Hypotenthuse Ep 7 - Louise Harra

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SPEAKERS

Sophie Lane, Laura Hewison, Louise Harra

L **Laura Hewison** 00:05

Hello and welcome to Hypot-enthuse a podcast all about science, maths and the world around us from the Maths and Physical Sciences faculty at UCL, or as we like to call it MAPS. I'm your host Laura Hewison, and I am completely unqualified to be here, but very enthusiastic. With me as always, for MAPS is my excellent co host, the much more qualified Sophie Lane. And today we are joined by our very qualified guest Louise Hara, professor of physics at UCL's Mullard Space Science Laboratory. Thank you for being here. I nearly didn't say that right.

L **Louise Harra** 00:42

It's very nice to be here. Thank you for inviting me.

L **Laura Hewison** 00:45

So, Louise, could you start by telling us a little bit about your areas of research? What are you an expert in?

L **Louise Harra** 00:52

Okay, so I studied the sun. So I'm very lucky. And I get to study the brightest object in the sky. And we study it because it has an impact on everything we do. The fact that we exist

is because of the sun. And it affects the world around us, our technical world, the way we interact through spacecraft or way we communicate all those kinds of things, some complex.

S Sophie Lane 01:16
That's really interesting. And how did you like what sort of drew you to the sun as a research area? How did you end up specializing in that

L Louise Harra 01:24
I could say something flippant, I grew up in Ireland, and I didn't see it very often. I was actually I was just very interested in space for my child. And then had an opportunity as I went through university to get involved in space science. And that was what I ended up in solar physics, it could have been something else. But I ended up in solar physics, which is a nice place to end up in

L Laura Hewison 01:47
what's in what's involved in solar physics, like what, what is the actual kind of essence of what you were doing every day.

L Louise Harra 01:55
So the sun is huge ball of gas, and it's a magnetic star. So it involves different aspects. So an aspect is theoretical aspects. So understanding how the magnetic fields interact with the plasma. The other aspects are the observational aspects. So you can observe the sun right across the whole electromagnetic spectrum, you pick a wave, and you're able to see the sun in it. So being able to develop techniques to observe the different parts of the sun, in different ways at different times at different locations, and then developing the space instrumentation to do that, which is what we do much besides that.

S Sophie Lane 02:33
How does that kind of vary from I guess, I don't know if it's called stellar physics. But just because I mean, all kinds of people are studying stars near and far, isn't much more in depth with the sun or the same kind of rules apply to both.

Louise Harra 02:47

It's more in depth than that you've got you can especially resolve it. So you can actually see really high resolution detail. So you can't see that in other stars yet, something you will be able to. But there's a lot of crossover as to Wistar as you can see, basically the sun all stages of its life. Whereas the sun, we've got it at one point in time. But we can observe the dynamics, the activity, we can observe the solar cycle, we can observe really fine scale structures that are more dynamic and will heat up plasma. And we can observe the huge eruptions that occur that can affect the Earth's environment. So we can observe those things that are really challenging to do and stars, but we know they impact exoplanets.

Laura Hewison 03:28

So those eruptions that you're talking about, how do they affect the earth? Because we don't well me as a person who does is like Oh, yes, nice tan on the beach. That's about my kind of the further is that I go for its sun worshipping. How does the eruptions that happen affect what's going on in my life?

Louise Harra 03:50

So in your life as well, obviously, you can get a nice suntan. I'm very pale. Me too. So the way it would affect your day to day life is we are completely reliant on spacecraft these days. So although you may not confess to it, you're a spacecraft user. Excellent.

Laura Hewison 04:12

I've got a TARDIS out the back Actually, it's today.

Louise Harra 04:16

So using your debit cards, using your phone, watching the TV using aircraft like me to be if you're on ship, all those kinds of things, drilling for oil, all those kinds of things. We'll be using spacecraft.

Sophie Lane 04:30

I'm going to put in my Instagram bio that I'm a spacecraft user, where you are.

Laura Hewison 04:36

So how, how will an eruption affect that is it kind of because of magnetic pushes and poles or is it just like there is a giant jet of solar stuff out there in space and the aircrafts have to go around them?

L Louise Harra 04:50

It will affect in the future. Pick the example of aircraft it will affect it because of communication. So with aircraft obviously they have to be able to communicate at all times where they are That's really important for safety. And if they're flying over the poles, which more and more airlines do to save fuel, that's the region that's most most at risk on the earth of being disrupted by an eruption. So at the polar regions, you get more likely to see Aurora. So the northern Southern lights, and that's the region where if planes go over during a large eruption, that's when you'll you'll get disruption to the radio emission. And that means they can't communicate. So if you get a disruption in that, and they can't communicate, they have to divert. So they'll get a warning that just store from the sun has occurred, and then they'll have to divert, and that costs the airlines money. And that takes your journey, but longer

S Sophie Lane 05:46

term, I'm sitting in his room waiting for my plane to depart. Borealis Exactly. So is this these eruptions? Is that what you call that with that space weather? Is that yeah, that's one part of space weather. So whenever I like talking about space weather, because it makes me like, it feels really cool. Like it's the weather in space. And what like what are the other kinds.

L Louise Harra 06:07

So space weather is anything that comes from space, so so that can be cosmic rays. So they come from outside the solar system, it can be anything else from the sun, so as well as the coronal mass ejections that were spoken about, you also get solar flares. And they, they will emit highly energetic particles and allow us to heat up the Earth's atmosphere quite quickly. So you'll get that response as well. The which can affect spacecraft, they can deorbit early due to that, for example. So the space station is they always watch the orbit, and they'll keep upping the orbit on it to make sure it doesn't do orbit. You don't want that when you've got people on board. So that's a very sort of real human impact of space weather and that, and then you get steady structures on the sun that will be there for a long time. And they'll produce what's called a fast wind, which for us is hard to comprehend, it's 800 kilometers per second roughly, so very, very fast when the heads towards us, and that will be a steady wind, and that can have effects on spacecraft as

well. And the electronics, any sensitive electronics, you bombard it with high speed solar wind, that kind of capacity to be affected. See, I always kind of thought

S Sophie Lane 07:24
this is probably somehow meant to, you know, have a physics degree and remember things but I always thought that spacecraft because there was there's just not a lot of stuff in space compared to here that they could just sort of carry on as they are without much interruption like is this because they're so close to us, or is it is space such is the fact that space, the vacuum is that sort of space is true,

L Louise Harra 07:44
this is a vacuum, but you still have part of the sun in it, if you like and that can even be felt right at the edge of the solar system. So the Voyager spacecraft that were launched in the 70s are just one of them is already headed out of the solar system, the other ones just about to head out of the solar system, they can still sense the solar wind. So you've still got it's very low density, it's very low. It's such that you wouldn't be able to feel it. But it's still there. And the difficult thing is the particles are charged. So if you've got charged particles near electronics, that's where the danger comes in.

L Laura Hewison 08:22
So how often are we looking at, say a big solar weather event or a big eruption? Is it kind of every week, every couple of weeks?

L Louise Harra 08:31
It varies with time. So there is something called the solar cycle, which varies over an 11 year period. And the peak period is during the peak of that. But even when we're at a period now where the sun's relatively quiet, I was about to ask what what what's he been up to lately. But even with that, we've had some cracking Aurora have appeared in the past week. So when when you see an aurora, you know that the sun is dancing somewhere another?

S Sophie Lane 09:02
Are there any, like space weather events that we should be like, worried about? Like, are there some things where you know, like, you know, like a space hurricane? Like, it's such a stupid question.

L

Louise Harra 09:17

I like the name of that. And it's actually not such a silly description, because a hurricane is very fast winds. And that's what we essentially get from the sun. So there have been studies looking into what the worst storm is that we could get and the economic impact it would have across the world. So there was a big storm in the 1800s that during that period, we weren't so technically advanced, so it didn't have such a huge impact. So people have tried to look at what the impact would have on current day and occurred it could affect electrical grids, so electricity power cuts could happen. Airplanes could be grounded potentially. You could have impacted In the communication at all levels, all those things not being able to use your debit card anymore. All those kind of things, suddenly, countries start to grind to a halt. Because we're so used to having that global infrastructure, even transporting our groceries from A to B, and all that kind of thing. We're all using spacecraft all the time. Do you mean I wouldn't be able to order my packages on Amazon? It would be a major crisis. How do

L

Laura Hewison 10:25

we how do we predict that? How can we definitively say, oh, that will happen? September 2013, based forecasting? No,

S

Sophie Lane 10:35

we will do space weather forecasting is a thing,

L

Laura Hewison 10:38

can I become a space weather forecasting? Girl,

L

Louise Harra 10:40

I'm sure you. And I think that probably will be a thing today. But it's actually actually is a real thing. So the Met Office in the UK has a space weather section, this is my new job.

S

Sophie Lane 10:56

I'm going back to retrain, I want those business cards. I thought you wanted spacecraft user.

L Louise Harra 11:06

So they do have a section on space weather. And the reason for that is because industry is dependent on understanding space weather and then responding to it. So if you know something's happening in advance, you can do certain things to respond. So you can adjust things, the loads and electricity grid to help it protect itself for when this big rush comes in.

L Laura Hewison 11:26

That was a great fact that I learned when they when they do that. Because I just imagined that electricity existed, you know, it was just there, I turned a tap on stuff was warm. And then I learned that they have to like feed it in and out. And they have to moderate it to the television breaks during large broadcasts. Yeah. And once they got it completely wrong, because there was an unscheduled break in the in the Royal Wedding once and everybody went to make a cup of tea and it nearly crashed the UK electricity grid is one of my favorite facts.

L Louise Harra 11:58

Well, it could be even worse than this big space weather event that we will get eventually.

S Sophie Lane 12:02

So how to how does mean, as I say, we know how weather forecasting works. I don't personally know very well how weather forecast. But how, how do you predict what the sun is going to do? Like? Because it doesn't mean it's not seasonal? It's not? You know? How do you how do you? How do you start

L Louise Harra 12:22

in the same way that we do in the earth really, because if you maybe look back 50 years ago for Earth weather forecasting, if we want to call it that we're probably in the same position, I was best weather forecasting, and we were 50 years ago. So we have got a fleet of spacecraft that observe the sun. And we are getting in closer at the minute as well. And people are actively processing that data. And you can see, you know, when you look at the sun, you can see something nasty building up. So you can you can see that thought you weren't supposed to look at the sun, shielding my eyes for me. So look at the sun directly. Look at our website to see images from the spacecraft, clearing that up. So you can get some good knowledge. To give you some prediction in terms of saying on Friday, this week, there will be a storm at 20 to 31. we're nowhere near that accuracy yet. But we

can give a probability that an event will occur. But then the additional problem is whether it'll have a big impact on us because we are so tiny compared to the sun. That that's that's another difficulty in predicting that.

L Laura Hewison 13:38
I wanted to kind of ask, actually, you know, we have this very symbiotic relationship with the sun that gives us life. But it is just one star out of millions and billions and trillions out there in the universe. Is it particularly special if we kind of just got really lucky here and just like next to the best star in the entire universe? Or are we just our favorite? Or Or have we just kind of you know, happened upon one that's just very normal, but it happens to do what it does for the earth. It's actually quite a dull star in the grand scheme of things. So we like it.

L Louise Harra 14:17
We like it. And it is a very beautiful thing. But it's a middle aged star that's kind of not too active, not too quiet. It's sort of in the middle

L Laura Hewison 14:28
like taking long walks on the weekend and having a nice pub lunch on Sunday.

L Louise Harra 14:32
So it's not you get other stars where they might have blaring in coronal mass ejections from it would make life very hard to exist on its planet. So yeah,

S Sophie Lane 14:41
I was gonna say is that why we exist? Because it's like, like we thinking, Oh, that's that we have a boring son. But if if we had a really we had a really interesting we had a teenage son that wasjust like super erratic, raging on the weekends and then like sleeping in till midday every, every day. So good.

L Louise Harra 15:00
But I think it's partly our location to is the main thing that we're not. When if we were Mercury's distance, right, it would be very challenging so that that's where we're sending

our spacecraft. And that's not somewhere I would want to be. We send a spacecraft. But you can survive there.

S Sophie Lane 15:18
Yeah, so the we send spacecraft close to the sun to understand space weather. But how do we build spacecraft that can survive space weather without knowing what it is?

L Louise Harra 15:29
Okay, so the main problem with being close to the sun is the heat. So that's the main issue with it. Because no matter where you are in the solar system, you'll still get space weather. But the closer you are to the sun, you're going to get the temperatures increasing?

L Laura Hewison 15:45
I would say I wouldn't I would. That would make sense. Yes, I wouldn't imagine us getting a lot colder.

L Louise Harra 15:51
No. So getting close, the biggest problem is with the electronics. So we've got delicate electronics that everybody's got a nice smartphone these days, if you've put one out in the sun, like my mother did, when she visited me, she put her phone out in the bright sunshine, one of her very hot days of summer. And the phone, just switch yourself off and go do hot, can't do anything. And that was just 35 degrees. And this is when we're getting temperatures over 500 degrees. So it's like sticking it in an oven and putting it up for work and leaving it there for four years and expecting it to work. During that time, it just won't work. So we had to develop a heat shield. So that was developed. And it's like a big protection in front of the spacecraft that faces the spacecraft. And it takes the heat for all the instruments, which is very good if it so that the front of the heat shield will be around 500 degrees centigrade. So it'll be hot, hot, hot. And then behind it will be at a balmy kind of 2530 for our instruments. So there'll be quite comfortable behind the clouds. Amazing, very pleasant. So this this spacecraft that you're speaking about, is this the one that you have been working on. It is Yeah, so this is the European Space Agency. So Orbiter Mission that will be launched in hopefully February 2020.

L Laura Hewison 17:20
Can you tell it can you tell us a little bit more about it and the project and what it's trying

to do and what you specifically did, because this is fascinating. Okay, so

L Louise Harra 17:28

this project has been going on for quite a while. And one of the reasons to be going on for quite a while, it's because of the heat shield to get that right. So the spacecraft has been built just a bit north of us and Stevenage by Airbus, defence and space UK. So people don't think a lot comes out of North London, but this spacecraft that will be blasting to the sun will be. And then on board, there are a suite of instruments on board and half of them will be seeing the sun and half of them will be touching the sun. They're actually going to touch it. Anything that flows past the spacecraft, the instruments be touching, measuring all different kinds of things from those past now

L Laura Hewison 18:08

I'm just imagining a spacecraft

L Louise Harra 18:12

sticking out, okay, because it does actually have a boom sticking out. So with instruments on the boom.

L Laura Hewison 18:19

And so what does the actual spacecraft look like? How big is it? Is it kind of, you know, is it a massive thing? Or is it smaller than we would think it's about three meters high.

L Louise Harra 18:31

Maybe a bit taller than that. So it is taller than us. And it's heavier than us together? So yeah, so it's quite a big beast. And it's currently being going through its final testing in Germany. No, we shake it, we heat it and make sure everything works under the shaking and heating.

S Sophie Lane 18:51

How long is it going? Is it going to come back?

L Louise Harra 18:54
It will be then shipped to Cape Canaveral will be launched from there. Like when it's launched?

S Sophie Lane 18:59
Is it gone? Bye bye forever is not one of the ones that lands No, no. No. Is that sort of quite sad?

L Laura Hewison 19:07
I kind of bonded with any inanimate objects. So

L Louise Harra 19:11
I'm kind of gonna miss it. Yeah, if you given it a name, well, we just call it saw putter but we did have a kind of farewell Airbus to the spacecraft before into Germany and that was a bit sad going to spacecraft.

S Sophie Lane 19:27
That's an exciting I can't imagine having made something that's going to go into space and like touch things that are gonna go into space. Is it really cool?

L Louise Harra 19:34
It's cool. Did you put something on it? That was like, you know, like a little he says hi, yeah, I did, I wouldn't be allowed to tell you.

L Laura Hewison 19:44
And so what was what was your specific role in that? What was your kind of part of this wonderful co project.

L Louise Harra 19:51
So our instrument work with the images. And so that's three telescopes looking in different temperatures and all So looking at different fields of view, so one will observe the whole sun, and the other two will focus in and the high resolution stuff.

Laura Hewison 20:07
Great. And what will they be used to kind of discern from now on.

Louise Harra 20:13
So it will be the first time will be a place the sun, and we've never been able to image the sunlight close before. So we need to be able to see the sun in order to know what's coming past us. And so that will be our visual if you like. And the other really neat thing about this mission is will you use phenos to get energy for phenos to go to the ecliptic. So normally will be spacecraft will be sitting in the ecliptic plane, but we want to knock out of the ecliptic to look down at the poles. And we have never seen a deposit like so clever. Yeah, so that will be the first ever sight of the solar poles.

Laura Hewison 20:54
What do you think they look like? Do you think they'll look radically different?

Louise Harra 20:58
I think they might do because I think they they drive the whole activity cycle of the sun. And that's the key thing that we don't have. And it's like exploring a completely new regime. We haven't seen it before. So we always expect to be surprised. That's amazing. Very exciting. So how does that work with Venus? Is it like kind of? It's like a slingshot. Yeah.

Laura Hewison 21:23
That's cool. Um, so there's it's the solar orbiter? Or the solo button or the solar orbiter? So the solar orbiter? It's not the only one going up there right now. Correct. There's this other cheeky little one called the Parker Solar Probe. How do we feel about him? Are we there? Are you guys are working together? Or is it like one big scientist race, so you're kind of like, I'm imagining it like Wacky Races, but going to the sun and you're trying to like whack each other out of orbit.

Louise Harra 21:59
That's definitely not what we actually work very well together. I mean, Parker Solar Probe as a was launched in August, and probably a lot of you saw that Divi It was very nice launch. And it's a smaller spacecraft. And the reason why it's smaller is because they want

to get as close to the sun, then we will, but they can't see it. So because they're going in much closer, they have no ability to observe directly because I don't look to some directly. So we don't look don't touch thing and that doing a touch, don't look thing, we're not touching as well. Both

L Laura Hewison 22:36
are doing by remember, remember the hand ship. And

S Sophie Lane 22:40
how close it How close is close.

L Louise Harra 22:42
So for them, they will get in, if you think about the distance between the Sun and the Earth, they'll get in 4% to the sun, whereas we'll get about 25%. So they'll get much closer. And just tomorrow, they'll start their very first perihelion, which is one of their first closest points. And we're currently with the spacecraft that we also work on. at UCL, the hanadi spacecraft we're working with them to point to see so that we can see for them to see where possibly the wind is coming from that they're measuring. So we've been having lots of fun trying to work out where their sources of the wind might be to point in the right place.

S Sophie Lane 23:28
So the crane is that, that that's what we're going up to look at.

L Louise Harra 23:31
So the krona in the sun is the other atmosphere of the sun. So in some senses, we're actually already sitting in the corner of the earth, so it extends far away. But it's the bizarre part of the solar atmosphere where as you go away from the surface of the sun, and you move away from the surface of the sun, the temperature starts to go up, rather than go down. So it's like walking away from an oven or campfire and getting hotter as you go away. Why does that do that? That's a fine question. So that's one of the questions that we want to answer. So it is because of the magnetic field The sun has this magnetic field and we get energy out of that through different ways. So it is because of that but the exact reasons why are highly debated.

Laura Hewison 24:17
Excellent. And and I saw that one of your areas of expertise is coronal mass ejections. Correct. Is that like a solar flare? Or is it something slightly different

Louise Harra 24:31
coronal mass ejection, there are the eruptions that we're talking about earlier. It's just a longer name description of them. So it's anything that is released from the sun mass released from the sun, suddenly, including a solar flare. Solar Flare is a release of electromagnetic energy. So it's a bright flash if you like. So it's more related to the electronic magnetic energy whereas a coronal mass ejection is the mass. Oh, excellent.

Laura Hewison 24:58
That was and that's that's my takeaway from So

Sophie Lane 25:00
what else is being built at the malad space science laboratory that's related to this.

Louise Harra 25:06
So another instruments being built, there is a solar wind analyzer, which Chris Hogan is pi off. And that will be one of the instrument that touches the sun. And in fact, you can see a model offered in the Science Museum at the minute in their mission.

Laura Hewison 25:24
That's so exciting. Have you had a bit to do with the, with that particular analyzer and

Louise Harra 25:30
not me, but we're, what we're doing noise, the two groups, so the solar wind analyzers in the space plasma group, and I'm in a solar physics group, where it's starting to combine the science together to lead up to using both our instruments together once they're there,

Laura Hewison 25:47
and then you will start the solar and space weather forecasting channel. And you'll be

presented. Thank you. I like that. Well, there's one question that we always ask our guests on Hypot-enthuse. And that is, who is your science hero? And that is because quite often, people have somebody that inspires them to get into this area, and we would like to hear about yours.

L Louise Harra 26:15

Okay, so there are a number of people that I over the years have, I guess, I've looked to as mentors, the one person that has consistently inspired me as somebody from my hometown, which is a small place in Northern Ireland, and not much comes from there.

L Laura Hewison 26:35

Would you like to name check it?

L Louise Harra 26:36

Yes, American country. And its Jocelyn Bell Brunel who discovered pulsars in the 60s, and should have possibly been given a Nobel Prize for it. But during her whole career, she has been an excellent leader in physics. And she's always been very generous with her time to early career people and has been enthusiastic and encouraging people from all parts of communities to go into physics. So she would be my personal site.

L Laura Hewison 27:11

And what an excellent person at that. Thank you so much for joining us to listen to Hypot-enthuse. And we'll see you next time for some more MAPS chat.