO>/<1 Day> (=11,059 kmh^{-1}) so the cable would have to impart a lateral virtual force to accelerate the car sideways; this force will add tension to the cable.
(j) Over time, as the elevator cars move up and down the cable there would be some cable wear.
(k) The space elevator would be a prime terrorist target or subject to attack by a rogue nation in a time of war.
(l) The GSO is 35,786 km above the Earth's surface. Even if the elevator cars were able to achieve (vertically) the record 501 kmh^{-1} of the Shanghai Maglev train (horizontally) it would still take about 3 days to reach GSO.

We have to remember that, once constructed, the cable would be almost entirely impossible to repair and so any weakening of the cable by some event might render the cable practically unusable. Some thought would have to be given on how to decommission and disassemble a space elevator if the cable were to be damaged or weakened.

Another obstacle to the construction and operation of a space elevator is the economics[5]. Building a space elevator falls into the realm of 'International Megaproject' but to be worth it either the investment and operating costs have got to be better than rocket launches or else there are other strong motivators such as much lower environmental impact.

For GSO the current cost of a re-usable rocket launch is about 11,300 US\$kg^{-1} but this could potentially be reduced to about 3,000 US\$kg^{-1} using the proposed Skylon space plane or 50-150 US\$kg^{-1} using the proposed SpaceX Starship. Estimated development costs for Skylon and the SpaceX Starship are US$ 15 billion and US$ 10 billion respectively.

An estimate[6] (mostly wet-finger-in-the-air and now twenty years out of date) of the cost of building a space elevator is US$ 40 billion rising to US$ 54.3 billion for a dual-cable system (it being relatively easier and cheaper to install a second cable once the first is in place). The estimated time frame for constructing the first cable is 26 months with an additional 7 months for the second. The operating cost is estimated at US$ 160 million per annum.

I think that those old figures for costs and (particularly) timescales are now likely to be *very* out-of-date but, even using these old figures, the economics of a space elevator look rather shaky when compared with the falling costs of modern re-usable rockets and the promised costs of re-usable space planes. Environmentally, of course, the space elevator would likely be *significantly* cleaner.

So, will a space elevator ever be built? It would be a magnificent project to get working and a wonderful testament to the tenacity of human endeavour but the materials issues, risks involved, level of required international collaboration and economics of operation mean I think it unlikely. Hopefully, I'm wrong.

References and further reading

1. *V Kosmos na Electrovoze* (English translation, *To the Cosmos by Electric Train*), Yuri Artsutanov, Komsomolskaya Pravda, 31-Jul-1960
2. *The physics of the space elevator*, P. K. Aravind, Am. J. Phys., Vol. 75, No. 2, Feb-2007
3. *Space Elevators - An Advanced Earth-Space Infrastructure for the New Millennium*, ed. D.V. Smitherman Jr., NASA Marshall Space Flight Centre, Alabama, Aug-2000
4. *New method smashes record for longest carbon nanotube forests ever made*, Michael Irving, New Atlas, 4-Nov-2020
5. *Space elevator economics*, Wikipedia
6. *Chapter 11: Budget Estimates*, Bradley Edwards, 2003
7. *Space Elevator: A Lasting Dream for a Sky-reaching Tree*, Tian (Autumn) Qiu, Sustainable Nano, 1-Apr-2014
8. *Engineers Are Creating a Real Space Elevator. Can They Succeed*?, Matthew S. Williams, Interesting Engineering, 11-Sep-2021
9. *Space Elevators Are Less Sci-Fi Than You Think*, Stephen Cohen, Scientific American, 25-Nov-2022

This is my penultimate President's Spot as I won't be standing for re-election as FAS President at the AGM on 8-Oct-2023. By then I shall have had the privilege of completing 6 years as President so it's time to stand aside and let someone else take the reins. I retired from paid working life a few years ago and now want to enjoy my retirement, perhaps write a couple of books and take my dog, Mr Darcy, for walks.

Stay safe and clear skies!

Paul

Royal Astronomical Society of Canada: Recent Vandalism at its Hamilton, Ontario Observatory

On 3 July, the observatory of the RASC's Hamilton Centre was vandalised by a man and a woman in a pick-up truck. Victor Abraham, Hamilton's Outreach Coordinator has provided the information below.

On Tuesday afternoon of 4 July, one of our members was accessing the observatory to do some regular maintenance when they noticed that both buildings had been heavily vandalised. Both buildings had gaping holes where the doors and walls once had stood.

We came to learn that a male and female had rammed their truck into both of the buildings, causing the damage. While nothing was stolen there was a significant amount of structural damage to the buildings (see image below). There was also significant and direct damage to the Centre's pier mounted, 14" Celestron HD Edge scope and the accompanying accessories such as, the focuser, eyepiece, controller, diagonal, CGE mount and the computer that controls it all. The full extent of the damage is still being assessed however it's highly likely that there's secondary damage to the Centre's 16" RC by way of the lime dust from the cinder blocks and cement. It's highly likely that the mirror will have to be sent away for recoating. The Centre's 17" truss tube Dob, although mostly covered, may have suffered the same secondary damage.

We were fortunate that nobody was at the observatory when this incident occurred and that we have CCTV footage of the event. The video pinpointed the incident to Monday 3 July at 8:34pm and has been handed over to local law enforcement. Despite being overwhelmed with cases, they are investigating and we are told they have some leads. Immediately, we had a disaster recovery team come and secure the facility the same day. They did an excellent job!

As discouraging as this incident has been, we are determined to keep doing our outreach. We recently started up Friday Night at the observatory and a recent meeting was one of our most successful events with over 25 people in attendance.

We have started a GoFundMe page to help recover and build back even stronger! We are also open to in-kind donations of equipment that can help in our effort to promote astronomy.

Established in 1974, The Hamilton observatory has grown to serve as the focal point for the club's numerous and diverse astronomical activities. Consisting of two purpose built buildings, the observatory enables members to observe, photograph, measure or simply enjoy the spectacular wonders of the sky.

The larger Leslie V. Powis building (left in the picture) serves as a meeting place and houses the Centre's comprehensive astronomical library, and museum. It is equipped with a small weather station and as well as a comprehensive security and video surveillance system monitoring the observatory grounds.

The Chilton Building has a roll off roof and is a versatile building with AC power and houses numerous scopes, including the Trillium 16" Ritchey Cretien telescope, a 17.5" Dobsonian and other portable telescopes.

Ref: Hamilton Observatory
hamiltonrasc.ca/club-observatory

Royal Astronomical Society of Canada:
rasc.ca

Thanks to Karim Jaffer of the RASC for sending this article to the FAS.

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Readers' Images: Markarian's Chain

Mark Hardaker FRAS

(Fordingbridge Astronomers)

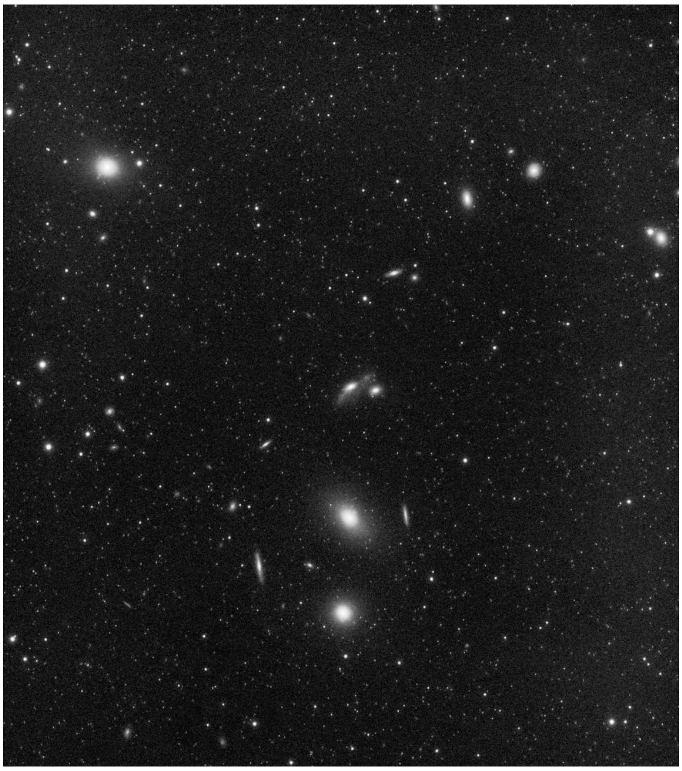
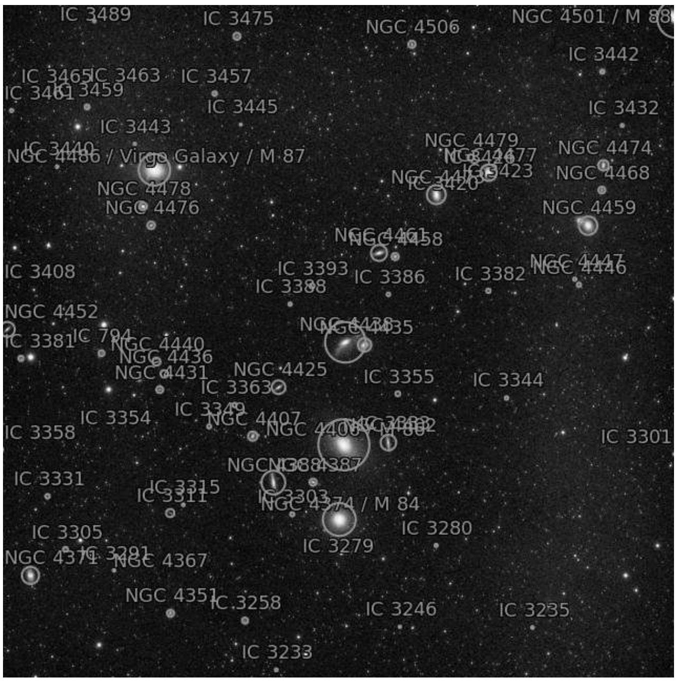


Image Above: M84 (lower galaxy) and other Markarian's Chain galaxies in Virgo.

Image below: *Same image with identifying notation added.*

Images Credit: Mark Hardaker FRAS



I imaged Markarian's Chain, centred around Messier 86 in Virgo, on 2023 June 7.

I have recently acquired a Redcat 51 and ASI533MC Pro camera, together with my ASIAir Plus. With the assistance of our marvellous friends and colleagues at Fordingbridge, I finally managed to get 30 images of the Chain, 90-seconds each at gain 101 and stacked them with lights and darks. The result was further processed in Deep Sky Stacker (DSS).

For a June night, I was astounded at the depth of view which resulted with hundreds of faint galaxies visible in the field. To check them all, I sent the result to astrometry.net, which confirmed what I could see.

As an 'ancient astronomer', used to *visual* observing, sketching and recording, my recent move to astrophotography show that, if you join your local astronomical society, you can find help in abundance to get you started and to advance quickly. I will never move away from my good old optical observing, but astrophotography is a delightful way to get more from our hobby.

Mark Hardaker FRAS
Fordingbridge Astronomers
fordingbridgeastro.org.uk

Deep Sky Stacker:
deepskystacker.free.fr/english/index.html

About Markarian's Chain

Markarian's Chain is a stretch of galaxies that forms part of the Virgo Cluster. When viewed from Earth, the galaxies lie along a smoothly curved line. Charles Messier first discovered two of the galaxies, M84 and M86, in 1781. The other galaxies seen in the chain were discovered by William Herschel and are now known primarily by their catalog numbers in John Louis Emil Dreyer's New General Catalogue, published in 1888. It was ultimately named after the Soviet astrophysicist, Benjamin Markarian, who discovered their common motion in the early 1960's. Member galaxies include M84 (NGC 4374), M86 (NGC 4406), NGC 4477, NGC 4473, NGC 4461, NGC 4458, NGC 4438 and NGC 4435. It is located at RA 12h 27m and Dec +13° 10'.

Wikipedia
en.wikipedia.org/wiki/Markarian%27s_Chain

If you would you like to see your best images on these pages? Then please email high quality jpeg images with full details of how the image was obtained, including equipment and processing software, to **newsletter@fedastro.org.uk**. Please include your name and the name of your Society.

Hertford Astronomy Group

Programme for 2023/24

Sep 6, 2023	**Roger O'Brien** HAG President	The SpaceX Starship
Oct 11, 2023	**Richard Goodrich** Historian and author	How the 1910 Return of Halley's Comet (Almost) Destroyed Civilization *An event for World Space Week*
Nov 8, 2023	**UH Astronomy Students**	Various topics
Dec 13, 2023	**Rodney Buckland** Open University	Remote and Robotic Telescopes
Jan 10, 2024	**David Arditti** President, BAA	Astronomers' Tools: Choosing the right telescope
Feb 14, 2024	**Alan Davies** University of Hertfordshire	Rainbows and Atmospheric Phenomena
Mar 13, 2024	**Ruth Gregory** Head of Physics, King's College	Beyond Einstein and Modifying Gravity *An event for British Science Week*
Apr 10, 2024	**Jerry Stone** Spaceflight UK	The Development of Island Zero - Space Habitats *Celebrating Yuri's Night*
May 8, 2024	**Ian Morison** Jodrell Bank (Retd.)	Our Island Universe - the Milky Way
Jun 12, 2024	**Andrew Coates** UCL / MSSL / SPA VP	Life on Mars / Habitability of Jupiter's moons

Whether you are an experienced astronomer or just starting to take an interest in the night sky, then join us on the 2nd Wednesday of each month, except July and August.
Note that the September meeting is on the first Wednesday.

We meet at The Lindop Building, University of Hertfordshire, College Lane, Hatfield AL10 9AA
Doors open 7:30pm. Meetings start at 8:00pm

Membership is just £10 per year, and is calculated pro-rata.
Visitors are charged £2 per meeting. Under-18s and full-time students can attend for FREE.
Under-16s must be accompanied by an adult.

Members may also attend meetings of the HAG Astrophotography Section at no charge.

For more information, visit the website or write to programme@hertsastro.org.uk

www.hertsastro.org.uk

Facebook: https://tinyurl.com/yets7jyp

Affiliated to the Federation of Astronomical Societies

Jerry Stone FBIS FRAS
Freelance Space Presenter
Spaceflight UK
07487 620661

Hertford Astronomy Group
Programme Secretary & Publicity Officer

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House of Lords Science and Technology Committee reports on the Health Effects of Noise and Light Pollution

Earlier this year, the House of Lords Science and Technology Committee invited written evidence to its enquiry into the effects of artificial light and noise on human health. The questions were tightly focused onto the evidence base for health effects, how these "neglected pollutants" intersected with public policy and regulation, and invited recommendations for change in government policy.

The Royal Astronomical Society submitted a very comprehensive response on behalf of the UK astronomical community, and numerous other individuals and organisations made their views known. Oral evidence given to the committee by a wide variety of academics and professionals working in the field of light pollution.

The report was published on 19th July, and could, if acted upon, mark a sea-change in how this most regulation-averse of governments deals with the scourge of irresponsible lighting. The Government position has been that "the existing measures are sufficient to manage the problems caused by artificial light and there are no current plans to revise them".

If you don't want to read the entire report, at least take heart from the Summary of conclusions and recommendations, some of which follow:

The Government should commission research to establish how light intensity, wavelength, duration, time of exposure, light history and age affect the circadian system. This should move beyond laboratory-based studies and investigate more realistic light exposure patterns for humans. Such knowledge would provide an evidence base for guidelines that could mitigate the harmful effects of light pollution on human biology, including the circadian system, mood and alertness.

DEFRA should establish a standard methodology for tracking, monitoring and reporting on light pollution. This should be in place by the next five-year Environmental Improvement Plan cycle. The Government should commission a regular survey to track light pollution once the methodology is agreed. The research should aim to understand both indoor and outdoor exposure to artificial light at night, so its health impact can be quantified.

The Light Policy Statement and planning guidance should incorporate up-to-date guidance from the Society of Light and Lighting, the Institution of Lighting Professionals and the Chartered Institute of Building Services Engineers, on best practice for lighting.

The Government should make clear that exempt facilities are still expected to conform to best-practice lighting guidelines.

This was a very focused enquiry with a necessarily narrow scope (human health effects – possibly the least well understood consequence of irresponsible lighting) but we think it gives cause for hope that those with the power to do so may, at last, begin to take these issues seriously.

Steve Tonkin
FAS Dark Skies Adviser

Space Oddities Live!

We are Space Oddities, a YouTube channel bringing you live astronomy and space exploration news, discussion, special guests, competitions, quizzes and more every Monday evening in a livestream at 8pm UK time on YouTube and Facebook. Each week an international panel of amateur and professional astronomers, who used to work together at the sadly now-defunct internet radio station Astro Radio, get together to chat about anything relating to the Universe and to keep our audience up to date with anything in the news, as well as present interesting presentations on a huge variety of astronomical subjects. We have a lot of fun!

We would like to become more involved helping astronomical societies and clubs in the UK and elsewhere to promote themselves and their activities. At a time when it is becoming more and more difficult to prise people away from their homes and their electronic devices in order to attend meetings, we would like to do our bit to help! If you are a member or official of an astronomical society or club and would like us to advertise your group and its events on our weekly livestream, please send an e-mail to spaceodditieslive@gmail.com with the details. We are also more than happy to show any promotional videos you might have. Promoting your society with Space Oddities is completely free – the only thing we ask in return is that you tell your members about us!

Space Oddities Live YouTube channel can be found at: youtube.com/@spaceodditieslive
Our Facebook Group is at: facebook.com/groups/spaceoddities

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www.rothervalleyoptics.co.uk

Stratford-upon-Avon Astronomical Society

The Stratford upon Avon Astronomical Society meet every 1st and 3rd Tuesdays at 8pm (doors open at 7.30pm) at Alderminster Village Hall. Everyone is welcome, especially beginners and those wanting to learn more. The first Tuesday is a Club Night, on 1 August and the speaker on the third Tuesday, which is on 15 August is due to be Dr Pamela Klaassen from Edinburgh University, with a talk called The James Webb Space Telescope – from launch to first science. Please note that the speakers usually start quite promptly at 8pm.

Each month one of our members offer pointers to what to look for in the sky during the coming weeks.

Perseid Meteor Shower

You may hear meteor showers being mentioned by the media, sometimes called shooting stars, these events happen as planet earth passes through debris trails from comets or asteroids.

One of the astronomers' favourites is the Perseids (one reason is because it is warm summer night observing). It is caused by Comet Swift Tuttle. Although in 2023 they are active between 17 July and 24 July, they peak on 12 August and 13 August, sometimes reaching a rate of 100 meteors per hour (although you will be lucky to see that many) and is best observed after Midnight.

The best way to observe it, is by getting a comfy lounger, (a cold drink an optional extra) and place it where you can see look north towards Perseus and Cassiopeia ('the W') where the centre (the radiant) will be located, then look to the sides to see the trails. Binoculars may help to find the radiant, but they give you a narrow field of view, so naked eye observing will let you see the shooting stars.

Let's hope for clear skies

Adrian Wakeham and Dave Benton

Send Your Name to Europa:

NASA Invites Public to Sign Poem That Will Fly Aboard NASA's Europa Clipper Spacecraft

Members of the public are invited to add their names to an original poem dedicated to NASA's Europa Clipper mission before the spacecraft begins its journey to Jupiter's moon Europa in October 2024. The poem and the names will be like a message in a bottle, travelling billions of miles as the mission investigates whether the ocean thought to lie beneath Europa's icy crust could support life.

As part of the "Message in a Bottle" campaign, names received before 11:59 p.m. EST, 31 December 2023, will be stencilled onto a microchip, along with the poem, written by U.S. Poet Laureate Ada Limón and titled "In Praise of Mystery: A Poem for Europa."

To sign, read the poem, and hear Limón recite the poem in an animated video, go to:

https://go.nasa.gov/MessageInABottle

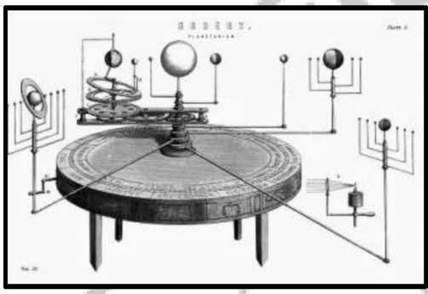
The FAS AGM is on Sunday 8 October 2023 at 14:30 hrs

via Zoom

Society for the History of Astronomy

Online Zoom® Webinar

"Designing Orreries and Building Historical Replicas"



By Peter Rigby

Peter is a retired professional engineer and member of the Institution of Engineering and Technology. He has a had a lifelong interest in astronomy and the history of engineering. In retirement he builds engineering models in his own workshop and specialises in the design and construction of orreries.

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The online presentation will review the history of orrery development in Britain from an engineer's perspective. The craft and design methodologies employed in their construction. The problems and limitations faced by the early developers: some of the leading characters involved; and the building replicas of some of their most important designs.

Wednesday , 1st November 2023 *at 8pm (GMT)*

Full Zoom™ link details will be made available to SHA members and guests near to the date.

Please contact:- meetings@shastro.org.uk

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