Stars Over Surrey

Stars Over Surrey, a monthly guide to astronomy and developments in space with Graham Laycock and Rachel Dutton of Guildford Astronomical Society.

And this is Graham Laycock welcoming you to Stars Over Surrey and with me as usual with all the information is Rachel Dutton from the Guildford Astronomical Society and a fellow of the Royal Astronomical Society. Hello Rachel. Hi Graham, how are you? I'm very well, and you? I'm very well, thank you. Well, we've had an interesting month.

Anti Cyclonic Gloom

What was all this doom and gloom at the beginning of the month about? We had anti cyclonic gloom, which, one meant no stargazing, but it was pretty depressing, I think, for a lot of people, just the first two weeks of the month. So, leading up to it, At the end of October, I certainly experienced a lot of fog in Guildford, but the 1st to the 11th of November, we pretty much had zero hours of sunshine at all, I'm sorry.

No, no, yes, it was really gloomy. Yeah, there was just no gaps in the clouds whatsoever and it felt like, not suffocating, but normally you get some kind of movement in the sky and there just wasn't any gaps in the clouds whatsoever. So I think a lot of people really feeling that. Some areas a couple of hours away got up to 12 minutes of sunshine cumulatively, throughout those first week and a half of the month.

So it was really bizarre, but it was called anticyclonic gloom. And it's caused when high pressure. Traps moisture near the Earth's surface, resulting in a prolonged period of cloudy, dull weather with mist and fog. And some of the characteristics are high pressure, or an anticyclone, which is a big, slow moving weather system that spins clockwise in the Northern Hemisphere.

And you also see light winds, which prevent low cloud from lifting and clearing, or air quality can contribute to it because the pollutants build up, so it appears to be worse in cities, and also temperatures when they drop, like this time of year, the moisture condenses overnight and the low cloud rethickens.

So, in the lead up to that, the end of October, I went outside and everything was really foggy and the normal place I set up my telescope, it looked like the trees were having a rock concert, so I put that on Instagram. I put a picture on the screen for you, Graham, if you have a look.

It's quite spectacular, isn't it?

It was. There's light shining through the trees. It looked like they were having a rock concert or something. It was really, really bizarre. So, if anyone wants to go to the replay page, they'll see all the pictures there, or they can go to at astro underscore cellist, on Instagram, and they'll see all my pictures there.

I did get a few pictures on a few clearer nights, but we haven't had that many of them. So the other pictures I've got for you to look at, the first one is the Andromeda galaxy.

Trees in the fog Credit: Rachel Dutton FRAS

Credit: Rachel Dutton FRAS

So that's our nearest. galactic neighbour. It's 4. 5 billion years away and it's due to collide with us at some point in the future, which will be known as Milkdromeda.

You can just about see the dwarf galaxy in there.

Indeed, yes.

Yeah, and you can see the brighter bit in the middle, so that's where you've got all the stars clustering in together around the supermassive black hole.

Right.

And then can you see the sort of darker stripes going through? So those are the dust lanes.

So in their current, status, where you get clouds of dust, that stops light getting through. Interesting. So the gas in that region cools down enough. for the gas to sort

of clump together and ignite and create fusion. So the dust clouds hide stellar nurseries. And then later, as these stars form, some of that dust will turn into planets to go around the stars.

Quite an image, yes.

Yeah, so that's Andromeda, and that's after an hour of data.

Credit: Rachel Dutton FRAS

I managed to get the full beaver moon. So, Um, I've got two images here, one which was straight off the scope, one which was very slightly processed to bring out the sort of redness of the iron and the blueness of the titanium within the seas.

But what I find quite interesting is we consider a full moon to be basically the whole disc is lit up, but basically there is no shadow on the east or west side. But how you can normally tell whether someone's got a full moon picture. You can see if you look around most of this moon that it's quite a crisp edge.

Yes.

Credit Rachel Dutton FRAS

But if you look at the bottom, slightly towards the right, you can just about make out some crater shapes. Yeah. So it's actually not quite a full moon, although technically it is, but in this case, it's the angle of the moon and the sun. So the sun must be higher up and shining slightly from above, so that you've got a tiny bit of that crater detail, below where the shadows are playing.

So I always find that interesting when I look at full moon pictures, you can see whether it was nearly a full moon or quite a full moon. That technically is, but sometimes depending on the angles of everything and how it lines up, the top or the bottom can have some greater detail, which you don't see often with the Terminator moving left to right.

So I always have a peek around there when it's a full moon. And then my final image is the Orion Nebula. So, my favourite constellation of Orion, you've got the four outer stars, you've got the three stars of the belt, the three stars of the sword, and this is the middle star of the sword, and what we can see is this sort of large cloud complex, there's lots of red cloud in there, so that is where the new stars, because it's a stellar

nursery, are radiating ultraviolet light and it's lighting up that gas and it makes it look red.

Credit: Rachel Dutton

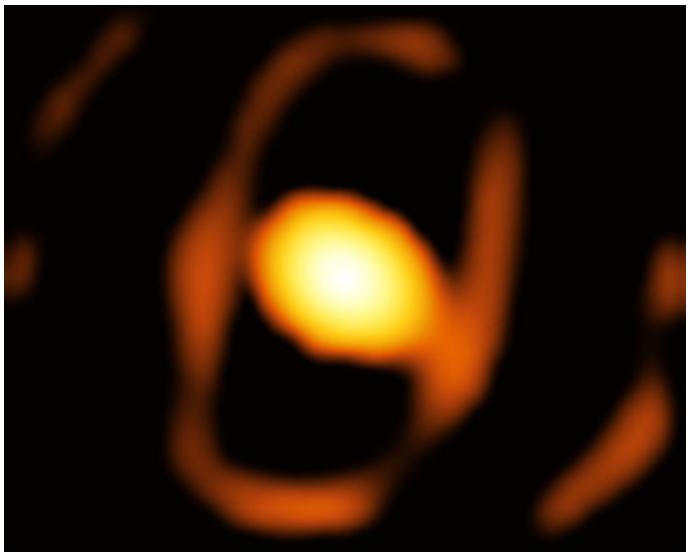
Oh, that's right. Is that right?

Yes. And you can also see some dust as well. Yeah. In there as well. On the left, just to the top, there seems to be a separate bit with a, with a bright light and, yes. A red cloud around. Yeah. So that's, um, I think it kind of almost looks like a, a bird, right?

With Yes. Yeah. A beak.

But yeah, that's the Orion Nebula, right? So not much star gazing thanks to the anticyclonic gloom. But we did manage to get some in. Well done.

Now we've got the first close up pictures of a star outside the Milky Way.



Credit: ESO/K. Ohnaka et al.

It's quite something. It is. It's really exciting for a number of reasons. So I don't know if you've ever been to the Southern Hemisphere.

No, I haven't. Okay, so obviously the sky looks different there and the constellations like Orion are upside down, but then they also have all the sky that we can't see as well in the Southern Hemisphere. So when you go there on a clear night, you can just about make out the large Magellanic cloud and the small Magellanic cloud.

And they do look like these fuzzy nebulous clouds, but actually they are two dwarf satellite galaxies orbiting the Milky Way. But they're also combining their stars with the Milky Way. So they are very slowly integrating with us. And within the Large Magellanic Cloud, there is a star called WHG64. I'm going to call it the Woe Star, I think, from now.

And that's in the Large Magellanic Cloud. It's 160, 000 light years away, and it's 2, 000 times larger than the sun. It's a chunky star. It is, isn't it? That is chunky. So the European Southern Observatory imaged it using their very large telescope interferometer and get real time data about the star. Now this star is a type of star called a red supergiant star.

So stars that are doing their main sequence using hydrogen into helium, that's considered the main life cycle of a star, and then depending how much mass they have, They will move through that faster if they've got more mass. And at the end of that fusing hydrogen into helium, they then swell up, their outer layers move further away from the core, as they start fusing that helium into heavier elements.

And then, as they run out of helium, That gets, fused further again, so you just get elements being fused together to make more elements, etc. And their atmospheres are much further away, and the heavier elements create this kind of dustiness as well. So you can see that this is a really extreme example because it's got so much mass.

So there's this cocoon shape of dust as the outer layers are shedding. Um, which means it's leading up to a supernova. You can see the elongated bits as well. So you've got, it almost looks a bit like the eye of Sauron's, but side on, I think. Yes, yeah. So you've got like the star, you've got the dust cocoon, and then you've got this other sort of ring around it that's quite elongated.

And that is an emission that might be due to a bipolar outflow along the axis, or it could be due to an interaction with an unseen companion star. And so it's supernova imminent, it's supernova any day, but not quite as imminent as we believe it to be. Beetlejuice might go supernova. It's probably not going to be within our lifetime or even human lifetimes.

Oh, right, right. A long time away.

Yes. Now, a **zebra pulsar and the crab nebula.**

Right. So, when the WOH star goes supernova, it will leave behind a remnant that will eventually become a black hole because it's really massive. But some heavy stars are going to form a neutron star after going supernova where they are massive but not quite as massive as the ones that turn into a black hole.

So the Crab Nebula is this spectacular supernova remnant. It's an experiment. banding cloud of gas that was blasted away from the main star, and it leaves this pretty cloud in space that we call the Crab Nebula. I highly recommend looking up images because it's stunning. Now, within that nebula is a neutron star, and neutron stars have very extreme magnetic fields that we can detect when they hit our detectors.

And stars are spinning, and the magnetic fields are coming out the poles, and as the stars are spinning, that magnetic field is spinning around with it. So you get one detection every time it completes a rotation. And as they spin at different speeds, um, you get these sort of different pulses depending on the, um, speed of the orbit, sort of the speed of the orbit, the speed of the rotation even.

So we're going to listen to some examples that kind of better explain it. So this is what you would hear if you were to just have an on off registration for we detected something. Let's go for this one.

So can you hear that pulse as the magnetic field interacts with our detector? Indeed, yes, you can hear it with the rhythm, yeah. And they are the most accurate clocks in the universe because they are so constant. And listen to another one.

That was going really fast. Yes. And each time you hear that pulse, that's a full rotation of that star. So can you imagine how fast these stars are spinning? Indeed. So we've got a couple more.

Wow. That's really fast. We've got another one that is so fast. It sounds like a musical note.

That almost sounds like one distinct note to me. I thought it was my leaf blower for a moment. I keep thinking someone should compose music made from, um, pulsar noises. Anyway, the Crab Nebula is a little bit different and it's causing a little bit of confusion. So, with the Crab Nebula, they are getting these pulses And if you were to imagine, um, the waveform being drawn, so I don't know if you've ever seen like a seismology, um, graph sort of being drawn with a pen as it's going along or like lie detectors where you see the pen is wiggling a little bit on the paper and then as it gets positive detection you get this big spike and it wiggles a bit.

Now with the others, the waveform, you've got that wiggle, but it's a very narrow wiggle. So it's low amplitude, high frequency. It just looks like a little bit of a squiggly line. When we get to the crab pulsar, it's quite a significant wiggle. Um, see, I'm showing Graham the chart here. You can just about see this.

Yes, and you can see that spike. And if we listen to it, you can hear just about the pulses, but it's not really clear Um, what the pulse is.

So I don't know if you could hear it. It sounded like little static charges. Yes, it's just like a little click now and again. Not very loud. Yeah, I'll play it again so people can listen. I think it sounds almost like a static discharge click that you get.

So you can tell there's a lot of interference on that. And this doesn't make sense because Pulsars are our super clocks. Um, they are so accurate that you could use them as beacons to navigate across the universe, if you could travel across the universe. So, um, even so, actually, if you remember the Voyager golden record, There's images of the sound waves of the different pulsars so that if you place all the different pulsars around us in a circle, you get the idea of where they are in relation to us, you can find our solar system.

That's how accurate pulsars normally are. So this is really confusing for a lot of people. So pulsars keep the same spin, which we call angular momentum when they

were a star, and they do lose a little bit of speed as they get older. Just a tiny bit, and it takes a really, really long time for it to be noticeable.

So we started off with the slower ones, those were the older ones, and the ones where you get almost that note, continuous note, those are the younger ones. So, As I said, this has been a bit confusing. They called it the Zebra Pattern, but it turns out that the Crab Nebula doesn't just have this main pulse and most pulsars have an interpulse as well, which I'm not going to talk about.

It also has these extra pulses that they've called HFC1 and HFC2, and they were trying to figure it out. But it turns out that the plasma around this pulsar's magnetosphere is causing the Crab Nebula to break apart. Um, the sound to be treated like it's going through a diffraction screen. When I say sound, I mean the magnetic field.

That is creating that sound when it hits our detector. So, when you see, for example, someone, um, shining a light into something to create a spectra, it splits that light out and you get a rainbow. The same thing is happening here with that magnetic field signal. So, it's being diffracted through that cloud of plasma.

As a result, we're getting these weird interference sounds. Yeah, now that is interesting.

Now, what about black holes? How do they get their hair? I didn't know they had hair.

Yes, that's the whole thing about hairy black holes. So black holes have three characteristics that we can measure. They have mass, so how much of them there is, and we can infer that from the effect they have on things around them.

They also have a charge and they have a spin. We've talked about spin. It's all stars and everything in space rotates. However, anything that is not one of those characteristics is called hair, such as magnetic fields, which we've just talked about. So a black hole may be born with magnetic field, or it may acquire one by swallowing magnetized material.

But this no hair theorem says that in such cases, the magnetic field on the event horizon, so that's the point of no return going into a black hole, of an isolated black hole would be quickly radiated away, returning to the black hole back to a sort of bald state as it were. They're really sticking hard with the hair analogy.

So basically what that means is that if the star, the black hole, gets a magnetic field it'll radiate away so it shouldn't have magnetic field. Which would be fine, if it wasn't for the fact that we see black holes producing these jets. And jets come from the accretion disk, so where the black hole has matter attracted to it, it spins around in a disk around the outside, it gets heated up, and when there's too much matter for the

accretion disk, it gets funnelled towards the poles and sent out in these huge jets, which lots of people like to call black hole burps.

Because it is like a pressure release and these can emit gamma ray bursts that are observed around black holes with very strong magnetic fields. So how much material that's The black hole can have on its accretion disk depends on the spin and the mass of the black hole. So for these jets to happen you need magnetic fields and you need an accretion disk with matter to send up in a jet.

But where does the magnetic field come from if we have this no hair theory, i.e. it radiates away? So black holes, they start off as a proto neutron star. before collapsing further into black holes. And as we just discussed with neutron stars, they have very strong magnetic fields. So, could it be that the further compression of a neutron star into a black hole causes those magnetic fields to also be compressed and therefore be some more concentrated and therefore sort of stronger?

But, if you've got a stronger magnetic field, that will cause the star to lose its angular momentum, and the proto neutron star won't accrete as much material, and certainly not enough to cause these jets. So it's kind of a bit of one of these sort of catch 22s. And previous simulations have shown that if you can decrease the magnetism enough to accrete matter, it isn't strong enough for the jets to form.

But these simulations showed isolated neutron stars and black holes. And if you go back into the simulations for a neutron star with an accretion disk added in as the model. Then the accretion disk can save the magnetic field as it transforms into a black hole. So it looks like the black holes inherit their magnetic fields from the mother star.

Right, so that's where we've got to so far with that. Yes.

Let's move on now to Uranus images.

Right. So, this one was a bit of an interesting experiment. So, as various planets in the solar system get closer to the Earth, Hubble images them, and we've got this regular Hubble archive constantly being updated with these images, so we can see and track visible changes in these planets over periods of time.

That kind of makes sense. Indeed. You, you want to be able to track what's going on and for the outer planets, we haven't even observed them in one full orbit yet, so we don't know what their seasons look like, if they get impacted by something, um, if an impactor gets nearby and breaks apart and turns into rings, etc.

We would see those kind of changes. But this time, not only did Hubble get the Earth facing side of Uranus, the New Horizons probe, which is way off in the Kuiper belt. And it's a lot smaller. Um, also took an image of the far side of Uranus. So, they could see both sides of the planet at the same time. Now, there isn't any new science data released as really, as um, a result of that.

But the interesting thing is kind of calibrating those two images together because we're now building more observatories that are looking for exoplanets. And you are going to end up with a scenario where different observatories are imaging or detecting the same exoplanet and we want to work out how you can merge the data from the two together to get something meaningful.

So this is sort of leading the way and paving the path for further exoplanet discoveries. My goodness. Will we discover life somewhere else eventually? Sure we will. Now, apparently Uranus is getting colder. Yes. Now, Uranus is a pretty interesting planet anyway, because it's over on its side. It spins in a different direction to all the other planets in our solar system.

So we think it probably got hit. By something, another planet at some point that flipped it over. It has a huge atmosphere, but the corona extends out 50, 000 kilometers. And what is really strange is every time we've had probes measure its temperature, it's decreasing quite significantly. So the temperature was first measured by Voyager 2 in 1986, and Several probes have gone back and measured it and it's pretty much, um, half of where it used to be.

So, first of all, they were looking at seasons. We haven't observed all the seasons on Uranus yet. So, each season is 21 years. And since 1986, we've had two seasons, um, in a couple of years, we'll go into three seasons, but they discounted that seasonal variances, so that's been ruled out. Another potential reason may be linked to the solar cycle, which is every 11 years, but again, there were no trends or correlations there either.

However, when they looked at the solar wind, which is charged particles that come from the sun, we've talked about them a lot with Aurora. There has also been Decreasing, um, of outwards pressure of the solar wind in that time that isn't correlating with the sun cycle, but it does kind of correlate this decrease, crease in our pressure with the decrease in Uranus's temperature.

So thinking about how the sun heats up a planet, we know that the earth, which is much close to the sun, it's the light from the sun and the radiation from the sun that heats up the earth. If you're following, um, as I said, with auroras, you also know that we do get the solar wind that interacts with our magnetic field and gets funneled into our atmosphere, and we see these pretty auroras sometimes.

However, Uranus is much further away, so there isn't as much light, but it does get the solar wind. But with decreasing solar wind, Uranus's magnetosphere is expanding and making it more difficult for the solar wind to reach the planet. So scientists are now considering that those outer planets are being heated more by solar wind mechanisms rather than by light or radiation from the sun.

Right, that's what they think.

How about, does the moon, Miranda, have any oceans?

So, Miranda is one of the moons of Uranus. It has 28 moons that we know of, some larger and some smaller, and Miranda is one of the smaller ones of the larger set. So Miranda, being one of the small moons, was also imaged by Voyager 2 in 1986, and it took readings from the South Pole.

But not much was done with that data at the time, and Miranda has quite an interesting surface. It's this weird patchwork of sort of straight lines, and it's got some really steep cliffs in it. But if you can imagine giving a cat, a sort of clay ball, and it sort of runs its claws down in one way, you move it over, and then it runs its claws into another way, and you get these patterns of deep grooves and lines, and then it sort of move it on a bit, and there's another one, so it's very patchworky, but there are these clear grooves.

And scientists wanted to re look at that data again with more sophisticated technology and data modelling. And using models, they wanted to see if they could recreate this strange surface features on Miranda. And what they ended up with was a model of this icy crust that's about 30 kilometers deep, so you have an upper layer which is super brittle, and then a lower layer which is slightly less brittle, and then an ocean around 100 kilometers deep, and then the core.

So of course we need more data, but we've gone from Thinking, okay, Europa, the moon of Jupiter has an ocean, two other moons of Jupiter have an ocean, and oceans could mean life. Then we've had Titan, has oceans of methane. We're now looking at Enceladus having some form of ocean, as it's got geysers. And now we're looking at moons of Uranus.

May having an ocean, so there's more places in the solar system to look for life. Now that is interesting, isn't it? Where there's water, as they say. Yes.

Now, the Nancy Grace Roman Telescope has got a mirror.

Yes, so this is an observatory I'm quite excited about. So this observatory is going to be another space telescope, and it's going to have a chronograph.

And what this means is that it looks at a sun, but it has this disc in front of where the sun is. The sun or even it looks at a star and it'll place this in front of the star to dim that star so that you can see other bright objects nearby like exoplanets. And if you think about when you look up at the moon, and when on a full moon, it's so bright, it washes out the sky around it.

This is the problem we have when we're looking for direct images of planets around stars and other solar systems. So. If you cover up that star, you can then get rid of that light pollution from the star and see the planets. So, this one is going to be able to resolve down to Jupiter sized planets. So we're getting closer to Earth sized planets now, and hopefully at some point in the future we'll be able to build something with the resolution to be able to detect Earth sized planets.

But it's now got all the components it needs to be assembled. So the mirror has just arrived. It's Hubble grade or Hubble quality mirror. So very good quality mirror. But the interesting thing I find about this is that It wasn't good enough for the U. S. defense, so they gave it to NASA to use instead. So it makes you wonder what they've got at their earth pointing, um, satellites, mirror wise.

So now they've got that ready to go, they're assembling it, they will do all the testing for it, and it's due to launch in 2027. Fascinating stuff. Well, that's kind of fine. What a clever idea. Yeah, I do like the fact that they're, they're repurposing things and there's a history of doing telescopes, but it always does make me wonder what the, uh, American Defense Satellites have, if the leftovers come from the space program.

We may know one day.

Anyway, let's go on now to **Astronomy Tip of the Month**.

Right, so this one's a little bit bigger. boring, but I feel it's kind of quite important in the current sort of weather. Um, a lot of people have been struggling on the days we have observed this month. So just bearing in mind when it's really cold and you've got a lot of moisture in the air, the moisture makes it feel far more colder again.

So make sure you're wearing plenty of layers. There are now clothing Available for sale, which have heating inside them or heating elements like you can get jackets that have heaters inside and to keep your core warm. There are jackets with, um. sort of infrared reflectors on the inside of them to keep you warm.

So there's a lot out there in sort of camping technology terms, but it's easier to get rid of a few layers than if you're really, really cold, especially your feet. So I've been finding my toes have been really cold recently. And if you're using a scope or binoculars, or even using a camera, make sure you're using dew heaters and dew shields so that you're not getting water breezing into any nooks and crannies in the optics and potentially causing damage there.

Some good tips there. It is getting cold, isn't it? It is. And honestly, that's one of the biggest barriers to astronomy. Other than cloudy skies. Yes. Yeah. Right.

What's the target of the month?

Okay. So the target of the month is going to be the International Space Station. I always say this in December, because it kind of gets mistaken for Santa going over on Christmas Day.

And if you want to believe that, that's absolutely fine. But it's a fun one to try and find. And it's a fun one to get your kids out and observing in December. Trying to find the space station and waving to the astronauts. There are two ISS tracking apps, so you can find one of those, or even both of them, get them on your phone and start tracking the space station as it goes over ahead.

All right. Good stuff. Well, we'll be back in a couple of minutes after these important messages with a look at space news, Astrocast and a forthcoming event. So join us shortly. Stars over Surrey. Your monthly guide to astronomy and developments in space on Brooklyn's Radio.

Space News

And welcome back to Stars Over Surrey with Graham and Rachel. Rachel then, first bit of news then, Starship test flight six. Yeah. We saw all that and Donald Trump and Elon jumping up and down, but it didn't get the chopsticks to work.

No, but you remembered about the chopsticks from last month, which is good.

Right, so, last month we did talk about Flight 5, where the super heavy booster, so the bit that pushes the rocket up, was, the only thing that went up, so that launched, and then it came back down, and it was caught by what they call these chopstick arms of the Mechazilla, and this was a true historic moment in terms of spaceflight, because you wouldn't have a car and throw away the engine at the end, or you wouldn't get on a plane and throw away the engine on a plane, but that's what we currently do with rockets.

This showed that there was a way of having a reusable rocket. Yes, he's previously had rockets that landed on these legs, but that's a lot of extra weight. And it really is quite impressive that these sort of chopstick arms, um, caught what was essentially like a 20 or 40 storey building. I can't remember off the top of my head.

But it's like catching a skyscraper in the air. So that was quite spectacular.

It does look amazing, doesn't it? It really does.

It really is phenomenal, the scale of this. Yeah. So this time they have the super heavy booster and then Starship on top. And they launched, um, and they did a number of testing, especially on things like the heat shield.

What I found particularly amusing was that they had a banana inside the fairing to see how it'd float inside. Really? Why do they, why did they choose a banana? I think it's just like an amusing but small object and it wasn't a real one. It was like a foam toy one, I think. Oh, I see. So it's not going to cause any harm and all the rest of it.

But it did have strings so it couldn't go too far or get stuck in something important. But yeah, I just enjoyed this really serious test flight. There's a banana in there. But anyway, they did a lot of testing on various different things. As I said, the heat shield is a main issue and that's actually a big issue with the Orion capsule on the Artemis missions at the moment.

So it did a successful launch, successful separation. They were going to go for the catch again, but they had to abort. So it landed in the Gulf where it exploded. And it's thought that the reason that they didn't manage to do the catch catch was because the antenna on Mechazilla that was needed to send signals back and forth between Super Heavy and the tower, um, was bent, so it wasn't able to work, so they aborted.

Um, and then Starship itself, they did a couple of tests on that, as I said, with the heat shield, but also they, Practice turning on one of the Raptor engines so that they know they can re fire their engines in space. That would enable sort of precision maneuvering. And that worked too, and then again, Starship came down in the Indian Ocean where it beautifully demonstrated that it could right itself, right before belly flopping and then exploding into the ocean as expected.

Yes, rather elegant, I thought. Yeah, the footage is just incredible. Indeed, absolutely amazing.

Now we're celebrating the 100th woman in space.

On Friday the 22nd of November, Emily Calandrelli, an American engineer and scientist who is well known as the Space Gal, became the 100th woman to fly in space as a commercial astronaut for Blue Origin on a 10 minute suborbital flight.

Emily is a really inspiring woman. She has worked for NASA. She has also, um, had her own television show, Emily's Wonder Lab, where she was promoting science and STEM and doing science experiments, all whilst heavily pregnant. She still does this on Instagram. She's going to be launching her own YouTube channel soon.

And she's got a ton of science books for kids. Now, when I was little, I remember being super inspired by seeing Helen Sharman, the UK's first astronaut. And I hope that she continues to have this wonderful influence that she already has on many little girls as they watch her reaching the stars. And well worth it for her.

I think we're worthy at 100th. Yes.

Now, can astronauts call for help from the moon?

They call 111. Yeah, this is something that people are now starting to think about as we're talking about taking people back to the moon. So the far side of the moon is radio opaque, you can't get radio signals there. So you kind of rely on, at the moment, there's a couple of satellites you can bounce radio signals off to communicate back, which is how the robotic missions are sort of safely landing and sending things back home.

But, you know, realistically, If you've got people starting to settle on the Moon, you can't use satellite phones like people do in remote areas. Because we don't have a constellation of satellites around the Earth. So at the moment, if you were stuck somewhere on the Moon, you're going to be stuck there.

So what, some scientists in Adelaide, and the US are collaborating on is to develop a satellite constellation, similar to those launched by SpaceX, but on a much smaller scale that would go around the moon. And therefore, you could transmit emergency alerts to this network of satellites, which could then send that data on to other lunar stations or back to the earth, or, you know, whoever it might be relevant.

This would be quite exciting. They're looking at the things they need to get this to work. So they've been given a grant of 100, 000. Um, but things they have to take into account are things like battery life and can they increase battery life? And also there's no atmosphere on the moon. So those satellites are going to be bombarded with space weather from the sun.

Um, They are also going to be dealing with, when they're on the far side of the Moon, depending on how, what their altitude is from the Moon's surface. They may be dealing with extremely cold temperatures to extremely high temperatures. And we've talked about this before, with the different missions that have landed on the Moon.

Can they get through a day night cycle? Well, they're going to have to find material that can get through. cope with that kind of, um, extreme environment pending, as I said, on the elevation from the Moon that they're looking to do. And in case anyone's thinking they haven't heard of any Australian astronauts, there is a qualified Australian astronaut who graduated from the European Space Agency earlier this year called Katherine B.

So you can look her up, she's doing some amazing outreach at the moment.

Right. Very good indeed.

Now on to the Hera mission.

So this one is Hera, like the Greek goddess.

Oh, sorry. Hera mission.

Yes. So, this is where everyone jokes about avenging the dinosaurs. Some of you may remember in 2022 there was a mission called DART.

So what this was, was they were thinking, okay, we've got a problem with near Earth asteroids. They're really hard to see because they're small, they're dark, they're not reflective. We don't see them until they're really close. And obviously dinosaurs were wiped out by an asteroid impact. Well, we think they were anyway.

So we jokingly call this the Revenge of the Dinosaurs, but thinking of planetary defence, one particular thing you could do is have some kind of rocket ready to go that could give that asteroid a nudge, and it just has to be enough of a nudge to

change its trajectory. So they decided to do this with an asteroid with an asteroid moonlet, known as the Didymos system, out in outer asteroid belt.

So they sent a mission all the way out there. And they just nudged the moonlet, um, and that had quite. A huge impact. We saw this massive stream. It's changed this moonlet's orbit around the main asteroid itself. And we want to know more about the impact that it had so that we can better work out and calculate the impacts of nudging an asteroid.

Because you don't want to sort of nudge it and then it And then it goes into the moon or something else. And asteroids are particularly difficult to deal with anyway, because they are these little rubble piles. So some of them, um, we've landed on, and they've not been that solid a surface. If you imagine like quicksand or something like that out of rubble.

So some things can sink when they land on the surface. But they want to explore the crater impact from The DART mission, and they've also got two little CubeSats as well that are going to practice a type of landing called Robust Ballistic Landings. And this is going to be testing how you can land on these rubble piles where you've got very little gravity, so there's no assistance there.

And they're also spinning as well, so it's quite challenging to land on an asteroid. Yes, sounds like it, yes. Yeah. Yeah. And they're tiny as well. Yes, they're tiny, dark, spinning. Not solid, no gravity. Yeah, but people want to try and mine these asteroids in space. So, you know, you need to be able to figure out how you can do that.

But before that, you need to figure out what they're made of and send science missions. We had a packed agenda last month, so I didn't mention it then, but Hera was launched in October, and in November it did a second 30 minute burn, so it's now on course to get its gravity assist from Mars next year, so we know that this mission is now launched and it's safely on its way, and hopefully we can find out a bit more about how to protect Earth from these storms.

tiny little rocks. Yes, let's hope they do it in time.

Right, we're moving on now to Wooden Satellite, launched.

I know this one had me foxed a little bit because you just don't think wood in space. So I was thinking when I first heard this, when you learn about the fire triangle at school, you have oxygen, which is in the atmosphere, you need fuel, wood works as fuel, and then you just need to heat it up and you should get a fire.

The friction in the atmosphere can cause it to heat up. Yeah, so I was thinking this doesn't sound like the best idea, and then I read into it a little bit more, so we'll explore that. So the problem we've got at the moment is we've probably got too much in terms of satellites there. Um, we are at risk of something called Kessler syndrome, and this was, um, a guy called Kessler put forward the idea that you just

need one satellite to break up after you've got so many there, and all those little bits are going to go into other satellites at a very high impact, explode those, which then has other bits of satellites, which then go into more small bits, but then you just get this like chain effect of yeah, the domino tiny bit.

Yes. And bearing in mind, you can have a tiny bit of paint black come off one satellite. Just imagine how small the little paint fleck is. And I've seen, um, Pictures of impacts where you've got holes from something that small and the hole is roughly the sort of size of a washing machine Good grief But what a splinter of wood to do wonder but it should burn up because it's so small.

Ah, right But we've got this problem with the satellites. We've got The original ones that were launched when we first got excited about space, no one thought about what we do to de orbit them. So that you've got all these junk satellites up there, you've got more constantly being launched, not necessarily with plans on how to de orbit them, which I think there should be.

In any event, when we're launching something from Earth, presumably we've got to make sure we don't hit a satellite on the way up. Yes, and also there's going to be, if you do hit the point of Kessler syndrome, where you've just got this de orbit. debris fields encasing the Earth. You'll no longer be able to send anything through that, so there'll be no more space missions.

The ISS and the Chinese space station will have to come back down if you keep those astronauts alive. You won't be able to send anything out and things coming in will be hit by these as well. So I've got this vision now of all these sheds circling Earth. That's, um, actually not a bad visualization.

You can find these situations where people have, drawn what the Earth looks like and there's sort of jokes that any intelligent life coming through our solar system, having seen like the Voyager golden records or having experienced like the Arecibo, some of these sounds how we just go, “Oh, that's just such a messy front yard. Goodbye”.

Because we've just got so much in terms of satellites around the Earth as it is. It's. It's mind boggling when you look at the simulations and there are now thousands going up every year with no, no checks and balances in place, other than, you know, as you launch them, you've got to get, if you're in America, for example, you get launch license from the FAA and in the UK, it goes through the Civil Aviation Authority, I'm not sure, there's, you know, an aviation authority in the UK that look after our launches and every country, well, most countries have some kind of authority.

We've got China launching things as well that we don't know about. So anyway, Japan were thinking about this and they were like, what about wooden satellites? So obviously the components inside would still be metal, but if the majority of the casing

is wood, When you're done with it, just accelerate it enough that it heats up, it sets fire and then it should all be incinerated within the atmosphere and then gone.

So they're kind of using that to their advantage, um, and they've launched the satellite. It's in space, it was launched upon a Falcon 9 on the 5th of November. It's headed towards the ISS where it's going to dock onto Kibo, the Japanese module. And after that, it should go further out into space and hopefully complete its mission with being burnt up in the atmosphere.

Clever stuff. We'll see if that works then, and they could be going for sheds in space. They could be, but satellites are getting smaller now, so it might be a box in space. A very small shed in space.

Right.

Oh, this is a bit more serious. **Cracks in the ISS.**

Yeah. Losing its atmosphere, I presume. Yeah. Yep. So In the ISS, it's a pressurized habitat, and inside that you have your atmosphere for you to be able to breathe.

And unfortunately, there are cracks on the part of the tunnel that connects the docking port to a Russian module. So, the space station maintains its own atmosphere, and back in February, They were monitoring these cracks and the ISS was losing about 500 grams a day of its atmosphere out of these cracks, but now they are losing up to 1500 grams a day, which is about three pounds, if that makes any more sense to you.

Um, Which they're losing to space and no one knows why these cracks are happening or what's causing them It is becoming a priority now because they're going to have to either make more atmosphere or send more atmosphere there. Could it just be the age now of the ISS and all the stresses and strains?

It's probably that because the ISS wasn't a brand new thing that they just sent up there. It was actually several older space stations that they connected together and then added more modules on over time. So it is showing that it's probably going to have to be deorbited soon, but the plans for that are already underway.

Right. Now, I see we've got trash compactor for the ISS. So, do you remember a few months ago we were talking about the ISS? crashed into a house and it was, um, actually sort of part of the waste disposal, like this massive piece of metal didn't burn up in the atmosphere and crashed into a house in Florida.

Yes. Yeah. So what happens is they have these containers that they fill up with all their waste products. So they're doing experiments. So all the waste from that, um, if you imagine you eat a piece of food out of the space. food packet and you put the packaging in the rubbish and of course you've got all the human waste and things like that.

So that all goes in there and then they jettison it off and it should burn up in the atmosphere. Most of the time it does. So if you ever see what looks like a shooting star that comes out of the ISS, that is likely containing astronaut poop, which seems to amuse all the children I do outreach with, no end.

When you throw things in the bin, you've also got, like, the air and stuff around you in there as well, and also like water vapour that you're breathing out. And here, that kind of doesn't really matter. In the space station, where you're already leaking out bits of your atmosphere, and you recycle your water.

They are losing bits of atmosphere and water every time they do that. So having a compactor means that not only can it compress all the stuff down so they can get more waste in there when they just send it off, it means they can keep more atmosphere and more water rather than making it or transporting the chemicals to make it to the ISS.Good idea. Good idea. Well, that completes our look at space this month. Now for

Astrocast for December

1st	New moon
4th	Moon near Venus
7th	Jupiter opposition
8th	First quarter moon near saturn
13th	Moon near the Pleiades
14th	Moon near Juptier, Geminids
15th	Full moon
17th	Moon between Castor & Pollux
18th	Moon near Mars wth daytime occultation
21st	Winter Solstice
22nd	Last quarter moon, Ursids
25th	Mercury at elongation
28th	Moon near mMercury
30th	New moon
For optics users, Titan shadow transit on saturn 6th december, Ganymede shadow transit on Juptier 8th and 9th	
Venus and Uranus are evening planets.	
Mercury is a morning planet.	
Mars, Juptier, Saturn and Neptune are well placed most of the month.	

And let's go on now and look at events taking place in December.

Yep, so on the 4th of December, the University of Surrey has its Stargazing Night. On the 5th of December, Guilford Astronomical Society has 20 years of the Neil Gerald Swift Observatory.

So, time to main astronomy at its best by Dr. Paul Kuhn, who is a Senior Research Associate at the Department of Space and Climate Physics Faculty, um, at Mallard Space Science Laboratory, which is not that far from us. Um, At the 10th of December, Farnham Astronomical Society will have their AGM, which is for members only, plus how to use the SeaStar telescope, which is the one that I use, and on the 13th of December, Yule AGM, um, Yule Astronomical Society will have their AGM.

Right. Well, thank you, Rachel. And thank you so much for taking us through this month's Stars Over Surrey. And we look forward to being with you again next month. It's on the 31st of December at 8 o'clock. So a New Year's Eve. Looking forward to the following year. So wishing everyone clear skies because we haven't had any in November.

And that's all from us for this month, so it's goodbye from Graeme Leacock. And goodbye from me, Rachel Dutton. And that's Rachel Dutton, who's from the Guildford Astronomical Society and a Fellow of the Royal Astronomical Society.

Stars Over Surrey on Brooklands Radio. Join us on the last Tuesday of the month at 8pm for the monthly guide to astronomy and developments in space.

About

Rachel Dutton FRAS is an astronomer and cellist and she looks after outreach at the Guildford Astronomical Society. She presents Stars Over Surrey bringing a monthly review of space news, astronomical matters including a review of the past month's discoveries, events and space missions, Astrocast what to look for in the night sky over the coming month, forthcoming talks and events.

If you want a reminder of when the show is on, and links to the images discussed, you can sign up here for notifications from Rachel.

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