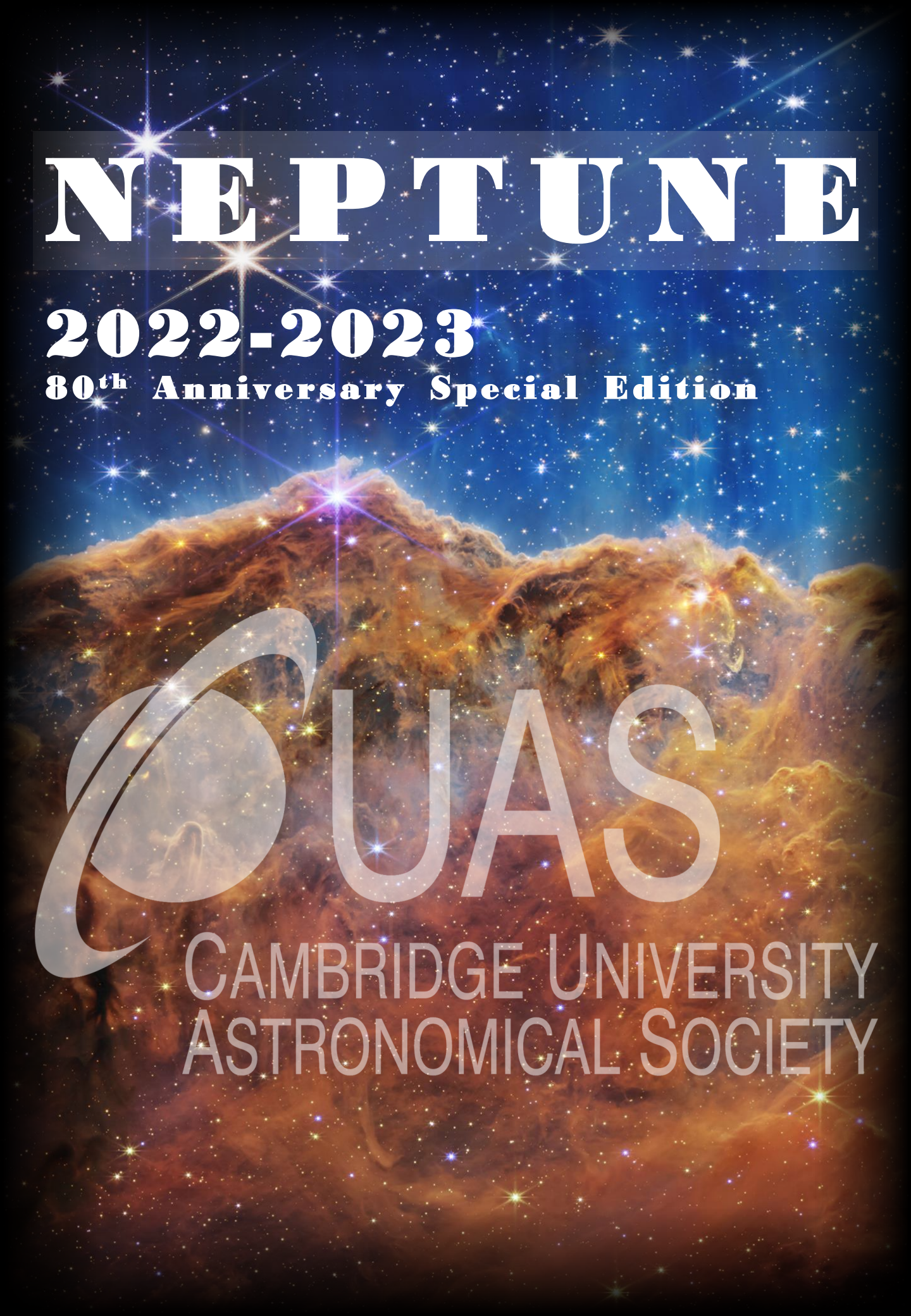
NEPTUNE

2022-2023

80th Anniversary Special Edition



Welcome!

This year, we celebrate the society's 80th anniversary, and, for better or for worse, the return of Neptune after a 3-year hiatus. As I dug into the archive for inspirations on what goes in this "Editor's Notes" section, I noticed a recurring pattern of allusions to the traumatising experiences of being forced into labour. So, in the spirit of keeping traditions alive, I shall briefly, only briefly, comment that I too empathise with such an experience.

Jokes aside, 80 years is a long time. To put it in perspective, 80 years is just a bit longer than Halley's comet's orbital period, and more than enough time to make 3 round trips to Neptune and back. Alumni and long-time supporters of the society will be pleased to know that after 80 long years, CUAS is still very much alive and well. Having been involved with CUAS since 2021, as chair initially and then as events officer, I can proudly say that the society has recovered well from that one global pandemic, and is doing better than ever. The past few years have been very busy indeed – we continue to upkeep interests in astronomy with talks, and have embraced a hybrid style of engagement via livestreams that all are welcomed to watch; we've had unprecedented interests in our ObsNights and ObsDemos, and we pride ourselves in bridging access to the wonders of the deep sky to wider audiences; and of course, many fruitful evenings have been spent in pubs, lamenting our workloads, sharing our aspirations, and expressing our love for the stars above.

In honour of the silver anniversary, I've decided to put in a little extra effort and do some redesigning for this issue of Neptune to make it look a bit more like an actual magazine. Keen-eyed readers would notice that the cover and background images are taken from JWST's impressive portfolio. In this issue, we walk down the memory lane with an old friend, explore a series of interesting projects, check out a few pretty pictures taken by professionals and amateurs, and perhaps even learn a few astronomy jokes to unleash at opportune times?!

Initially, when I was told that the society publishes an annual newsletter with submissions from members (mostly from within the committee), I had deep concerns about the readership and outreach of this thing. But then I realised that it's not a question of "who even reads this?", but a question of "who do I want to show this to?". The vision I see for Neptune is that it should reflect the spirit of CUAS – to be a nexus for the deeply passionate, and a sandbox for the newly initiated. I'd like to encourage future committees to keep this platform alive and try new things with it, to encourage the professionals amongst us to share their ideas and expertise, and to encourage those with newfound interest in the stars and the night sky to share their journeys.

Now a brief interlude for a bit of history: why Neptune? Legend has it that in 1846, at the Northumberland telescope, Neptune was observed and recorded for the very first time. Unfortunately, the realisation that this was the undiscovered 8th planet was not made until the German astronomer Galle announced his discovery. Since then, Neptune has found a very special place in the hearts of Cambridge astronomers. This great blunder has been celebrated in numerous ways, including a routine to observe the planet at the Northumberland, deny seeing it, and go to the pub instead, as well as having a magazine that bears the name of the one that got away, so that we may still say "we've got Neptune".

This issue of Neptune has turned out to be something I'm rather proud of. The hope is for it to physically manifest on the tables at our Annual Dinner, but only time will tell. I suppose it's enough rambling from me. You are not here for this. For all the good, juicy bits of astronomy, read on.

Xavior Wang,
Neptune Editor 2022-2023

Review of the Year

And just like that, another year of CUAS goes into the history books. This was probably not the smoothest year in CUAS's long and varied history, but regardless it is one I am sure we will look back on fondly.

Overall, the Society experienced good growth coming out of the COVID era, with over 200 new members joining us this year. While (sadly) there was no Garden Party in Easter term, we kickstarted the year with Professor Alan Heavens giving a rather concise treatment of dark energy, a Freshers' ObsNight, and a pub quiz at the Maypole. There was excellent variation in the speaker line-up this year, with five female speakers out of a total of 11, covering topics from planetary systems and space weather to massive galaxies, gravitational waves and black holes, and catering to a range of audiences. Particular highlights were theoretical deep dives into galaxies and black holes by Professors James Binney and Steven Balbus respectively, both of the University of Oxford, which appealed to the Pt II/III Astrophysics students amongst us; Dr Emma Chapman took us on a JWST trip through the early Universe, while our very own Jon Shanklin brought the Antarctic experience to Cambridge with many anecdotes and stunning pictures to accompany them. Over the course of these talks we grew familiar with the Wolfson Lecture Theatre, with its own little quirks: the fire safety system persisted in producing static over short repeated intervals and the projector system had a habit of switching off at eight o'clock sharp, which resulted in many hasty efforts leaping over the bench to restart the system as quickly as possible.

It has been a busy year for the Northumberland Telescope; the Thorrowgood remains out-of-use but shall undergo repair work soon. There were eight ObsDemos, with nearly 170 people attending at least one demo, and a total of 57 ObsCards were issued. Four ObsNights were run, each enjoying very strong attendance, with about 100 people turning up to the Michaelmas ObsNights. In November we were invited to Harston and Newton County Primary School to run a stargazing event. Despite the suboptimal weather conditions, it was highly successful, with over a hundred people attending, and thankfully the skies cleared up later in the evening. We look forward to potentially returning to run another event in the future.

This year also marks the 80th anniversary since CUAS's founding. It is technically the 81st, but if there had been an Annual Dinner every year since CUAS's founding this would be the 80th dinner! We are very excited to welcome past committee members back to Cambridge, and in particular to hear their stories and share some of ours.

I certainly did not expect to find myself writing the Chair's Review of the Year, but circumstances dictate, and I am extremely grateful to the rest of the committee for their willing cooperation and hard work behind the scenes to keep the wheels of the machine well-oiled and turning. To the outgoing committee, thank you - it was a pleasure to work with you all, and to the incoming committee, I wish you the best of luck. CUAS will flourish under your leadership.

Jessica Lok
Secretary 2022-2023

Observation Secretaries' Report

This has been another busy and exciting year from the observational side of CUAS – we had our 2nd excellent year of ObsTests in a row, with 169 people attending at least 1 ObsDemo and 57 members gaining their ObsCard. We only managed to hold 4 ObsNights this year, with the astronomy gods dishing out the cruel and unusual punishment of lots of unforecast clear nights but very few forecast ones in Lent term. We made up for this however with the popular introduction of ObsNight snacks, and the ObsNights we have run have been very well attended with upwards of 50 people at each one, and well over 100 in Michaelmas.

We also ran an informal 'ObsMorning' on Castle Mound during the Lunar Eclipse and despite the unsocial hour at least 30 people turned up to catch a glimpse of the moon in its bloody hue. Sadly, the clouds seemed intent on only covering the section of sky that contained the moon during the peak of the occasion, but those who arrived early managed to see the moon whilst only partially eclipsed. The morning wasn't a complete waste however as a scattered line of planets could be seen in the 20 minutes before the sun washed them from our view.

This was somehow only my 2nd total lunar eclipse despite having been doing astronomy for nearly a decade now, and as the setting of the full moon doubles as sunrise by definition, I also saw my 1st sunrise from Castle Mound.

In November we held a stargazing event at Harston and Newton Primary School, featuring the ever popular laser tour of the sky given by Aniruddha, and observing with the 8 inch SCT. The best part of being an ObsSec is hearing people's expressions of joy when they see something cool in the sky for the 1st time, so it was fantastic to introduce astronomy to so many children and even a few parents.

In January, we received a donated telescope and mounts from Roger Griffin, a former professor of astrophysics at Cambridge, who passed away last year. They were handmade by Roger himself when he was young, and as an ObsSec team we're amazed at the intricate mechanisms and electronics of the mounts as well as the quality of the construction. I look forward to seeing it in use at ObsNights.

In my last couple of weeks as an ObsSec before my constitutionally mandated retirement from the CUAS committee, I figured it was my turn to spend a bit of the societie's money on cool observing stuff, so we bought an OIII filter. The snowy weather and my impending dissertation deadline means I haven't had a chance to try it out yet, but I look forward to doing so in Easter term.

I can't quite believe myself and Joseph have reached our 3 year constitutional term limits as Committee members, it seems like yesterday we were sitting in the 2020 AGM nominating ourselves as ObsSecs. Since then, the entire committee has turned over. Of all the current ObsCard holders, I'm the 7th longest standing and Joseph is 14th. I think we both look forward though to passing on the baton to the new generation of ObsSecs and I know we leave the role in vary capable hands.

Ralph Battle and Joseph Thornton,
Observation Secretaries 2020-2023

2022-2023 Outgoing Committee

CHAIR

Lehan Li
Murray Edwards College
3rd year Astronomy

SECRETARY

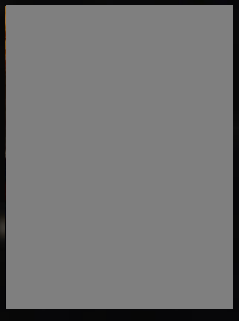
Jessica Lok
Fitzwilliam College
2nd year Natural Sciences

TREASURER

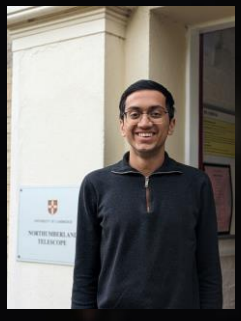
Shikang Ni
Wolfson College
2nd year Natural Sciences
(also Membership Officer)

OBSERVATION SECRETARIES

Ralph Battle
Emmanuel College
4th year Earth Sciences



Joseph Thornton
Robinson College
4th year Astronomy



Aniruddha Aramanekoppa
Fitzwilliam College
2nd year Natural Sciences

Haozhe Zhu
Downing College
2nd year Engineering
(also Webmaster)

EVENTS OFFICER

Xavior Wang
St Edmund's College
3rd year Physics
(also Neptune Editor)

PUBLICITY OFFICER

Coco Cheong
Trinity Hall
2nd year Natural Sciences

STASH OFFICER

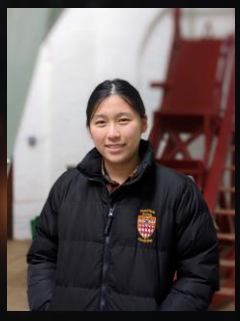
Stephen Sun
Homerton College
3rd year Engineering

2023-2024 Incoming Committee

CHAIR

Alex Blake-Martin
Fitzwilliam College
2nd year Natural Sciences

SECRETARY

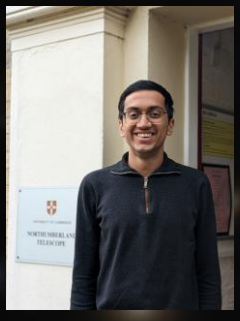


Jessica Lok
Fitzwilliam College
2nd year Natural Sciences

TREASURER

Sam Webber
Churchill College
2nd year Natural Sciences

OBSERVATION SECRETARIES



Aniruddha Aramanekoppa
Fitzwilliam College
2nd year Natural Sciences

Guang Liang Yeo
St Edmund's College
1st year Natural Sciences

Mahdeia Hidary
Fitzwilliam College
1st year Natural Sciences
(also Stash Officer)

EVENTS OFFICER

Daniel Nicolae
Trinity College
3rd year Engineering

PUBLICITY OFFICER

Daniel Choi
St John's College
2nd year Mathematics
(also Webmaster)

MEMBERSHIP OFFICER

Coco Cheong
Trinity Hall
2nd year Natural Sciences

NEPTUNE EDITOR

Charlie Mack
Fitzwilliam College
2nd year English

Reminiscences of a past Chairman

We are celebrating the 80th birthday of CUAS, but let me start by taking you further back. A lot further back, in fact. 200 years ago the Cambridge University Observatory was established, its headquarters being that fine building at the top of the drive which now houses the Library of the Institute of Astronomy. It is said that the Observatory was the first department of the University (rather than of one or more Colleges), although I think there are other claimants for this honour as well.

Shortly after the building was opened, an important lady was being shown round. I guess she was the wife of the Master of a College, because in those days Fellows were not allowed to marry. She was taken to view the transit instrument (in that small dome above the main entrance). The building had been located with some care so that the transit dome was exactly due north of the tower of Grantchester Church, about 4 km away. As the tower was unlikely to move, this made it easy to check the alignment of the transit instrument when necessary. Anyway, she was very impressed by the view of the church tower, and exclaimed, "I can even see the inscription on the tower" which she proceeded to read out. The Director said, "Madam, that is most impressive. Could you please return tonight and observe the Moon." "Well, yes, but why?" "Because that inscription is on the far side of the tower."

Fast-forward to November 1942 and the proposal to form a University Astronomical Society. Sir Arthur Eddington did not feel that there would be much interest, but about 150 people turned up to the first meeting. The date may seem odd: there were a few other things going on. The joke is that the wartime blackout was the last time anyone had actually seen the stars from Cambridge. The answer is a bit more mundane. At that time Cambridge was being used for two- or three-month intensive Officer Training Courses. For those going into the Navy or RAF in particular, navigation was an important component of the course, and so astronomy had a real practical value to them.

I was born about three months later, in February 1943. (I had hoped to attend your 80th anniversary Dinner, but health issues prevented me from travelling.) I went up to Sidney Sussex in 1961, joined CUAS immediately, and was elected as Treasurer for 1962-63 and Chairman for 1963-64. During those three years I made extensive use of the observing facilities.

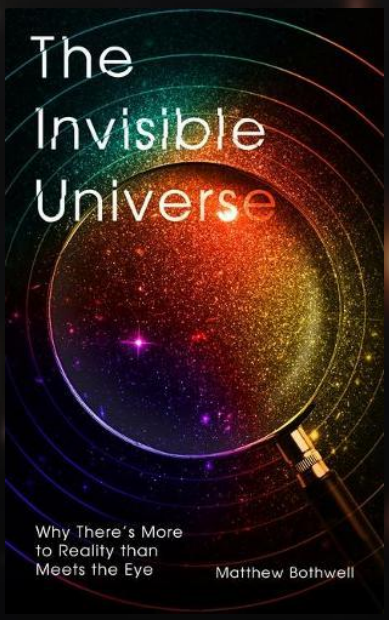
There was always a problem for a member in his or her first year on the Committee. Much though you wanted that year to be splendid, if you hoped to be (or feared that you might be) elected Chairman, you didn't want all the prize speakers to be claimed by your predecessor. (In those days there were fewer prize speakers than there are now.) My predecessor had secured both Martin Ryle and Patrick Moore for his year. Who was left ? I was lucky. I got Prof. Blackwell from 'the other place', and Prof. Brück, the Astronomer Royal for Scotland, to speak to us. But my real coup was to persuade Fred Hoyle to address CUAS. When I got to the Mill Lane Lecture Rooms with him, I realised that if I had not been the Chairman, and so obliged to introduce the speaker, I would have been listening to Fred's lecture sitting in the corridor outside the lecture theatre!

For a few years after I came down, I was able to return to Cambridge for the occasional CUAS lecture. The one that I recall most vividly was that given by John Glenn. He had a model of the rocket, and demonstrated just what a tiny proportion of what went up came down again. (I am talking of 60 years ago: this is better understood now.) But during the question session, someone asked him, "what were you thinking during those final few minutes before lift-off"? His reply (no doubt well-rehearsed) was, "Well, I remembered that all the half-million components of the rocket below me were manufactured by the company that submitted the lowest tender". Years later I told this at an office event, and the Sales Director told me that he would be using that story. The point was that we had a reputation for excellence, but not necessarily for cheapness, and there are times when it is worth paying a bit more for quality!

David Purchase,
Chair 1963-1964

David addressing the 75th anniversary dinner

Book Review – "The Invisible Universe"



Book cover

In his first popular astronomy book Dr. Matt Bothwell takes the reader on a tour of the universe through a path laid out by our understanding of the light we see, but more importantly the light we don't. His knowledge of the subject is to be expected from his background in the field, but the effortless reading of his book backs his skill as a writer to an equal degree.

The book guides the reader through a range of discoveries that have been made over the centuries. Whether from Democritus to Newton, or from the modest radio, to powerful magnetars, Matt covers vast swathes of science with ease allowing the structure of the electromagnetic spectrum to guide readers naturally from one topic to another.

No prior material is needed to enjoy the beauty of the cosmos explored in the pages of Matt's book, with all relevant information explained with clear imagery, making understanding accessible to those without a background in science or maths. Whilst perfect as a popular science book for those that may be interested in astronomy, the book is not without its charm for those that have prior knowledge of the topics discussed. A great amount of research has clearly been done on the history of astronomy, with both the people involved and the nature of their discoveries discussed in a humanising way. The poetic phrases woven into the book both make the archaic theories of the past more sympathetic and the ingenuity of those that pushed the boundaries more impressive.

My only criticism of this stand out book would be that in places Matt appears to underestimate his audience. The descriptive imagery he employs makes the reading clear and understandable, but can, at times, cause engagement to dwindle as points are made with more words than are needed. Covering these topics without getting bogged down in maths is an admirable achievement in itself, but there are times when an extra diagram, graph, or the odd equation would concisely explain a concept without detracting from the elegance of the book.

The Invisible Universe sets out to tackle a daunting field of study, and thoroughly delivers. It deserves to be at the top of the list for any aspiring astronomer.

Joseph Thornton,
Observation Secretary 2020-Present

Dr. Matt Bothwell

To See in a New Light: There is More than Meets the Eye

Say you were robbed of all but one of your senses, which would you rather not lose? Unsurprisingly, an overwhelming majority would choose their sense of sight. In fact, we estimate that about two-thirds of our brain is involved in processing visual information. We, as a species, interact with the world primarily through our vision. However, the human eye, as complex an organ it may be, is still rather limited. The smallest objects that the naked eye can resolve are about 0.1mm, and the furthest objects we can see are the indistinguishable twinkles of starlight. It is no wonder that throughout history, people have devised various apparatuses to supplement our rudimentary vision, inasmuch as to augment it with the very forces of nature.

First Light

From the ancient Egyptian's depiction of glass meniscal lenses in 2000B.C., the Mesopotamian's use of the Nimrud lenses in 700B.C., and 1st century A.D. Roman philosopher Seneca's application of refractive crystals in perusing fineprints and spectating distant gladiatorial showdowns, optical technologies have come a long way in their intricacy, clarity, and capability. Most notably, in 1609, Galileo Galilei pointed an array of calibrated lenses to the heavens for the first time and observed the hitherto unseen moons of Jupiter, pioneering the field of observational astronomy. Interestingly, in the same year, Galileo made a few tweaks to his telescope, flipped it around, and invented the first compound microscope.

Since then, optical technology has become an indispensable and ubiquitous visual aid. Today, we can zoom in to the scale of individual atoms with transmission electron microscopes and atomic force microscopes. At the other extreme, the Hubble Space Telescope sheds light on Icarus, a star halfway across the universe nine billion lightyears away, the farthest observed yet.

The Electromagnetic Paradigm

Nonetheless, even with the mind-boggling sophistication that enabled these powerful devices, the fundamental principle is consistent — they are all manifestations of electromagnetism. Optical microscopes reflect and refract light into useful geometries, the Hubble Space Telescope detects signals from the infrared to ultraviolet spectrum, and even the electron or atomic force-mediated apparatuses exploit the electrostatic interactions between particles. In fact, you can even say that almost all human inventions, interactions, and experiences predicate on this medium.

You take a spoonful of hot chicken soup. It stays in the spoon and doesn't fall through because of the electromagnetic repulsion from the metal atoms. You get distracted by Netflix and spill the soup on your thigh, your pain receptors mobilise waves of potassium and sodium ions that bind to ion channels down a chain of neurons to tell your brain: "ouch". You call mum with your phone, made with semiconductors, transistors and other electronics, and you ask her how to soothe a bad scald, your voice carried by radiowaves across the globe to your worried mother. Yes, it always has been electromagnetism.

Forces of Nature

However, electromagnetism is not the only force of nature. At the frontier of particle physics, scientists have established the Standard Model, describing a collection of elementary particles of matter and energy, smaller than even protons and neutrons, as the all-encompassing constituents of the universe. In theory, if we can understand precisely the properties and interactions of each particle, we will have a complete description of nature and the laws governing it. With this knowledge, every chemical reaction, biological process, and cosmological phenomenon can be impeccably modelled. That is, if we understand the Standard Model to infinite precision and have infinite computing power.

To See in a New Light: There is More than Meets the Eye

The point of introducing this exotic theory is not to comment on the plausibility of a 'theory of everything', but to bring to light the fact that the model describes not one, but three fundamental forces. The omnipresent electromagnetic force is mediated by particles of energy termed photons. The strong nuclear force and weak nuclear force governing the subatomic realm are carried by particles named gluons, W bosons, and Z bosons. Unlike electromagnetism, which permeates the whole universe, and whose reach extends ad infinitum, the nuclear forces are, as the name suggests, confined within dimensions smaller than an atomic nucleus. With its counterparts barely manifesting on the scale of our human experience, it is no surprise that we regard electromagnetism as the singular conduit of nature.

So far, we have been avoiding the elephant in the room. There is a fourth fundamental force much like electromagnetism, which facilitates the interaction between all things, whose range knows no bound. This entity, excluded from the Standard Model due to our lack of understanding, is all-pervasive but remains the most mysterious. We are of course talking about gravity. We know so little of gravity because it is weak. So weak that its magnitude is 10^{38} times weaker than the strong nuclear force, 10^{36} times weaker than the electromagnetic force, and 10^{29} times weaker than even the weak nuclear force.

A Resounding Success

We seem to have steered quite far from the theme of optical technology. However, where we are heading now is in fact the way forward. Recent discoveries have highlighted that despite all the razzle-dazzle we can do with light, we are still mostly in the dark. Indeed, there is truly more than meets the eyes. And now, it is time to break a few paradigms from time immemorial.

Far out in the unremarkable corners of the desolated lands of the North American continent lie two oddly shaped facilities with long, orthogonal arms. On 14th September 2015, a few beams of laser bounced about in these arms to create strange patterns and everyone cheered. The first direct detection of gravitational waves had been made at the Laser Interferometer Gravitational-Wave Observatory (LIGO). Gravitational waves are a type of periodic oscillation. Specifically, like how sound waves are the compression and expansion of air molecules, gravitational waves are the cycles of stretching and squeezing of space itself. The particular gravitational waves detected at LIGO originated from two black holes 1.4 billion lightyears away. Their perpetual inward spiral ended in a cataclysmic merger, and the sheer impact of this marriage resonated through the universe like a cosmic church bell.

This discovery was so exciting for three reasons. Firstly, we had proven Einstein right, yet again. The next cause for celebration was the incredible engineering feat involved in the detection. As mentioned, gravitational effects are extremely weak, and even the collision of two cosmic monstrosities could only produce a stretch in spacetime a thousandth of the width of a proton. Yet, this minute signal was detected and isolated from chaotic background noises. Finally, and most crucially, the discovery opened the door to a whole new way of observing the universe. Thus far, we have been blind to half of the happenings in the cosmos. But now, we have set the precedent for seeing the world in a completely new way.

A Bright Future

The potential of 'gravitational optics' is limitless. Recall how much progress we have made as a technological civilisation since we learned to wield light to our advantage. If we were to be able to harness gravity and bend it to our will as we do with light, then near-light speed spacecraft, artificial gravity, and even micro black holes would just be a few technical problems away. The world truly changes when you change your perspective and see it in a new light.

Xavior Wang,
Chair 2021-2022

An Astronomy Related Lockdown Project

I've had a 60 x 900mm refractor for about 8 years now and never had a proper mount for it (I had it on a very heavy equatorial mount but it was ridiculous overkill) and I was thinking last Michaelmas term how it would be good to have a portable telescope to bring to Cambridge. I already had the perfect telescope, but it needed a tripod, and what better a lockdown project as to build one?

I hadn't done any woodwork since high school but you never really forget that sort of thing, so we found all of the tools, cleared a space on the workbench in the shed, and brought some materials. I went with a 12 pack of 2.1m x 30mm x 16mm spruce, a 10 pack of 10 mm bolts and wing nuts, and a 100 pack of wood screws, costing something like £15.

I had a look at some pictures of homemade tripods and read a few forum posts, but mostly I just made it up. I like to observe standing up so I knew the legs had to be extendable to get the eyepiece of a refractor sufficiently high off the ground. I also knew the legs had to be able to fold in, so it was relatively easy to transport. I drew up a rough design with these features and got to work.

Using only basic tools I then cut, drilled and screwed, to build the three legs. I started by planning the timber and cutting it to length, then making the clamp piece (figure 1). There was immediately a problem, the clamp could spin in place which I hadn't thought of, but that was quickly solved with an additional short piece of timber (figure 2). I then attached the outside rails of the leg together at either end, with the inner extendable rail in place. I made two more identical legs, then rounded all the edges (figure 3).

Next up was the hub where the top of the legs attached. I had been thinking about how to do this for a while and I ended up making an elaborate device which wasn't as rigid as I'd hoped, had far too many screws in too small an area, and didn't provide any good way to attach the rotating part of the mount (figure 4). I had a small piece of plywood lying around so I cut it into two disks, and attached mounting points for the legs on the underside of one, while drilling a hole in the centre of both and putting a bolt through to act as an axis, with the two disks making a turntable which was relatively stable and was much more effective as a central hub. I then attached a frame to the top disk, which had an additional pivot to allow the telescope to move in altitude. This completed the main part of the mount (figure 5).

As you can see from the photo, it isn't 100% finished yet. I still need to add a system to attach the telescope tube to the mount, likely with hose clamps, and I need some way of rigidifying the legs. There's a little bit of play in the hinge where the leg meets the central hub, which allowed the hub to rotate slightly by twisting the legs, not by much but enough to bug me. I could make some sort of tray which attaches to the bottom of the legs while in use, preventing them from moving. Alternatively, I could accept a little bit of movement and just add some string or chain so the legs all fold out to a fixed angle.

If I was to do another similar project I would mainly focus on making the leg mechanism more rigid. At the top the hinge would be much wider to reduce the amount of play, and there would be a sliding hub with hinged supports attached to the legs, a bit like how an umbrella unfolds. This is a fairly common feature in tripods, but I thought for a first project it was best not to make it too complicated. I would've liked to use pipe fittings as the rotational components for the altitude and azimuth motion, but I couldn't find any metal fittings large enough at a reasonable price (although I didn't look especially hard). Search for 'telescope pipe mount' to see what I had in mind. If I was building for a larger telescope, I would make the legs fixed length and angle, it would make the whole structure so much stronger, but it wasn't what I was after in this project.

An Astronomy Related Lockdown Project

This project shows that with rudimentary skills, and a few basic tools (plane, chisel, mallet, handsaw, electric drill, screwdriver, spokeshave, vice, ruler, square) you can make a useful piece of equipment. I thought there wasn't much point in providing detailed plans, partly because I never made actually made them, and partly because the design isn't that fantastic, I'm not an engineer. I used 7 of the 12 strips of wood, 8 of the 10 bolts and about 70 screws. Maybe when we're able to run Obsnights I could even bring it along for a bit of fun. All that remains is to see what it's like in use!

Ralph Battle,
Observation Secretary 2020-Present

Figure 1

Figure 2

Figure 3

Figure 4

Figure 5

Completed mount with telescope

Observing the Moons of Uranus, Part 2

In the 2016-17 edition of Neptune, I wrote about my observations of Titania and Oberon, the two largest and brightest moons of Uranus, with the Northumberland telescope. They are both around magnitude 14 and would be easy objects on a moonless night if it were not for the glare of Uranus. In fact, the proximity of the planet means that the moons are generally quite difficult to see, and their visibility with the Northumberland is highly dependent on the quality of the sky; any interference from moonlight renders them invisible. They can sometimes be seen with a 28mm eyepiece (218x magnification) but more often a 20mm is required (305x magnification).

Uranus has two more moons that are visible with large amateur telescopes. Both orbit closer to Uranus than Titania and Oberon, and the glare from the planet therefore presents an even larger problem. Ariel is the closest to Uranus; at magnitude 14.3 it is only slightly fainter than Titania and Oberon, but it only reaches 14 arcseconds from Uranus at greatest elongation. Umbriel orbits slightly further out but is only magnitude 14.9.

On the night of 27 October 2021, I pointed the Northumberland at Uranus and noticed that Titania and Oberon were visible at 218x magnification, indicating that this was a good night. I had wondered whether Ariel might be visible at high power when conditions are suitable, and decided to give it a go.

The resolving power of a telescope is limited by diffraction and determined by its aperture. For a scope with an aperture of D inches, Dawes' Limit states that double stars separated by less than 4.56/D arcseconds cannot be resolved. This means that there is a limit to how much magnification is useful: beyond a certain point, one will only be magnifying blurriness. A commonly cited rule is that magnifications higher than 50x per inch of aperture are not useful. This suggests 600x as the maximum magnification for the Northumberland, but in Cambridge the seeing is usually too poor for anything beyond 300x or 400x to be of much use. However, there are occasional exceptions to the 50x per inch rule. And, as I discovered, one exception is where one object needs to be separated from the glare of another.

To try and spot Ariel, I began by switching to a 15mm eyepiece giving 405x magnification. Titania and Oberon were still sharp, indicating exceptionally good seeing by Cambridge standards. There was no sign of Ariel, but the conditions were clearly good enough that even higher power was an option. The highest power eyepiece available in the usual Northumberland boxes is a 12.5mm but it is not in good condition, and so I instead used a 9mm eyepiece usually used with the Celestron CPC 800. This gave 677x magnification, violating the 50x per inch rule, but Titania and Oberon were still visible; in fact, the extremely high power had separated them far enough from Uranus that they were now very easy to see! I expect even beginners would have been able to spot them without too much difficulty.

I spent what must have been at least 15 minutes attempting to see Ariel at 677x. There were moments when I suspected I might have caught a glimpse of it, but eventually I resorted to desperate measures, and switched to a 6mm eyepiece giving a staggering 1016x magnification. Finally, at this incredibly high power, Ariel was far enough from Uranus's glare for me to spot it. It was still a very difficult observation, but with averted vision Ariel kept popping into view every now and again. Umbriel proved to be too faint to see. I then returned to 677x and managed to observe Ariel at that lower power too.

I was recently informed by Ralph Battle (ObsSec 2020-) that he had found a record of an observation of all four of the brightest Uranian moons in an old Northumberland observing book from around 50 years ago. At this time, Uranus was close to perihelion, and Umbriel reached magnitude 14.6, as opposed to its current 14.9. This may sound like only a small change in brightness, but it could make all the difference for an object on the limits of visibility. Uranus will next be at perihelion in 2050, so it might be a while until anyone spots Umbriel with the Northumberland again. Or perhaps it can already be seen by a talented enough observer on a good enough night.

Harry Metrebian,
Observation Secretary 2017-2020

Supernova 2022hrs

SN2022hrs is a type Ia supernova in the spiral galaxy NGC 4647. First detected by Koichi Itagaki on 16th April when it was around 15th magnitude, it has since brightened to almost 12th magnitude as of 1st May. It is considerably brighter than its host galaxy, and is conveniently located on the apparent line joining the nucleus of NGC 4647 to the nearby galaxy M60, making it an easy spot in photographs of the pair. Once the supernova reaches maximum brightness, its luminosity will then start to drop at approximately 0.1 magnitudes a day for the first 3-4 weeks, before dimming more gradually (approximately 0.01 magnitudes a day). Therefore it is best seen as soon as weather permits!

Type Ia supernovae form from white dwarf stars in binary star systems. The companion star starts to swell as it enters its red giant stage. The white dwarf accretes gas from the companion, until it reaches the Chandrasekhar limit (the maximum mass a white dwarf can support). As the matter falls in, the density and pressure inside the dwarf increases until new fusion takes place. As electron degeneracy pressure (the force supporting white dwarf stars) is independent of temperature, the star does not expand and cool as a star on the main sequence would, instead runaway fusion takes place. As the reaction releases more and more energy, the particles making up the star get faster and faster, until they have enough energy to fly apart from one another. The star explodes violently, causing a sudden sharp increase in brightness, which can be observed from Earth.

As these supernovae form through the same mechanism, and at approximately the same critical mass (approximately 1.4 times the mass of the Sun), the brightness of the resulting supernova is more-or-less the same. This makes these supernovae into "standard candles" - objects of known brightness. Comparing this brightness with the observed brightness, it is possible to deduce the distance of the supernova from Earth. Current methods allow for the distance to be calculated to an error of around 5%. This makes type Ia supernovae incredibly useful in the study of the expanding universe and for studies investigating the distribution of dark energy.

James Rawson

A wide field shot depicting the host galaxy NGC 4647, close neighbour M60, along with other Virgo galaxies, including M59 and NGC 4638.

A closer image just of the two galaxies, with the supernova indicated.

Space Project (AL37) [Space Exploration Program, Images from Deep into Space]

In 2019, I created Ansas L37 (AL37) an advanced space project and the 'Communi Intellectu Theory' to conduct a search for unidentified aerial phenomena (UAP) and physical objects and to investigate electromagnetic wave transmission from large deep-space communication facilities. Space Program AL37 is inspired by astronomy including Voyager Golden Record and Encyclopedia Galactica, philosophical and geometrical cosmology, scientific research of extraterrestrial life and the scale of different types of universal intelligences. By using telescopes, camera, and computerised systems to gather data from outer space, we detect signals and laser pulses originated beyond our solar system. We share a small part of our data with non-scientists, and we hope the program to be further supported by space agencies and Science Foundations in order to use a vast array of technologies.

The goal of the Space Program (AL37) is to search for extraterrestrial techno-signatures and to provide a continuous flow of outer space data and discovery of signals through powerful lasers and intense electromagnetic pulses. The type of signals that could prove the existence of alien life.

"Are there more type of intelligences in the cosmos?". We believe that the scientific truth should be expressed behind astronomical discoveries.

"Our mission is to discover interstellar messages that may carry information in relation to extra-terrestrial life, symbols, values, norms, capabilities, and material culture such as physical objects, technological advancements, spacecrafts and means of transportation".

The below images show a sample of the images gathered from outer space data.

Visit the website for more information: https://ansasl37spaceprograms.co.uk/
Twitter: https://twitter.com/AnsasL37

Anastasia Lazarou is a Modelling Program volunteer, supporting with collected data of the Galileo Project founded by Dr Avi Loeb at Harvard University and the Department of Astronomy.

Saturn and Jupiter have never been closer!

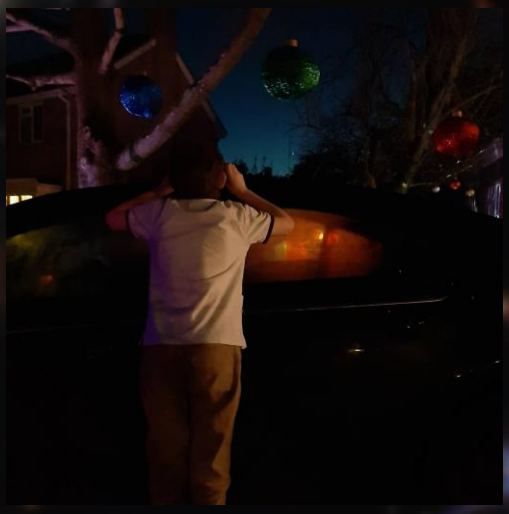
Jupiter and Saturn had a conjunction in 2020. But what is a conjunction?

A conjunction is when two or more planets get really close together on their orbit. They are not a once-in-a-lifetime chance but they don't come every year, either. Every two years Earth and Mars have one and this is when rovers are launched to Mars.

Being big means you are famous in the space world and Saturn is HUGE. Jupiter is so big that even compared to Saturn it is COLOSSAL. Anyhow, being famous means that everybody knows when you doing things like touring with a band or having the closest conjunction since the 1500s. The latter was what happened just last year.

It was so bright that I could see the conjunction from a tennis court with it's floodlights on and, on another night, from a light-polluted suburb. Boy was it spectacular! In my opinion it wasn't as good as a transit but it was still mesmerizing. Jupiter and Saturn put on a jolly good show!

Sebastian J. Thornton (age 11)



Getting a closer view of the Conjunction of Saturn and Jupiter (December 2020) with a pair of binoculars.

Astrophotography Corner

Photographs by Jared Wilson-Godber

M81 & M82, along with some very faint Integrated Flux Nebula

The Jellyfish Nebula, a supernova remnant in Gemini

The Bubble Nebula, The Northern Lagoon Nebula, and open cluster M52

M42

The Whirlpool Galaxy, taken through the Northumberland Telescope…

…and taken through my telescope at home through the same camera

Astrophotography Corner

Photographs by Haozhe Zhu

M31

M42

M44

Solar eclipse

Lunar eclipse

Solar eclipse over oil field

Lamost startrails

Milky way

Perseid meteor shower 2020

Milky way over volcano

Saturn

Astrophotography Corner

Photographs by Aniruddha Girish Aramanekoppa

2022-01-31 IoA sunrise

2022-01-31 Northumberland slit

2022-01-31 Northumberland Observatory

2022-01-31 Venus rising

2022-06-17 Northumberland at night

Jupiter 2021-09-08

Moon 2020-12-20

Moon 2020-01-10

Moon 2021-09-15

Moon 2022-01-20

Astrophotography Corner

Photographs by Aniruddha Girish Aramanekoppa

Moon 2022-02-11

Moon 2022-02-23

Moon 2022-02-23

Moon 2022-06-03

Saturn 2021-09-08

Sun 2022-06-17

Sun 2022-06-21

The Great Conjunction 2020

Venus 2022-01-31

Astrophotography Corner

Photographs by Anushka Sisodia

Two pictures of the moon that I took on 10th Feb on my first ObsNight

Photographs by Iris Huang

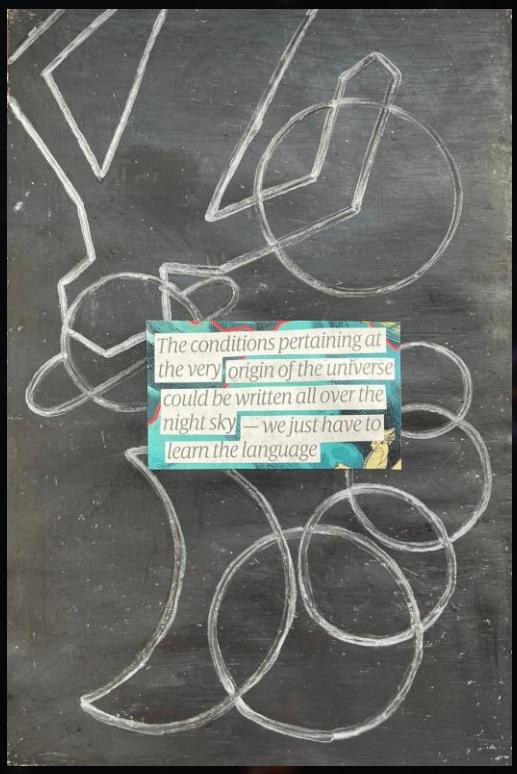
Photos taken on one of the ObsNights

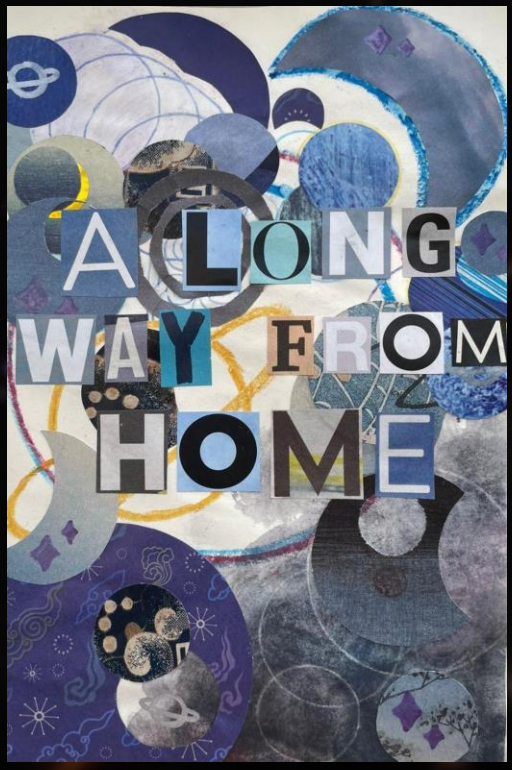
Photograph by Xavior Wang

Annular Solar Eclipse 26/12/19, Singapore

Art Corner

Art by Nadia Singh





Astronomy Jokes

How do you organize a space party?
You planet.

I was really disappointed when I came last in the astronomy competition, but they still gave me a map of the stars just for participating. It was a constellation prize.

I lost my astronomy job at the observatory. No matter how hard I tried I just couldn't stay focused.

Where does an alien go to learn about astronomy?
Universe-City.

I've been researching the field of astronomy. It's really looking up.

Did you hear about the great new restaurant on the moon? The food is excellent, but there's no atmosphere.

Where would an astronaut park his space ship?
A parking meteor.

What did the sun say to Canis Major?
Why so Sirius?

How does a man on a moon get his haircut?
Eclipse it.

What's a planet's favourite song?
Nep-tune.

Why wasn't the moon hungry?
Because it was full.

I'm reading a book about anti-gravity…it's impossible to put down!

How does one astronaut on the moon tell another astronaut that he is sorry?
He Apollo-gises.

How do you get a baby astronaut to sleep?
You rocket!

What do you call an alien with three eyes?
An aliiien.

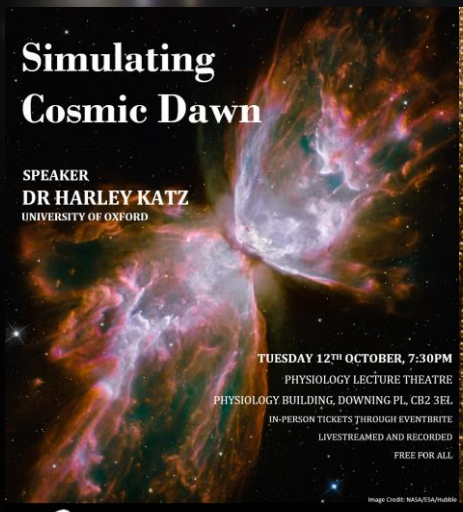
Where do you find black holes?
In black socks!

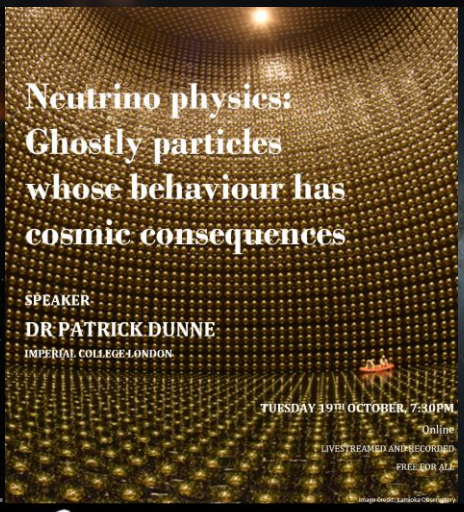
How does Jupiter hold up his trousers?
With an asteroid belt.

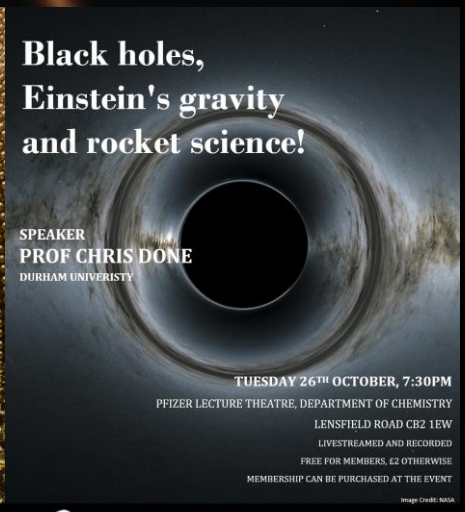
What did Mars say to Saturn?
Give me a ring sometime!

Sebastian J. Thornton (age 11)

Posters from 2021-2022 Talks







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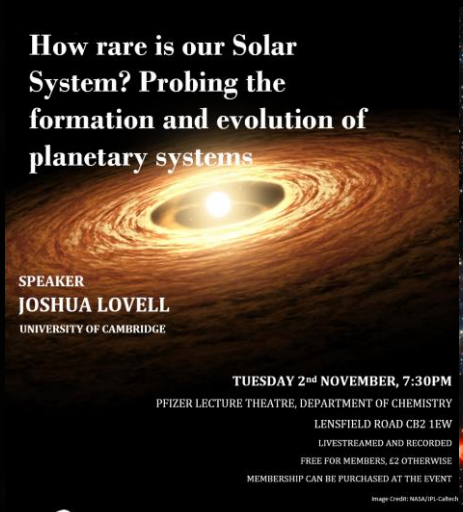

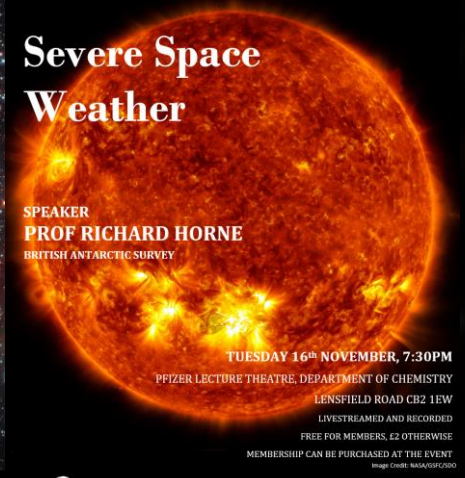

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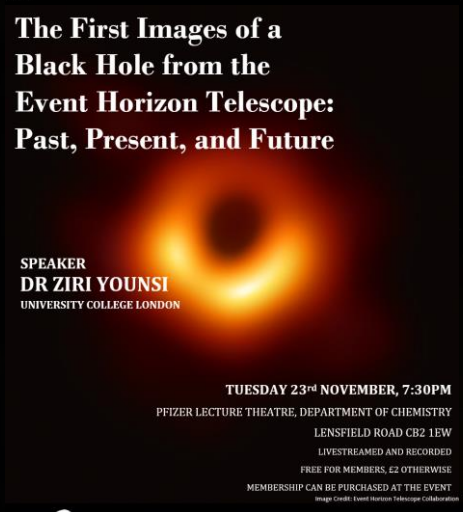

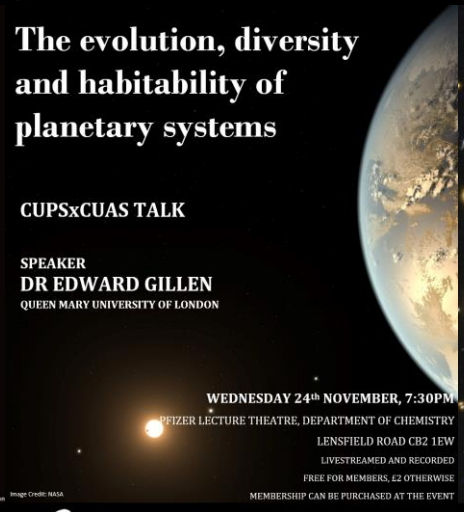

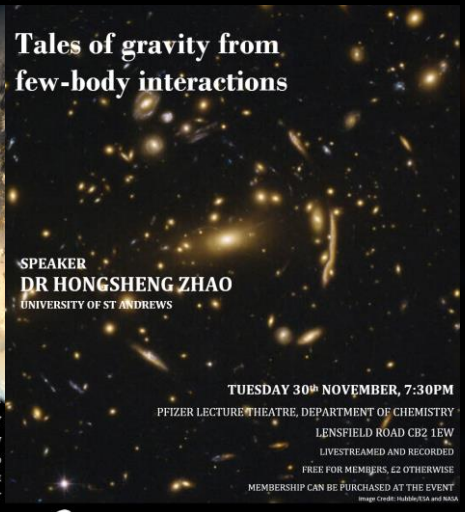

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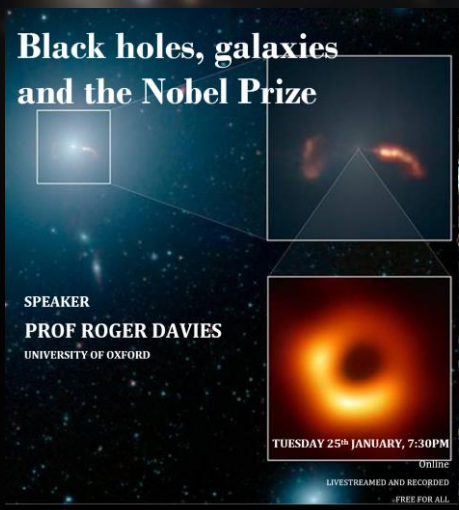

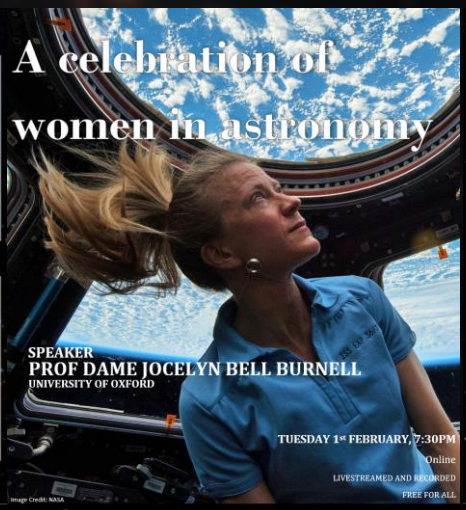

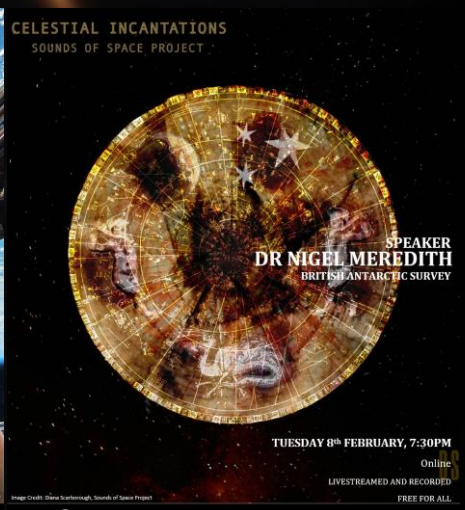

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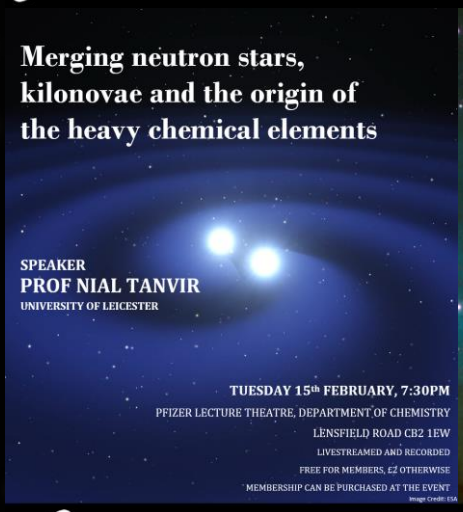

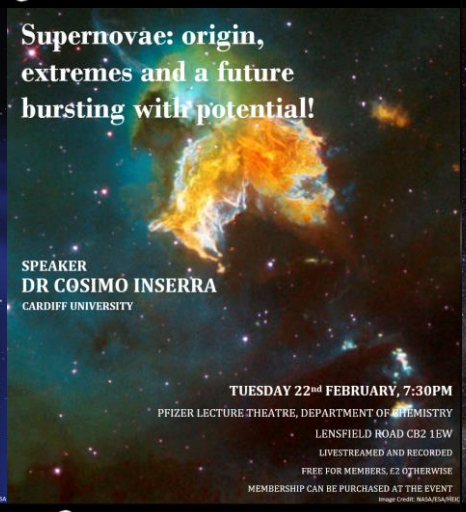

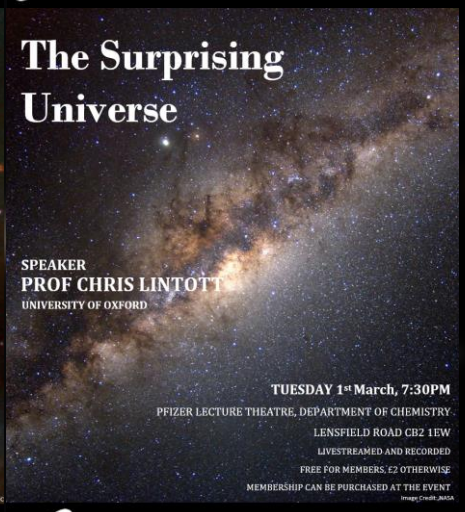

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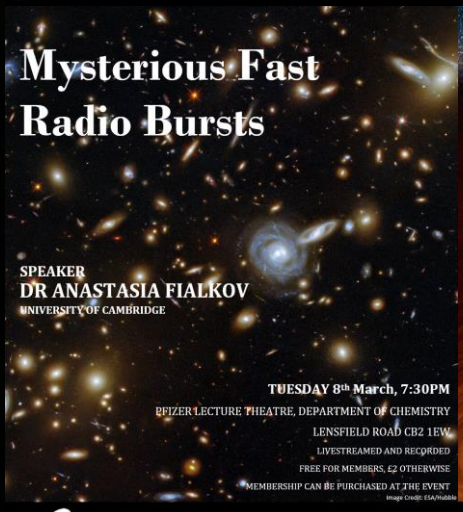

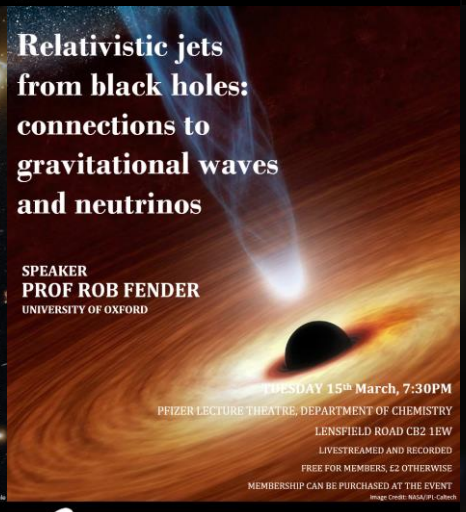

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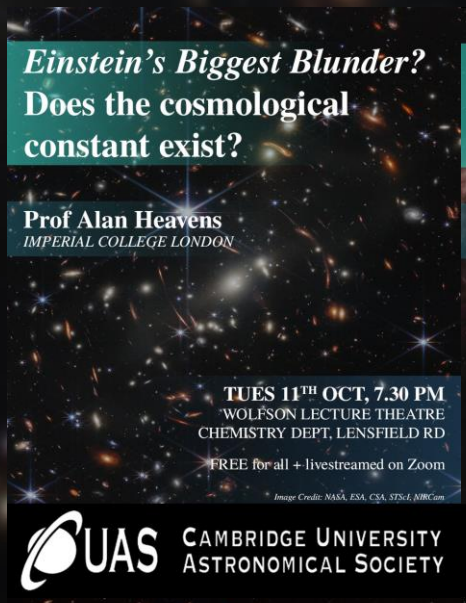

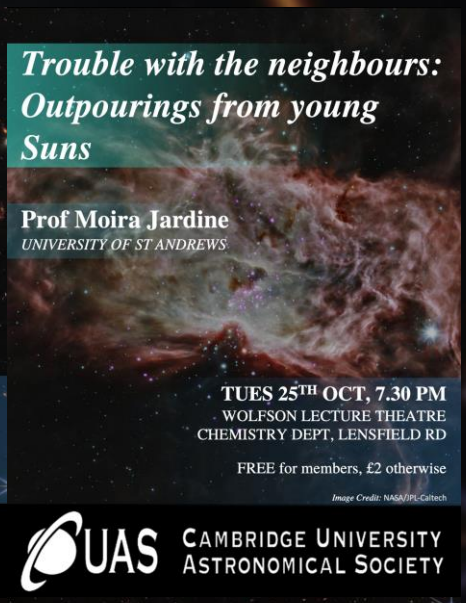

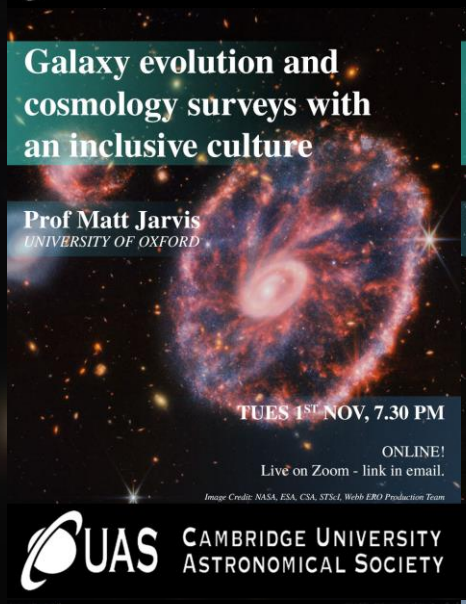

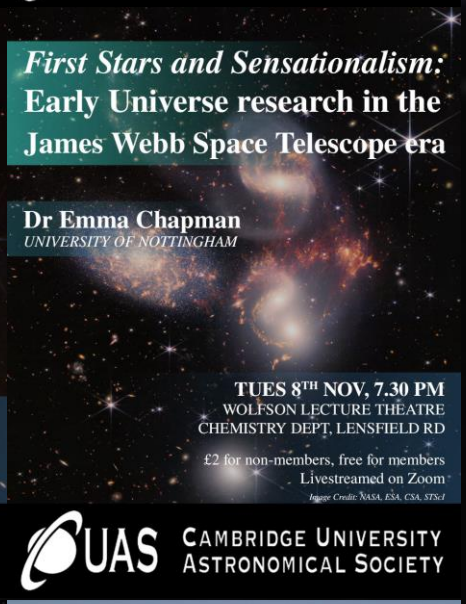

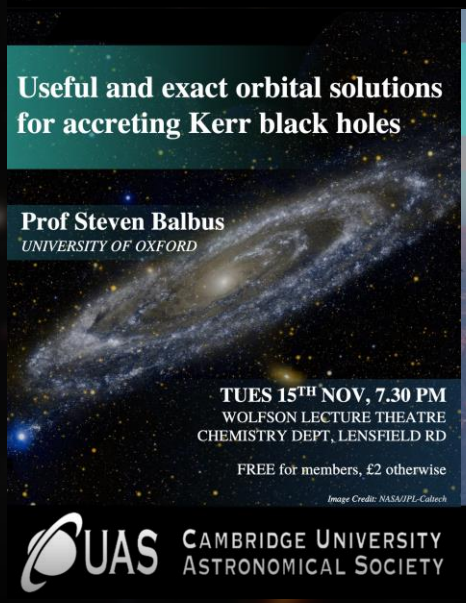

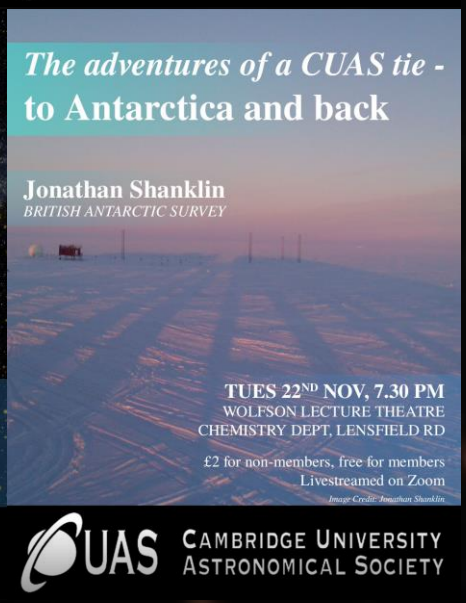

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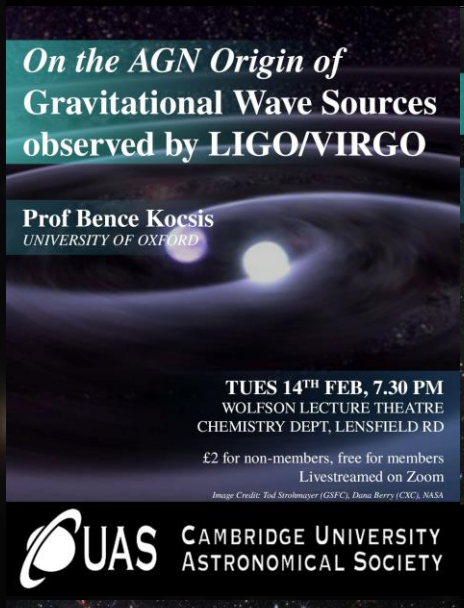

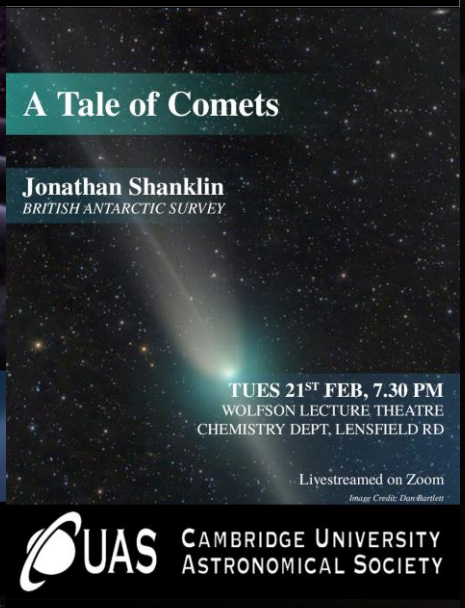

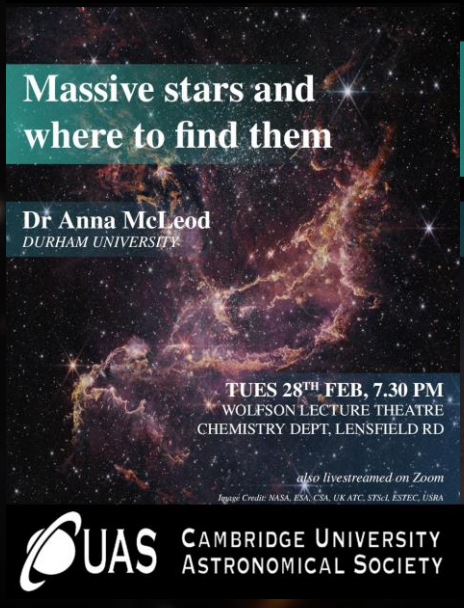

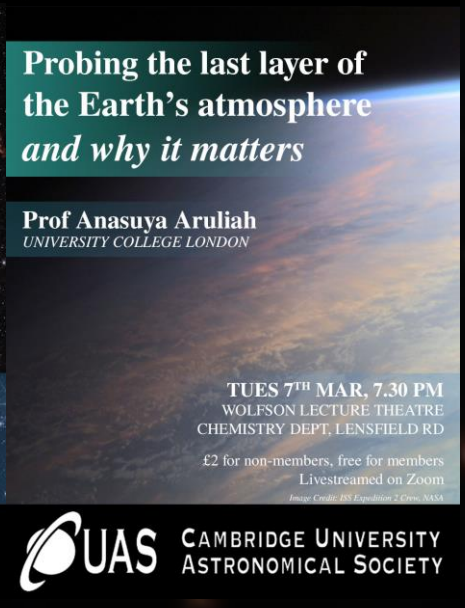

Cover image: NASA JWST – Carina Nebula

Background image: NASA JWST – infrared deep field