



Variety | Personality | Companionship

And welcome along to this month's Stars Over Surrey. I'm Graham Laycock and I'm joined by Rachel Dutton from the Guildford Astronomical Society and a fellow of the Royal Astronomical Society. Hello, Rachel. Hi Graham, how are you? Alright, thank you very much, and you? I'm good, and I've had some really weird studies to read over the new year, so I'm quite excited to get into them.

Let's Start with this asteroid hurtling towards us at great speed.

Yes. So asteroid 2024 Y4 was discovered and there was an announcement that went out in the beginning of January. And this is a short period asteroid. So it returns every 3.99 years. So we will see it again in 2028 and take more observations then. And with limited data that we have on it at the moment, we believe there is a small, tiny chance that it could have contact with the Earth.

Yes. It's been exciting the papers, this.

Yes. I say small. At first it was 1%. Then it was climbing up to 2%. Then it climbed up to 3%. And now it's back down to 1% again. So this is going to happen as we get more and more observations. As it circles back out, we will have less observing time.

The Hubble Space Telescope will be able to track it the further out it goes. And then in four years' time when it returns, then we can take more observations again. And try and nail down its orbit a bit more. And hopefully come up with a plan for 2032.

And is 2032 the crunch point?

Oh, Graham.

That's possibly the worst pun.

I think so, yes. That's the danger zone, is it? Would that do better?

Crunch point. So the projection at the moment is December 22nd. 2032. So let's talk about it a little bit more. They think it's somewhere between 30 and 90 meters. And if it does hit, it will be 7.8 megatons of TNT. And that initially does look pretty scary. So that's the equivalent of 500 of the little boy bombs dropped on Hiroshima. Two and a half, the grapple Y. Or 15.4% of the Tsar Bomber.

But due to its stony composition, it would be more likely to produce meteor airbursts than an impact crater or a tsunami if it hits the ocean. Now, this isn't a planet killer. But it would cause significant damage. So if it did hit the Earth, and bear in mind, even at its maximum percentage, 3%, that's 97%, that it wouldn't hit the Earth. I just want to say that. Yes. Even if it did hit the Earth, it would cause a problem if it hit a populated area like a city. But we could evacuate that city. If it hit the ocean, we might not really know much about it. And I say this because despite me comparing it to those well-known bombs, we have detonated bombs bigger than that on the Earth, in the ocean, and no one's really known about it or paid much attention.

Right. Okay.

So if it hits the water, we may not know about it other than deliberately tracking and detecting it. If we can't deflect it, and it does look like it's going to impact the Earth on a land site, it's going to be somewhere around the equator. There's a chance we can evacuate. But do you remember me talking to you about the DART mission last year where we went and nudged an asteroid? Yes.

Yes, that was going through my mind. We have been able to do it. Was that a similar size asteroid, though?

It's not so much the size. It's more the worrying about the technology. Right. So that took four years to create that mission and send it off. So theoretically, that could be done again within four years. But it's whether you would nudge it and whether that would nudge it enough. Because a little nudge can be enough to create a significant... ...difference in its trajectory, so it would completely miss the Earth. We might make it worse for ourselves in several hundred years' time, but I guess we could nudge it again.

Or, depending on the composition of it, it might be that if we nudge it, it starts breaking up. And that actually could cause more problems. Because you might have bits breaking up and descending through the atmosphere and turning into sort of fireballs. It might create... ...smaller meteors that are harder to work out their trajectories in time. So at the moment, we don't know much about it.

But we do know that we need more data. And even at its highest risk to us that we have so far, that 3%, that's still 97% chance that it won't hit us. Now, there is something called the Toreno scale. So... ...likelihood of collision, no. You're in the white zone. Then you've got the green zone. So a routine discovery in which a pass near the Earth is predicted that poses no unusual level of danger. Then you've got a close encounter. That's the yellow zone. And this is meriting the attention of astronomers.

Then you have a close encounter... ...posing a serious but uncertain threat of reoccurrence. Occasional devastation. And then you have the red zone, which is causing localized destruction, or a tsunami, and collision uncertain. So at the moment, we are going between the white zone and potentially entering the beginning of the orange zone. But that, as I speak right now, that risk has gone back down.

Right, okay. Well, it's good we've spotted this asteroid. Are there any others we've been looking at?

So we'll come on to the Bennu sample return in a minute. But I will just say, a lot of people question why we don't find these sooner. And they're dark. They're not reflective. Right. So we don't see them until they get really close. Right.

That's the reason then. Yeah. Yeah.

And now on to this Bennu sample return.

Right. So your favourite thing to say, the OSIRIS-REx mission. Returned a sample to the Earth. And then we can get it open. So they needed special tools to get it open because it was jammed closed. And there was about 122 grams of material.

And now some in-depth analysis has been found. So why do we care about what's on an asteroid? So we think that water could have been delivered to Earth by comets or asteroids. And that the chemistry needed for life was possibly delivered to Earth from comets or asteroids. And we want to know if there's chances of life elsewhere.

And also asteroids are a good record of what was going on in the early solar system and potentially give us clues as to whether we could find life or conditions to support life. Including us in other places. So the recent analysis by scientists at NASA's Goddard Space Center revealed molecules key to life on Earth, including all five nitrogen bases. And these are the molecules required for building DNA and RNA. And these findings support the theory that asteroids could have delivered the building blocks of life to Earth in the distant past. Now, included in that. We had the precursor molecules.

o these are the ingredients needed for organic synthesis, such as ammonia, formaldehyde and water. We have the salt and clay minerals, catalysts for synthesis and polymerization. So that's trona, magnesium, sodium phosphate, sodium chloride and saponite, also known as clay to us. Nucleo basis, which is genetic components of RNA. And DNA, such as purines and pyromidines. I can never say that word. And amino acids, building blocks of proteins. Now, we have 22 amino acids we're familiar with on Earth. And they found 14 of those in this sample, which is pretty exciting. And then we have two types of molecules. So you can have two molecules. So you can have two molecules that are identical to each other, but they're a mirror image.

Right.

And we call them, this is called geometric isomerism. And we have the L molecule and the D molecule. And there's a meme that goes around on Facebook regularly. And it's a picture, like a profile slide-on picture of Samuel L. Jackson. Then they flip it the other way around. And then you have Samuel D. Jackson. It's like a standard chemistry joke that you see on social media. Yes.

Now, we are used to seeing the one that we have on Earth. But this asteroid has a 50-50 split of these amino acids. So that means that chemistry for life on other planets or even other moons might be going the other way around. So it's actually pretty exciting. It means there's more possibilities out there.

How does all this material get on the asteroids?

That's a great question. We don't know. It could also be that interactions of some materials on that asteroid, say, for example, the solar wind, would create various different chemical reactions on the asteroid itself.

Right.

It could be that it's come into contact with other asteroids. It could be that some of these asteroids are different. It could be debris from planetary collisions in the early solar system. So there's lots of different things going on. But it's exciting. Yeah.

And now the Gaia mission has ended.

Yes. So I mentioned last month that this one is close to home because some of the scientists working on the data for Gaia are based locally near Dorking. So big shout out to MSSL.

Now, Gaia was an incredible mission. It launched. It launched in December 2013, and it finished up its science mission on the 15th of January this year. It lasted five years longer than we expected it to last.

And it had three instruments that allowed it to be really accurate. It had its astrometric instrument, which determines the positions of stars in the sky. And by measuring the same stars multiple times over different years, Gaia can measure a star's height. Position and proper motion accurately. It also has the radial velocity spectrometer, which measures the Doppler shift of a star's absorption lines. And this reveals the star's velocity along Gaia's line of sight. So like you have with a car going past, if you've ever been to a Formula One track day or a motor racing track day, you hear cars going by. You hear the sort of whining pitch going by. Going downwards. Yeah.

Yeah.

So light does something similar. It shifts to blue or shifts to red, depending whether it's coming towards us or going away from us. So that tells us where it's going in relation to Gaia's line of sight. And then it had the photometric instruments as well, which provided colour information of stars. Now, colour for stars gives us an idea of the star's temperature and its mass. So colour tells us a lot about stars. And all these work together to create the largest, most accurate map of the Milky Way ever.

Now, amongst its many achievements, it captured with pinpoint precision orbits of more than 150,000 asteroids, accurate enough to uncover possible moons. It also discovered a new type of black hole revealed only through its gravitational influence on nearby stars. And it's mapped the positions and velocities of stars with extreme precision by measuring about 1 million stars, sorry, 1 billion stars multiple times, and created this massive 3D map of the Milky Way that will be used for many, many years to come.

So I've mentioned before the various discoveries of asteroids and black holes in previous episodes. Where? They've gone into the data, seen that whilst looking for other things, and then gone back and looked for those things in the sky and found them.

Now, it also tentatively detected some planets. So that's a whole other treasure trove to dig into there. And it wasn't designed to be a planet finder, but it found some anyway. So on top of that, it survived a micrometeorite impact back in 2021. Which was the size of a grain of sand. And that punctured a hole in its protective cover, which started to allow a tiny bit of sunlight through into the spacecraft, disrupting its sensors even.

And in 2024, when we had those beautiful auroras in May, it got struck by a solar storm. And some of its electronics did malfunction a bit, which did create a load of false detections. But in all those cases, Gaia recovered. And continued normal operations. So she was out in the Lagrange Point L2, which you may have heard of if you follow the James Webb Space Telescope or the Euclid Space Telescope. They're all in that point. It is basically if you have the sun and the earth and you draw a line going through the earth away from the sun and come out the other side. It's this gravitational well on the other side of the earth. And that allows it to remain nice. And stable.

So what's happened since it finished its science mission? Well, it had about 15 days worth of fuel left. So they actually use that for engineering testing so that they can use some of that technology that was used on Gaia for other missions. So, for example, it's got the Mirrordrive electronics and cold gas thrusters that are used on Euclid. It's also a really clever telescope. It could. Collect more data than it could send back.

So it actually self-reviewed the data and only sent back the best quality data as well. And data release five is during 2025. And that's releasing just the first five years worth of data, which is 500 terabytes.

Wow. I can't imagine how big that is. It's big. Yeah.

I thought I worked with big data sets. Butt this is phenomenal. So once its testing is complete, Gaia will be placed in a heliocentric orbit away from the Earth's influence. And that will be happening in March. And it will be passivated to avoid any potential harm or disruption to other spacecraft.

So it will just carry on orbiting?

It will orbit the sun. Yeah.

Right. OK.

Yeah. So it's really sad. It's a very successful mission. It's done so much. For astronomers in general, the data is used for all sorts of different things. And sadly, she's come to the end of her life.

And now we move to the Bullseye Galaxy. I haven't heard of this one.



NASA, ESA, Imad Pasha (Yale), Pieter van Dokkum (Yale)

No, it's an interesting one.

But looking at your pictures, I can see why it's called the Bullseye Galaxy.

Yeah. So we'll put the pictures on the show notes. But the galaxy formerly known as LIDAR 1313424. In the constellation of Pisces, which is 567 million light years away from us, is what we're calling the Bullseye Galaxy now. So we have seen some galaxies with rings around them.

But mostly when we think of galaxies, we think of these beautiful spiral galaxies. There are other types of galaxies as well, such as ellipticals and dwarf galaxies. But spiral galaxies are the sort of iconic, the most iconic galaxies in the world. And these are the sort of Milky Way, Andromeda images that we're used to seeing. S

o we have seen galaxies with rings instead of spirals. Now we get spirals because we get pressure or density waves within the medium around the galaxy that forms around it. And the galaxy is spinning. And then eventually, as everything sort of coalesces into stars in the galaxy, you get these waves turning into... into denser regions, less dense regions, just like with sound waves.

Those create what we call the spiral arms. So galaxies we've seen with rings around them, most rings we've seen is two to three rings. This one had eight rings that were detected by Hubble. And then the Keck Observatory detected a ninth ring.

Wow.

Yeah, so it looks like this bullseye figure.

Yes, yes.

Also in the picture, that's not very clear, but it is there. What has caused this is a dwarf galaxy has literally traveled through the center of it, creating this gravitational disturbance, similar to if you drop a drop of water into a puddle of water or a pool of water, and you get those ripples coming out in circles around it.

So those density waves have gone from these swirling ones to... to these concentric circles coming out. And they think that this galaxy passed through about 15 million years ago, but they're still working that one out. So you can still see a thin trail of gas that links these two galaxies together, but it's a pretty exciting shape.

Indeed.

Let's move on now then to the most complete Einstein ring.

Yeah. So this is an experiment you can do. You can do it at home, Graham.

Oh, right.



ESA / Euclid / Euclid Consortium / NASA / J.-C. Cuillandre / G. Anselmi / T. Li. If you find a wine glass and find a responsible adult to drain it for you, and you get a candle or a light source and put it behind the wine glass, if you pick up the wine glass and you move the base in front of the candle,

you can get that light to go in a circle around the stem in that base.

All right. All right. That is... That is the best analogy you can do at home for gravitational lensing.

Right.

So what you have is you have a foreground galaxy that acts like the wine glass to amplify the background galaxy. And sometimes they've found these that have amplified things like supernova going off. So you see the supernova four

times. And sometimes they appear at different times in Earth times, so you can see two of the supernova images and go, I want to see the next one and observe that one. We get to a position where we can see it because it's all due to our relative positions. So normally we see these kind of blobs and it's usually, you know, two or four sort of smeared out blobs. But in this image, which will again be in the show notes on the replay page, you can see those blobs, but you can also see that they're actually connected. They're connected together in a ring.

Yes, I can. Yes. Looking at the image you have here. Yes. Yeah.

So in this one, the foreground object is galaxy NGC 6505. And that's the one that's warping light around it. And it's not a unique galaxy. It's just massive. And it's about 600 million light years away. And the background galaxy is not particularly special. It's 4.42 billion light years away. And it's never been seen before. So it doesn't have a name. We're only seeing it because of the way of the alignment between the Earth, the galaxy and the far away galaxy is enabling us to see it. And we're seeing it in this Einstein ring formation.

And now it's time for astronomy target of the month.

So Graham, we have two targets this month.

Oh, I say.

Two for one. Um, this is because we have two in March, right? So on the 14th of March, we have the full moon total lunar eclipse.

So if you had a blood moons, yes, I have.

This is where the Earth's atmosphere splits the light out like a prison does. And as the moon travels into the earth shadow, it passes into the red area of that prison. So it looks red. So always a beautiful sight. I'll be attempting to image it if we have a cloud free sky. And then on the 29th of March, we've got the new moon partial solar eclipse.

Um, so this is going to be where we have a tiny bit of the sun is covered up by the moon. It's not a spectacular in any way. Shape or form is a full solar eclipse, but I did see the

one a few years ago, um, from Newlands corner. And that was pretty exciting because you're essentially watching a ball of rock cover a ball of fire in real time. Um, so moving on from that is our tip of the month. And this is a safety tip for solar eclipse viewing.

Do not view it with your eyes directly. You need to be wearing either eclipse glasses. Make sure. They are ISO accredited. I think it's ISO 1, 2, 3, 1, 3 dash 2, but do look that up on the internet. If you are going to image it, you do need solar filters for your cameras as per all solar filters, make sure you test it and check it for scratches and holes first. Otherwise you will burn your sensor or potentially start a fire. Do not use regular telescopes.

You either need a specially modified telescope. Or. You can modify it yourself. If you know what you're doing, if you don't know what you're doing, come and join Guilford Astronomical Society and we'll teach you. Um, but again, you can set fires to things. You can cause damage to your eyes. If you look through a telescope that isn't properly converted. I've known people to, um, melt bits of the telescope as well. Unfortunately, other ways you can view solar eclipses, and this does work pretty well for partial eclipses.

Because you get this sort of crescent sun shape is using a pinhole cameras, colanders, and even disco balls and looking at the eclipse shapes reflect on the ground. Yeah, it's love the disco ball one because shiny eclipses on the ground. Yeah.

Brilliant. Brilliant. Right. Well, thank you for the tip of the month and that completes our astronomy section.

Space News and the Not So Stranded Astronauts

I know we're in a place where I kind of feel that we have to correct. Misinformation so recently, um, if anyone's been paying attention to the news in the US, there has been a lot of talk about, um, Trump demanding that Musk return the astronauts that are stranded now, and Musk replying, it shall be done and blaming the previous administration in not bringing them back.

So let's just recap the story so far back in the summer. Boeing Starliner did a test flight to the ISS with Sonny Williams and Butch Wilmore on board. They have various issues that they were trying their best to work out, but in the end decided it wasn't worth the risk of sending them back in the Starliner. So the alternative for returning them would be two of the astronauts due up in the next mission. And they were the ones that were supposed to stay on Earth. They would cover their roles and all the science missions that those two astronauts were supposed to do.

As it was planned to have this number of astronauts on board, there is still plenty of food and supplies and gases and everything for them to be able to breathe and eat. So that's not a problem. They're not stranded. They're perfectly happy and safe. They're well, and they're doing what astronauts want to do. They are in space. Now the plan was. That they would return in February as per the end of the mission.

However, SpaceX had a new Falcon 9 that hadn't finished going through its testing. So the next mission of crew to do the crew changeover was due to come up in February and relieve them of their duties. But due to this extra testing that they need to do on the new Falcon, it was pushed back. To March or possibly April. So it was SpaceX causing the further delay. Now they're talking about whether they can refurbish the older version

Falcon 9 to take that next crew up, which means that they can relieve Butch and Sonny and bring them back down within February.

But the plan all along has been for SpaceX to return them on Falcon 9 or the next generation Falcon, either in February or then March. And this hasn't changed. Now, there has been some back and forth on various social media platforms, and some people have said, well, it costs \$250 million to just do a quick trip up to retrieve two people. NASA would have had to have gone and asked for that funding in order to be able to do that because that was not part of their original budget.

Musk has hit back with the cost and the budget was never discussed. But there again, if you are on the inside of NASA, you're not going to be speaking to a supplier about budget necessarily. So I don't know necessarily what's happened with those conversations, but I can't imagine that a public organization is going to be too keen to ask for an extra \$250 million. So I think that one, possibly a bit of an awkward one. However, both the Astros. Astronauts have said that they're not stranded, they're safe, they're well, they are enjoying doing their jobs. They are doing what astronauts want to do, which is be in space.

Absolutely.

And I see Musk wants to de-orbit the ISS sooner than planned.

Yes. So the ISS has been an incredible success. It's been going for two decades. It's taken part in. Many science missions and created many opportunities across the world and within the space sector. The research that is done on it is very rounded. It's things from climate research to medicine research.

So making drugs in space more crystalline and that can make them more effective for certain things. Things like looking at how different viruses work in space, trying to grow food, trying to work out how astronauts react to different extreme conditions. So if we do want to go to the moon or to Mars or colonize on the planets, that research is going there. There's been Parkinson's research, cancer research, spinal cord research, all sorts of research going on there. But it is coming towards the end of its useful life. It is starting to get old and degrade. And the idea is. That it was supposed to start the deorbit process and SpaceX won the contract and this was supposed to happen in around 2029, maybe the early 2030s has been some back and forth on that.

So Musk said he wants to deal with it sooner and he was looking at 2026, so two years time as he thinks that we need to be focusing on Mars and not the moon. And then on top of that, NASA announced potentially a thousand job cuts. Then they had a stay of execution as they reversed that decision last minute. There have also been talks about whether the super heavy launch system, which is the NASA super heavy launch system, whether that will still go ahead or whether they'll just rely on third party suppliers such as SpaceX. And as I said, there may even be some risk to the Artemis program, as Musk wants to focus on Mars and not the moon. Again, we don't know. So there's a lot of uncertainty at the moment within the space industry, especially within the US.

And another thing been making the news, a bit of Falcon 9 landing in Poland.

So on the 1st of February, a Falcon 9 rocket launched from Vandenberg Space Force Base in California. And instead of burning up on re-entry and landing into the ocean, there was an engine failure. So it orbited the Earth for a while, giving Northern Europe a fireworks display to remember. On the 19th of February, and several large pieces landed in Poland and possibly even Ukraine.

One man found a charred tank in his garden, which was one meter by 1.5 meters. So a quite sizable piece of debris. But luckily, there's been no reports of any injury, which when you consider the size of that debris, and goodness knows the size of other pieces of debris, that's incredibly lucky.

Yeah, absolutely. Yes, really was.

Now I see Blue Origin's job cuts are on the way.

Yeah, this one's a bit of a shame because they had the successful launch of the new Glenn last month. And this month they announced an order to remain. First off, they are cutting 10% of the workforce, which is 1,400 jobs. So unfortunately, no one is immune to the job cuts.

No. Mind you, that is a big workforce then.

Yeah, 10,000, maybe even 14,000 employees. The numbers published have changed a bit, so I'm not sure their total number of their workforce.

And now Blue Ghost is set to land on the moon.

Yes. So I've been tracking this one. We didn't have enough time to talk about it in January. But Firefly's Blue Ghost Mission 1, named Ghost Riders in the Sky, launched from Pad 39A at NASA's Kennedy Space Center in Florida on the 15th of January this year. So the Blue Ghost mission will deliver 10 science and technology instruments to the lunar surface as part of NASA's Commercial Lunar Payload Services, or CLPS, initiative.

And upon launching in January, it will be spending approximately 45 days traveling to the moon, allowing ample time to conduct health checks on each subsystem and begin payload science. It's due to land in Mare Christian on the 2nd of March and operate payloads for a complete lunar day. So a lunar day is half a month, which is 14 Earth days.

And on the 14th of March, it will be a full lunar day. And on the 15th of March, Firefly expects to capture high-definition imagery of the total eclipse when the Earth blocks the sun above the moon's horizon. And then Blue Ghost will capture the lunar sunset on March 16th, providing data on how lunar dust levitates due to solar influences.

And this is really important for colonizing the moon or having any kind of base on the moon because lunar dust, or regolith, is sharp dust. It has lots of sharp edges. Because there's no weathering on the moon at all. And it can also create a lunar horizon glow, which was first documented by Eugene Kiernan on Apollo 17. And then following sunset,

it will operate several hours into the lunar night. And I don't know if you recall us speaking about this before, but lunar night is a big deal. And if you can get anything to survive lunar night, which is minus 120 degrees Celsius, then you're good to go. You're doing pretty well in terms of your engineering.

And now we go on to Artemis 2, booster stacked.

Right, so we had Artemis 1, which went to the moon, around the moon, and back again with no humans on board. The next stage, depending on current situations, is Artemis 2. And they're going to continue going until they are told to do otherwise by the current administration. So, this one...

This flight will send four astronauts on a trajectory similar to Apollo 8's historic lunar journey, with the crew travelling around the moon in an Orion capsule before returning back to Earth. And a crucial milestone in the mission preparations was reached when the technicians completed the assembly of the Space Launch System's twin rocket boosters inside the Vehicle Assembly Building.

So, the stacking process started in late... ...November 2024 and concluded on February the 19th. So, this is a big deal in terms of the progress going forwards. They had a large crane inside that helped with the stacking. And these boosters will form part of the most powerful rocket ever built by NASA. And that's more powerful even than the Saturn V that took Apollo astronauts to the moon. And when ignited, these twin rockets will jump off the moon, and they will be able to fly to the moon. And they will generate millions of pounds of thrust, working together with the SLS core stage to lift the Orion spacecraft and its four-person crew towards the moon, assuming that the SLS isn't scrapped at this point.

My goodness me, going to be quite a sight at launch, I would think.

It will. I'm quite excited for it, assuming it goes ahead.

Yes, it'll be over 50 years since man's gotten as near as this to the moon.

Yes.

Why have we had such a big gap? I wonder.

Funding, not enough want to do it. Yeah.

And now we go to Lunar Gateway's Halo module progress.

Yes, so the Lunar Gateway's Halo module is part of the next generation space station and Artemis IV. So the plan is that replacing the ISS is going to be a new mission. So nondirect replacement. Instead, we're going to have the Lunar Gateway, which will be a space station roughly a fifth of the size and volume of the ISS. And it will not be permanently crewed. And it will be going around the moon in a halo orbit, a near-rectolinear halo orbit. I can never say this one, Graham.

Well done.

NRHO Gateway. Ah. And it will host temporary expeditions. So it will spend a lot of its time vacant, but not doing anything. There will be experiments and other things going on autonomously. So whilst it's empty, there will be experiments going on and we will be testing autonomous operations so we can prepare for even longer duration missions, such as potentially to Mars.

And this is a crucial next step in that journey, because, even just between the Earth and the Moon, we have a one-and-a-half-second delay. So even in that event, we can still chat and have a reasonable conversation. You can have small talk. And you can send commands with a small lag but pretty much almost in real-time.

So if there's an emergency or something you have to react quickly, then you can send commands. you can still do that. Going to Mars, the delay is much more significant. Each message has to be super succinct and clear. You wouldn't be able to have a lot of back and forth. You certainly wouldn't have the small talk of, hi, how's your day going, before you start talking to someone. Because by the time that message gets to them, you know, a significant chunk of time has already elapsed.

So this is the next step in that process. And the plan is that Artemis 4 will be going out to the Lunar Gateway. So this is particularly exciting. The idea of this NRHO orbit is if you're too close to the Moon, yes, you can do experiments on the Moon's surface. But it's really hard to maintain that orbit. It requires a lot of fuel. If you're too far away, then you've got a more stable orbit that doesn't require much to keep it going.

But you can't easily get to and from the Moon. So the first part of this that is nearly ready is this HALO module. And this is being built in Italy by Thales Linear Aerospace Engineers. And HALO stands for Habitation Logistics Outpost. And this is incredibly important. And it's going to be built in Italy by Thales Linear Aerospace Engineers. A core module.

So it's currently at the company's Turin facility. But the module is set to head to the U.S. to the contractor Northrop Grumman Gilbert, Arizona site. So that will be on board an Antonov AN-124-100 aircraft. And it's made up of four pressurized modules. HALO will support the crew.

It will support experiments. And also internal and external payloads. And the whole idea of this is that you have the staging point. And that you have these reusable command modules going up and down between the station and the Moon. So it's really exciting that it's going off to Arizona for testing. And then hopefully we will start getting the different components of the next space station being built one at a time. And if you're curious, ESA is in on this. So they're designing the Lunar Link, which is going to be part of the larger Lunar Net DTN Framework Initiative. And Canada, famous for its arm on the International Space Station,

is also supplying the robotic arm for this one. Jolly good. Exciting stuff.

EVENTS

6th March	Guildford - Grant Bowskill - what's new in astronomical equipment
11th March	Farnham - The World of Radio Astronomy and Radio Telescopes – Andrew Spencer (FAS)

	Radio telescopes capture radio waves from a wide variety of sources across the Universe, in some cases from much further away than any optical telescope. Andrew explains how radio astronomy provides fundamental insights into how the Universe works.
14th March	Ewell - Prof. Sarah Matthews UCL
19th March	University of Surrey Stargazing Evening

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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