Hypot-enthuse Professor Helen Wilson on Ada Lovelace Day

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SPEAKERS

Prof Helen Wilson, Sophie Lane, Laura Hewison

L Laura Hewison 00:03

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, I press the buttons. But I'm very enthusiastic with me as always from maps is my excellent co host, the much more qualified Sophie Lane. And our guest today is extremely qualified to be here she is the head of mathematics at UCL Professor Helen Wilson, thank you for being here today.

P Prof Helen Wilson 00:38

You're very welcome.

L Laura Hewison 00:40

So, Sophie, I suppose as the person in the room who has more expertise in the area than I do, did you want to talk to Helen a little bit about her areas of research and focus?

S Sophie Lane 00:53

Yeah, I just want to hear about what your main area of research is, and how you kind of got into it.

P **Prof Helen Wilson** 01:00
So my main area of research is complex fluids. So I study the kind of fluids that don't fit in to the standard model. So we can model air, water, and many other fluids using one set of equations, a single set that scales for a load of different systems. Those are called Newtonian fluids. And I basically study everything else, which ranges from a whole different range of foodstuffs, to pharmaceutical products, lots of biological materials, and also industrial things such as mould, mould, plastics, that kind of thing.

L **Laura Hewison** 01:34
So you're like the rebels?

P **Prof Helen Wilson** 01:35
Absolutely.

L **Laura Hewison** 01:36
The stuff that doesn't make sense.

P **Prof Helen Wilson** 01:37
We're not touching the stuff that's just too easy, we want the stuff that squidges.

S **Sophie Lane** 01:41
How do you like find them? Do you just kind of look at it and go like, that seems to be doing something super weird.

P **Prof Helen Wilson** 01:47
To be honest, as a mathematician, I look at the equations that emerge from them, rather than looking for the new material. So most of that stuff happened before I came on the scene. So people have been studying things like pastes for probably centuries, I imagine. But the equations to study them have only come about relatively recently.

L Laura Hewison 02:05
Is there an equation to study quince paste, for example?

P Prof Helen Wilson 02:09
There is no single equation that works for all of these complex fluids, there probably is an equation for quince paste, whether it's the same one as for toothpaste, I don't know.

L Laura Hewison 02:17
That's really interesting.

S Sophie Lane 02:19
That was gonna be my next question. Are there any fluids that have com-, that have like a common equation, that you wouldn't expect?

P Prof Helen Wilson 02:27
Nothing quite as simple as the water and air thing. But there are lots of what's called viscoelastic fluids. So these will be things that have a memory, they have a molecule in them that can be stretched by the flow. And then they can basically remember that they've been through that stretching flow and suddenly release the stored elastic energy at a later stage when you're not expecting it. And shampoo and tomato soup fit into that category, and you wouldn't think they'd be the same. And many other things with polymers in behave the same. There's also a lot of similarity between different pastes. But that you probably would have expected

L Laura Hewison 03:05
I Well, I know that I definitely expected that (laughs). Do you have a favourite non Newtonian fluid, then that just kind of it- when you think about that one you're like, oh, yeah, that's, that's the fluid for me?

P Prof Helen Wilson 03:22
It's got to be something really bouncy. So molten mozzarella, or some other polymeric material. Those are the ones that really do it. Well, so mozzarella, once you've cooked, it becomes very stringy, and it will stretch, but it'll pull back a little bit. But actually, if you

just tip it, it will flow. And so it's borderline whether it's liquid or solid. And that's a common feature across quite a lot of the complex fluids that actually it's really borderline whether they are fluids.

L Laura Hewison 03:31
So molten mozzarella. So that's not, well, you see, it's not really a liquid.

S Sophie Lane 03:56
Yeah, something I feel like I feel like I've seen a lot of molten mozzarella in my life and it's never actually occurred to me that it's behaving as non and as a liquid.

L Laura Hewison 04:05
I've seen a lot of molten mozzarella that I've just decided to leave in a pan for days on end. So now I know that that's probably because I didn't fully understand the science behind it.

P Prof Helen Wilson 04:16
If you say so

S Sophie Lane 04:17
That really when you go to a restaurant, do you kind of look at everything on your plate and you're like, what's, how's that one different to that one.

P Prof Helen Wilson 04:24
I went to a conference last week and we had all sorts of radiologically interesting things on the menu from foam to gel to... pannacotta is beautiful in that it's not flowing, if it's done right. But a very, very small change in the cooking will make it into a full on liquid that does not hold it shape.

S Sophie Lane 04:43
See, I knew academia was like this. You all say you're going off to conferences and we will think oh, wow, they're going to do some really like hard hitting really like tough academic work. And then really, you're just like poking at pannacotta

P Prof Helen Wilson 04:53
You've got to eat as well!

L Laura Hewison 04:54
I do know, Helen that you've looked at with some of your PhD students the science of chocolate fountains

P Prof Helen Wilson 05:01
True. That's true, we did have a project on the chocolate fountain. Now chocolate is not actually a very non Newtonian fluid, you can almost get away with modelling it the same as water, or honey. But nonetheless, it was really interesting project to do. We studied how the chocolate goes up the pipe in the middle how it goes along the dome as it's slowly descending, and then the falling sheet, which is the bit you dip your strawberries into. The key things we discovered was were that on the dome, you can do some really beautiful mathematics, and absolutely use the same equations and get the same results as you do for lava flow down a volcano. That was pretty cool. It's cool. And the falling sheet. If you look at them, they fall inwards, which is quite surprising. That's not a non Newtonian effect at all. There's a water Bell thing in the entrance lobby of the British Library that does exactly the same thing with water. It falls inwards because of surface tension.

L Laura Hewison 05:57
So did you expect that going in or were you...?

P Prof Helen Wilson 06:01
I had an inkling, but I'd asked around colleagues as to why they thought it went inwards because the first time I saw it, I had no idea. And lots of people had different ideas. So we we were looking for that.

L Laura Hewison 06:12
I really do, I just have this mental image of you and some PhD students toting a chocolate fountain through the halls of UCL going "Oi, come have a look at this!"

S Sophie Lane 06:21
"Why's it doing that?"

L Laura Hewison 06:22
"Bring the strawberries"

S Sophie Lane 06:23
Because is that like where that project came from? Is that you looked at a chocolate fountain, like on earth is going on that?

P Prof Helen Wilson 06:28
Absolutely. I went to a wedding fair, because I was planning on getting married. And there was a chocolate fountain and I made them turn it off and on again, off and on again. So I could see how this thing started. And I couldn't work out what was going on. And then eventually I made it into a project and my project students worked it out.

L Laura Hewison 06:42
But I'd love to talk about chocolate fountains all day. But the reason we have you on for this special episode today, Helen. And apart from the fact that you're incredibly accomplished, um is we're also celebrating Ada Lovelace day. So I suppose Do you know a lot about Ada? Did you hear about Ada as a young undergraduate?

P Prof Helen Wilson 07:03
No, I didn't at all. The first I heard of Ada Lovelace was I think, probably this time last year when Hannah Fry was doing the documentary about her. And so I sort of vaguely I knew the name. I'd heard of the Ada Lovelace day, but I've never really known who she was or what she did. I know a bit more now.

L Laura Hewison 07:19
And I wonder why that is? I suppose something interesting when I was looking into my research, was I googled famous mathematicians. And of course, there's a whole list that comes up on Google. Four of them were women. And I suppose I can you guess what those what those four were, Ada is one.

P **Prof Helen Wilson** 07:37

Emmy Noether is presumably one Yes. Who invented materion rings, which are beautiful constructs in algebra. I would imagine Sophia Kovalevskaja would be one who had the Kovalevskaja Top

L **Laura Hewison** 07:50

No, she doesn't make the list. But what is the Kovalevskaja top?

P **Prof Helen Wilson** 07:54

So if you study at an ordinary spinning top, the equations which describe it was studied earlier, maybe a century earlier. But they had no exact solutions for a motion that you could write down the entire track of motion of the of these things. And she discovered that if you design one, so that to have its moments of inertia are identical, and the third one is half of the value of the first two, then you can get an exact analytical solution. It's a really beautiful piece of mathematics. You can't create this top and and spin it, because unfortunately, the point that it spins apart, spins about is not one of its ends, so you can't stand it on the table. While it's doing it. You'd have to do it in space. But it's nonetheless really beautiful mathematics.

L **Laura Hewison** 08:35

Okay, any guesses on the last two?

P **Prof Helen Wilson** 08:39

Florence Nightingale?

L **Laura Hewison** 08:41

No, she did come up though. But in my further research, she wasn't an the Google top listing. Sophie, have you got any idea?

S **Sophie Lane** 08:49

Oh, no. I don't know that you've made very nervous.

L Laura Hewison 08:55
Well, the other two were somebody called hy- hy- tenya.

P Prof Helen Wilson 09:01
Oh, Hypatia

L Laura Hewison 09:03
Hypatia

P Prof Helen Wilson 09:03
Ancient Egypt. Yes. Yes. No, I have heard of her. I tend to sort of discount her as being ancient history and therefore not relevant. But that's unfair, isn't it?

L Laura Hewison 09:12
Well, I had slightly because she's, she's described as you know, the accomplished woman. She's a philosopher and astronomer and mathematician, but she did live in ancient Egyptian times.

S Sophie Lane 09:22
There just wasn't a lot of philosophy or maths or astronomy get you know, you could you had time to do all three, because we just had discovered that much.

P Prof Helen Wilson 09:29
Especially astronomy. I mean, what were they looking for? It was just just naked eye right?

L Laura Hewison 09:34
"Big thing in the sky. I'd like to give that one a name" Done. And the other one was Marie - Sophie Germain.

P Prof Helen Wilson 09:42
Ah, yes. Okay, so I should have thought of Germain but I'm not really familiar with her

mathematics.

L **Laura Hewison** 09:50
Yes. Well, I mean, I,

P **Prof Helen Wilson** 09:52
What can you tell us? (Laughter)

L **Laura Hewison** 09:55
Not much apart from the fact that she was a French mathematician, a physicist and also a philosopher. So there's kind of branching again that that whole maths and philosophy kind of tightrope. So I suppose that does bring us around to the the reason of why we need something like an Ada Lovelace day. Just a very quick bit a bit about Ada Lovelace. You know a little bit about her Sophie.

S **Sophie Lane** 10:21
Ada Lovelace, for those who don't know, was an English mathematician and writer who collaborated with Charles Babbage on his proposed mechanical general purpose computer, the Analytical Engine. She wrote what is now considered to be the first computer programme and she saw the creative possibilities for a programme and computers. And she published what we would now call a computer programme to generate Bernoulli numbers. Am I pronouncing that right? Bernoulli Bernoulli Bernoulli numbers.

L **Laura Hewison** 10:45
Ada Lovelace day also has a little connection to UCL as one of aidas tutors by correspondence was Augustus De Morgan. And he was UCL first professor of mathematics. So yeah, unfortunately, Ada died at the age of 36. So her work was never really appreciated, I suppose in her lifetime, tragic. It wasn't until Alan Turing in the 40s that it was really put into practice. She was the first one, I think, to really think about the creative possibilities of what computer programming could do. And you know, how we've got memes now (laughs) Thanks, Ada, thanks. To the reason, I suppose we need a day like this is because there's not a huge amount of women in STEM. Is that still the case, Helen?

P Prof Helen Wilson 11:32
It is improving. So most places have a reasonably balanced undergraduate population in the math department.

L Laura Hewison 11:40
I did see, I just wanted to throw this in there. I did see that Cambridge, only 17% of their mathematics undergraduates in 2017 were women. Not saying anything bad against them, bit shady

P Prof Helen Wilson 11:53
Something terrible has happened there. Because when I went there some (clears throat) years ago, 25% of us were female. So how's it got so much worse?

L Laura Hewison 12:03
I don't know. And what- why do you think that there is such a gap? I mean, Sophie, you did a degree in physics.

S Sophie Lane 12:13
I did. Quite recently, I studied physics with astrophysics at Sussex, and I think we were 20%

P Prof Helen Wilson 12:18
That's very good for physics, because physics and computing are typically far worse than mathematics.

S Sophie Lane 12:25
Yeah, no. And it was. Why is that? Why is why is physics and computing typically worse?

P Prof Helen Wilson 12:30
We've tried to work this out. Because actually, I think the comparison with chemistry between physics is really interesting, because chemistry uses so many of the same skills and has a lot of the really similar foundations and chemistry is so much better than

physics on the gender balance. It's really weird. Like, it's a very strange disconnect, because I think it's I think it's the connection to engineering. And that's areas just taking a bit longer to catch up. And then obviously, like, the less women that are in physics, the less women want to go into physics, and then it becomes like, self perpetuating. Yeah, completely. But I went to, I went to an all girls school. And I didn't even I didn't notice that physics was a male dominated subject until I started telling people I was going to study physics started going to like interviews and open days and stuff. I think someone actually said to me, "Well, you'll find a great husband doing a physics degree" which was, so I didn't even know how to respond to that. Like I saw, I sort of realised it really suddenly. And it's interesting, cuz I don't know, if I'd known going there. When I when I was choosing my A Levels that I was going to be if I had thought at that point, I'm gonna be one of the only girls in my class, I hope it wouldn't have put me off. But I don't actually know like, maybe it would have done maybe that would have been better just went completely over my head.

L Laura Hewison 12:35

Do you think it was because you went to an all girls school that that kind of that perhaps unconscious bias of teachers being like, oh, maths, physics,

S Sophie Lane 13:47

I wouldn't, I wouldn't be surprised. We had a lot of girls doing math, we had as many people doing math in high school as we're doing English at A Level and everyone in my physics class went on to do either physics, math or engineering at university level, and I think it was almost like, but then we were a really small class compared to so I don't know it must be coming must be coming from somewhere.

L Laura Hewison 14:06

What do you think the major challenges are then facing women who was thinking about a career in mathematics?

P Prof Helen Wilson 14:14

I really don't know what the challenges are from. If you've decided that that's what you want to do. I don't know what's in the way. I don't know if there is anything in the way. I certainly looking at university admissions, which I've seen in several places, everywhere seems to be very keen to be open to girls and to be taking girls where girls apply. The problem seems to be at the application stage, or maybe something else has gone wrong

in Cambridge, who knows. But certainly here, we're taking about 50% girls across the math degrees and that's, that's lovely. And then when we get to the research students stage, suddenly, suddenly we have difficulty in keeping them and so our research student population is much less balanced. It's much closer to the 25% level. Rather than 50%. And that kind of generates on into this well known leaky pipeline effect. Yeah. By the time you get to the top, you've only got one or two drips left.

L Laura Hewison 15:12
Well, you are- You're quite far up the top right now.

P Prof Helen Wilson 15:16
The final drip.

L Laura Hewison 15:18
Well you study fluids?

P Prof Helen Wilson 15:20
Absolutely.

S Sophie Lane 15:21
We always have this conversation. It's really hard to have these to have it on a physics course that we'd we'd say, like, What's stopping- why aren't there more of us? But thing is whatever is stopping women going into schools that they've not didn't stop us?

P Prof Helen Wilson 15:32
So whatever it is, we've selected for the people who are not sensitive to whatever that yeah,

S Sophie Lane 15:36
whatever it is, it didn't work on us. So I think like, it's worth talking to people who thought about it, and then didn't do it. Yeah. And obviously, everyone thinks that their choices are deeply personal and not at all to do with massive societal influences. And then you look at a trend and you think, like, they can't all be just individuals.

L Laura Hewison 15:54
Well, personally, I just wasn't very good at maths.

P Prof Helen Wilson 15:58
So that is one of the hurdles. But I would expect that to apply to a fair proportion of the male population as well.

L Laura Hewison 16:03
And I think it definitely does. To what, what about your, your personal journey, then you mentioned that you went to Cambridge? And when did you first start thinking about a career, like you have now?

P Prof Helen Wilson 16:18
I knew very, very early that I wanted to do a maths degree pretty much as soon as I knew there was such a thing. I thought I wanted to do it. And nothing shook me from that, until I got to the end of the master's degree. And then I kind of teetered on the edge of the cliff going, Oh, I had a plan. I've done the plan. Now, what do I do next. And I really didn't have a clue. I applied for a very broad range of jobs at that point, with no particular thought that academia would take someone like me, I applied for all sorts of city jobs and civil service jobs and things that I would have hated. And I think the people interviewing me by a large, spotted that, and I didn't get anything. And I stayed on and did a postgraduate one year diploma, just because I had the option to and I felt it would look better on the CV than a year of being unemployed. And somewhere in the course of that year, I fell in love with it. And when I, I had just a snippet of reading research literature and understanding it and starting to put bits of it together, and I thought this was fantastic. And then I had the opportunity to do a PhD, and I jumped at it. And from there, it's sort of naturally flowed that, you know, obviously one of the things you consider after PhD as a postdoc, and obviously, one of the things you consider after a postdoc is looking at academic jobs. And I happened to come out of my postdoc, when a lot of institutions were having a big hiring spree, ready for the 2000 and small number RAE. And I was hired on that. So I was hired in October 2000, on a permanent post, and people of my age found it much easier to get permanent, academic jobs and people one year older, it's really most unfortunate the way it was bunched up. They've redesigned the process now in the hope of spreading that out. But it did work for me and I got a permanent job once I'd got it. I just found that I loved the teaching, and I was enjoying the research. And so there was there was no reason to

look anywhere else.

L Laura Hewison 18:17
Do you think that there was for somebody who was thinking about going and doing a maths degree, there is a world of opportunity, there open to them, they kind of they could take what they've learned and run with it in many different directions.

P Prof Helen Wilson 18:33
Absolutely. I, I have looked around my peers who did math degrees, and there is almost no career whose doors are closed with a maths degree. So my brother went and did economics because he wanted to be an accountant. And he looked back and said, I wish I'd done maths because now I know I could have had my exact same career with a math degree, and I would have had more fun during the degree. So if you really love it, you should do it. Because in almost nothing is close. One of my friends is now a solicitor, even things where you think you really ought to do something else. It's fine. You can do maths and still get there.

S Sophie Lane 19:07
I think I have something I think about a lot of STEM degrees is I think all degrees are really challenging and are loads of work. But stem degrees. When you tell people that haven't done one that you've done one, they go, they don't go like "Ah" they go like "Oooh",

P Prof Helen Wilson 19:20
Yes, definitely that.

S Sophie Lane 19:22
And like I think that that like does translate to like job like, you know, if you're applying for a job like a math degree. Yes, very shiny. It is impressive.

P Prof Helen Wilson 19:31
It's definitely a big point on a CV, it's not going to walk you through the door of anything, but it definitely helps.

L Laura Hewison 19:39

So I suppose out there at the moment, there's a lot of exciting stuff happening and a lot of really cool high powered maths women. It's a lot better than in Ada's day. Oh, yes. Yeah. Can Can you think of any really cool highlights that are out there at the moment that you think our wonderful listeners Should hear about?

P Prof Helen Wilson 20:01

Highlights of mathematics going on being done by women?

L Laura Hewison 20:04

Yeah, if you think of it

P Prof Helen Wilson 20:06

There aren't that many who are doing stuff that I know about. That's the trouble. I know the women because they start to have a high profile, I don't know their work.

S Sophie Lane 20:13

I wonder how you get that out there, then how do you do that?

P Prof Helen Wilson 20:18

Well, a lot of math research is not really easy to communicate with anyone outside of your field. So they, they communicate it to the people who can take it and run with it. And then those people take it and run with it. And that's the way that the research grows. But pure math is very, I don't want to say siloed. Because actually, there are really exciting things happening when different branches talk to each other. But it is very high level. Someone from completely outside someone like, someone like me, can't understand the highest level of pure master research. In an hour long seminar, it's already too high level for that.

S Sophie Lane 20:56

Wow.

L Laura Hewison 20:57
So what what is the highest level of pure maths research being used for what what are they...?

P Prof Helen Wilson 21:02
Depends which field but for instance, number theory is the underlying theory behind all of cryptography and security. So every banking system, telephone system, whatever is secured using number theory, and the cutting edge of pure math research could, in theory, at any moment, bring it all crashing down by finding a really easy way to factorise enormous numbers.

S Sophie Lane 21:04
Vaguely unsettling

P Prof Helen Wilson 21:17
And highly unlikely.

S Sophie Lane 21:31
I'm gonna hold you to that.

P Prof Helen Wilson 21:34
I think if that was gone wrong. I won't, you won't need to come after me, the whole world would have just fallen apart.

L Laura Hewison 21:42
Helen said maths related Armageddon. You could model that couldn't you could model maths related Armageddons and just see, you know, what's the what are the chances?

P Prof Helen Wilson 21:56
The worst we could do?

S Sophie Lane 21:59
I want to ask, earlier you were saying that you had your cliff edge moment at the end of your undergraduate?

P Prof Helen Wilson 22:04
That's right.

S Sophie Lane 22:05
Because that's something I think's interesting, because I finished my undergraduate and I decided I didn't want to go any further down academia. And I think it says I think there's a little there's a little jump between undergraduate level and going into research, where you've not known but most of us would have done like a final year research product projects. But being a research student is so different than being a taught student.

P Prof Helen Wilson 22:27
Yes.

S Sophie Lane 22:27
And that is, you know, I think obviously, we'd like a lot of women aren't leaping over that.

P Prof Helen Wilson 22:33
And yeah, perhaps that's an intimidating barrier. Yeah, I would hope that the finally a research project was a really good way to get a taste for it, and decide if that was something that that you like, but everywhere I've been, there are always some research, students who start and then reasonably quickly, like in the first six to nine months, decide that actually, they don't like the uncertainty of working with things where they don't know when they've got the right answer. And there might not be a way through this problem. And it takes a particular mindset to live in that zone of there is a lot here that I don't know, and to actually spend your life there, you've got to be comfortable with with stupidity, really, and some people just aren't. And maybe there's a gender bias in there. I really don't know

L Laura Hewison 23:18

I've become very comfortable with stupidity, it's how I live my life. And that kind of brings me on to my final question, Helen. Is maths, an art or a science?

P **Prof Helen Wilson** 23:30

Learning to use the tools of maths and becoming a practitioner of those tools? That's a science. But what you do with it has a distinct element of art in it, it is creative. You are selecting tools, and in some cases, creating new tools for the problems as they present themselves. And yeah, it can't be considered to be pure science, I don't think

S **Sophie Lane** 24:02

here's the question. And do you have a maths hero? And who are they and why?

P **Prof Helen Wilson** 24:08

I think in terms of local effects on me, actually, my hearing or in fact, heroine, would be Professor Susan Brown, who was the first female professor in my department. And she was still working here when I arrived as a lecturer. And she was very quiet and understated. She had this hugely impressive research portfolio, which I had absolutely no idea about. But she had taught math to the engineers for 39 years. And she was as proud of the fact that she had excellent student evaluations on those and the students were happy as she was of this incredible research. And she just showed me how you can get on and do this job really well, in all aspects. While Incidentally, being female and she wasn't making a fuss about being female, she was just getting on with the job. And it wasn't until she died last year that I realised how much that had subliminally affected me and my My ability to visualise myself in the place that I now am.

S **Sophie Lane** 25:03

It's a shame that she never got to see you as head.

P **Prof Helen Wilson** 25:05

Yes, I would have been.

S **Sophie Lane** 25:07

I know exactly what you mean about seeing women just getting on with things and that being really powerful. And then how would you feel like that sort of works with, like the

Athena SWAN and do you think they need to go kind of hand in hand, or do you think?

P **Prof Helen Wilson** 25:21

Yes, I think the Athena SWAN is designed to deal with a situation where there is a lack. And I was lucky that Susan was there. But not every department had a Susan to be a role model. For my generation, there was no one at my previous institution. And even if there isn't a role model in your institution, if Athena is doing its job properly, and bringing in the sort of change that should make life fairer, then that's got to be a good thing.

L **Laura Hewison** 25:50

Well, unfortunately, that's all we have time for today. Thank you so much for joining us on this special Ada Lovelace day edition of Hypot-enthuse. We'll see you next time for more maths chat.