

Dave Espley

I suppose the starting question is, when did you first get interested in physics? I'm guessing it was at high school, or sixth form?

Johnno Langford

Yeah, it's an interesting one that, actually, because at the end of my GCSEs I remember having a particularly poor physics teacher at GCSE and I almost didn't take physics for A-level. I was going to do history instead - so maths, biology, chemistry and history. And then I think it was my dad who said, look at the subjects you're doing - it probably makes sense to do physics as well. So I did it and then had excellent teachers at A-level, at college, and eventually liked it enough that I chose it for my degree at Manchester. So yeah, I almost didn't take this path at all. Could have been a historian instead, I guess.

Dave

And so what did you choose Manchester for? Was it just the reputation of the place because, we do have a good reputation for physics students in particular.

Johnno

Yeah. That's certainly part of it and obviously it's a very, very good university for physics - high requirement. So it does get the elite in physics which is nice and [there are] some excellent lecturers there, of course, but on the other side, a big part of it was my upbringing, in the sense of I've got some family up north. My sister went to Manchester Uni, so I visited her a few times and enjoyed the city a lot. It meant I was only 20 minutes on the train from Wigan so I could go to the football. But yeah, all that stuff combined with it being a very good institute for physics.

Dave

So actually studying at Manchester, then, was that was an enjoyable experience?

Johnno

Oh, it was great. Yeah. I absolutely loved my time in Manchester. Very fond memories, both of the course itself: very interesting - like I said, some excellent lecturers at Manchester. But then on the other side, the social aspect of living in Manchester is great. So it was a great experience, and like I said, I look back with fond memories.

Dave

And am I right in thinking that at some point during your course, you specialized in particle physics?

Johnno

Yeah. So again, somewhat by chance. So it was actually at the end of second year. I secured a placement and it was via this DAAD program, which is a placement program in Germany. And they send you to all different institutes around Germany, not just physics. And then I applied for three different things on the DAAD program, and one was particle physics, I think one was laser physics, and I can't remember what the third was. And you had to rank them, and it was somewhat of a random choice. But I chose particle physics as the first choice. Another reason was the fact that it was in Munich. So at the Max Planck Institute in Munich. So a place that I wanted to go and it's a good institute for physics as well. So that was the reason I picked it first and then obviously that led

to me then enjoying particle physics, taking the kind of modules that are suitable for particle physics in third and fourth year and led me on this path.

Dave

And I'm aware that you've recently completed a PhD, is that right?

Johnno

Yeah, that's right.

Dave

So is that in the same area of particle physics, because it came after your work at CERN didn't it?

Johnno

Yeah. It was based on an experiment at CERN, so the whole time I was working for an experiment at CERN. I spent six months out at CERN as like a long-term attachment, it was called, but the whole time was on the same experiment, analysing the data that comes out of that experiment. So yeah, it's connected to CERN.

Dave

I believe there are sort of four main experiments at CERN - was your work on one of those?

Johnno

Yeah. So there's Atlas, CMS, LHCb and Alice, and I work on CMS. So this is one of these general purpose detectors that are really trying to push the energy frontier of particle physics and see what we can get in really high energy collisions.

Dave

Are you able to sort of describe what the work at CERN involved in sort of layperson's terms, if that's even possible?

Johnno

Yeah, so directly what my PhD was... the title was basically "measuring the properties of the Higgs boson." So this is a particle that we discovered ten years ago, almost to the day, actually - we had these celebrations about a week ago, to celebrate it's ten years since discovery. And then in those ten years, we've been able to take more and more data and learn more and more about this particle. So it's particularly interesting because it's the particle in our model of particle physics that's responsible for giving other particles their mass. So before 2012, we had no experimental confirmation that the Higgs Boson existed. We knew things had mass, but we didn't know why or how. But in 2012, we managed to confirm experimentally both at Atlas and CMS – the experiment I'm working on – that this thing does exist. And then since then, yeah, we're taking more data. We're learning about how it interacts with all different kinds of particles. And I'm particularly looking in one decay channel that's the Higgs boson decaying to two photons. So that's the particle responsible for light, the propagation of light. So the Higgs boson can decay into two photons. And it's this nice channel that we can use to measure the properties of the Higgs boson; things like its mass, its own mass, and, yeah, how it interacts and couples to all of the different other particles.

Dave

When you were at CERN, what were the practicalities of living there? Was your accommodation paid for? Did you get a salary or ...

Johnno

The salary is still your PhD wage, so I'm paid by Imperial. And you can get paid by funding bodies like SDFC. And I think they do give you a bit of an increased wage when you go out there. Because mine was Imperial, I didn't get that extra top up. But nevertheless your accommodation is paid for, and as long as you go through like the SDFC these funding grants, or Imperial as well. And yeah, it was it was great to live out there, you know, and it's a very international collaboration, CERN, mostly speaking English, which is of course good if you don't know French, being out there. And so yeah, it was never a case of feeling an alien in a different city. It was a very easy life and very enjoyable life.

Dave

When it comes to analysing the results of the collisions, you know the experiments themselves, am I right in thinking that it's not necessarily a question of looking through a very powerful microscope and counting the things you see in front of you, it's more crunching computer data, is that right?

Johnno

Yeah, that's exactly right. Yeah. So these detectors, you can think of them as like giant cameras, but they're operating at, like, 40 million times a second. So that's how often we collide these protons. So a huge 20 metre by 15 metre by 10 metre camera, that's operating 40 million times a second, it's quite incredible technology, really. And yeah, when I say a camera, you have all these different detector technologies and you know, whatever the different particles moving through, they'll create some electronic signal, and that's basically read out in binary, if you like, ones and zeros, and they all feed through into processor farms that eventually filters its way down to people like me, the analysers. And so yeah, it's a case of crunching through the data rather than looking at these things through a microscope.

Dave

And I don't know if this is a fair question because obviously you've not been doing it as long as some of the other people I've spoken to. But what is more exciting for you? Is it having a theory which your experimentation then proves, or discovering something that was outside of the theory - of any theory - to begin with?

Johnno

Good question. Unfortunately, I have not, since joining, there hasn't yet been a, you know, gold standard "this is a new thing in particle physics." The Higgs was before my time. That would have been the last one of its kind. And even that was proposed by a theory before discovery. So we knew that something like the Higgs had to be there, and it was found. I think that was very satisfying. It's probably more satisfying to the theorists that come up with these ideas(!). Now, as we take more data, we're starting to see tensions with the standard model that maybe hasn't been explained by some theory as of yet, but potentially Chris Parkes spoke about it, I don't know, but in LHCb, they've certainly had some very interesting results over the last year or two. The RK Star anomaly and things like that, that are not necessarily theorized beforehand. And so finding these discrepancies like that is quite exciting, I do agree. And yeah, I'd say it's probably that – that if we see something in an experiment that hasn't been thought of by some clever theorists then yeah, that's probably more exciting for me.

Dave

Do you get frustrated when you see the kind of science on which you're working reduced to the tabloidy? "Oh my God, they're going to create a black hole and kill us all!" nonsense, or does it not bother you?

Johnno

I find it funny. But ultimately it's probably quite damaging for the field. I think, you know, you want to have the public on your side not only just because you want interest in the science that you do to potentially inspire scientists coming through, but also funding bodies. You need a lot of good public opinion on your side. So yeah, perhaps if I was higher up in the food chain, then I might find it more frustrating than what I do.

Dave

What does the future hold for you? Are you staying in the world of physics slash particle physics. Are you going back to CERN?

Johnno

So for now I'm certainly enjoying it and staying in the field. So I'm doing a postdoc now at Imperial. I've been doing that for a year and this will go on for at least another year. And then during this postdoc, I'm still working and still based on an experiment at CERN. And so I'm out there occasionally and still analysing the data that comes from the experiment. Longer term, yeah, I'd love to go back. Whether that's for two years, five years, whatever. And at the minute I'm enjoying it enough to say that that's the path I want to follow in life, yeah.