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Guest: Kate Scholberg

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Welcome to this episode of “My Journey as a Physicist” podcast.
Each episode features an interview with a physicist to learn about their work, their interests outside of physics, and their professional journey of how they ended up where they are today.
Season two features physicists involved in the particle physics planning community known as “Snowmass”. Hope you enjoy today's episode.

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00:00:32,100 --> 00:00:37,200
Welcome, Dr. Kate Scholberg. Could you briefly introduce yourself? What is your current job?

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00:00:37,200 --> 00:00:42,300
Yeah. I'm a professor at Duke university. I'm a particle physicist primarily, although my research

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00:00:42,300 --> 00:00:45,405
touches on nuclear physics and astrophysics as well. I'm

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00:00:45,405 --> 00:00:49,650
primarily interested in neutrinos, on neutrino physics and astrophysics.

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00:00:49,650 --> 00:00:54,495
I work on several experiments. I'm a long time member of the super coming to conduct

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00:00:54,495 --> 00:00:59,745
collaboration which is an experiment in Japan and also TTK which is a beam experiment.

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00:00:59,745 --> 00:01:04,980
I'm involved in a deep underground neutrino

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00:01:04,980 --> 00:01:10,080

experiment, which is a next generation neutrino experiment in the US, but actually most of my

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00:01:10,080 --> 00:01:13,909
time, I'm spending these days on an experiment called COHERENT,

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00:01:13,570 --> 00:01:18,580
which is an experiment at Oak Ridge national laboratory, can use of the free neutrinos produced

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00:01:18,580 --> 00:01:22,680
there, um do do neutrinos scattering experiments in neutrino alley.

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00:01:22,680 --> 00:01:25,800
So that's that's actually my project right now. Okay. Yeah.

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00:01:25,800 --> 00:01:29,820
Can you kind of go into a little more detail of like what the goals of your project are?

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00:01:29,820 --> 00:01:36,035
Yeah. I guess I'll talk about COHERENT. So that's an experiment where our primary goal is to look at

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00:01:36,035 --> 00:01:41,790
kind of especially interesting scatterings of neutrinos. Neutrinos are particles that have no charge,

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00:01:41,790 --> 00:01:45,870
a very tiny mass and interact only by the weak interaction. So they hardly interact with

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00:01:45,870 --> 00:01:49,830
anything, they mostly just go through stuff but they do sometimes attract and they scatter off

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00:01:49,830 --> 00:01:54,360
nuclei. So occasionally they will… A neutrino will come and it will smack

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00:01:54,360 --> 00:01:58,170
an entire nucleus and send it rolling off kind of like a rolling off, kind of

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00:01:58,170 --> 00:02:01,980
like a, like a bowling ball, and what this experiment is

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00:02:01,980 --> 00:02:05,040
trying to go after is, is to actually look at these interactions that are

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00:02:05,040 --> 00:02:08,490
called coherent. It's the interaction that's called CEVNS. It's C-E-V-N-S,

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00:02:08,490 --> 00:02:12,960
which stands for coherent elastic neutrino nucleus scattering.

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00:02:12,960 --> 00:02:18,240
And that's a process where the neutrino just kind of kicks an entire nucleus and makes it roll

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00:02:18,240 --> 00:02:24,375
off as an entire entity, rather than scattering off a constituent of the nucleus. And so the

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00:02:24,375 --> 00:02:30,690
main purpose of COHERENT the coherent experiment is to look at this process and try

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00:02:30,690 --> 00:02:36,090
to measure how often it happens. The standard model of particle physics makes a very precise

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00:02:36,090 --> 00:02:41,730
prediction for exactly how many scatters you should get for a given amount of neutrinos, and what

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00:02:41,730 --> 00:02:46,080
that means is that if we measure something that's different from the prediction, that could point

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00:02:46,080 --> 00:02:51,840
to some kind of new physics out there. So that's what we're after. We're trying to measure this process in a bunch of different nuclei,

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00:02:51,840 --> 00:02:55,980
starting with, well we've actually started with a relatively large nucleus and we're trying to measure it in

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00:02:55,980 --> 00:03:00,870
different sizes of nucleus, you know down to very small ones and medium sized ones. to check

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00:03:00,870 --> 00:03:03,960
whether the prediction the standard model is, is correct.

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00:03:03,960 --> 00:03:07,020
And in the process, trying to figure out if there's some kind of new physics that

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00:03:07,020 --> 00:03:10,110
might change how how many scatters you see.

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00:03:10,110 --> 00:03:13,350
So I guess that's the main thing. There's actually lots of other things that go along with that

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00:03:13,350 --> 00:03:18,810
that I, I could go on for a long time talking about, but uh
yeah this process called CEVNS is

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00:03:18,810 --> 00:03:21,840
is kind of the main point of the COHERENT experiment.

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00:03:21,840 --> 00:03:26,730
Okay, very nice. And then I know that you mentioned like all these different labs are like all over the world

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00:03:26,730 --> 00:03:30,150
and you mentioned very large collaborations like…kind of

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00:03:30,150 --> 00:03:36,360
can you describe the scale of like the group that you work with work with or collaborate with?

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00:03:36,360 --> 00:03:39,810
Like…who are you working with? You know more or less.

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00:03:39,810 --> 00:03:44,670
Oh yeah. Okay So for COHERENT, COHERENT is actually, by high energy physics standards it's a

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00:03:44,670 --> 00:03:47,880
relatively small collaboration. It's it's got, uh maybe about

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00:03:47,880 --> 00:03:51,270
80-90 people in it, which you know by standards of some

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00:03:51,270 --> 00:03:54,630
some kinds of science that would be enormous, but by standards of high energy

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00:03:54,630 --> 00:03:58,590
physics, it's actually pretty small. And so yeah. So

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00:03:58,590 --> 00:04:01,720
It's a group from about 19 different institutions,

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00:04:01,720 --> 00:04:06,340
four different countries. And you know we we meet together regularly. We have collaboration

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00:04:06,340 --> 00:04:10,720

meetings twice a year. We have lots of meetings every week Um and you weren't um for different

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00:04:10,720 --> 00:04:14,380
working groups because we have different kinds of detectors in the experiment and so we

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00:04:14,380 --> 00:04:20,529
have working groups that are organized around the different experiments and organized around doing physics with the whole suite of

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00:04:20,529 --> 00:04:24,895
different detectors. Yeah. So that's one collaboration. Now in contrast the DUNE collaboration

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00:04:24,895 --> 00:04:29,470
deep underground neutrino experiment, which is the next generation US one that is much more like

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00:04:29,470 --> 00:04:33,970
a traditional high energy physics experiment. It's huge. It's got more than a thousand people

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00:04:33,970 --> 00:04:38,350
in it. And I have lost track of how many countries but I think it's dozens of countries now. And

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00:04:38,350 --> 00:04:42,100
so that's really you know very large scale, social structure.

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00:04:42,100 --> 00:04:47,050
You know, when you get bigger collaborations you end up with much bigger, you know, much much

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00:04:47,050 --> 00:04:50,580
more bureaucracy, you know, much more infrastructure that you have to deal with compared to a

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00:04:50,580 --> 00:04:54,660
small collaboration but that's also pretty fun and interesting because you get to meet people from

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00:04:54,660 --> 00:05:00,190
all over the place and the collaboration meetings are kind of like conferences and you know in practice you end up working with a

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00:05:00,190 --> 00:05:04,285
working group, which is usually a small subset of those people that are focused on a

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00:05:04,285 --> 00:05:08,080
particular technical topic or a particular physics topic.

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00:05:08,080 --> 00:05:14,725
And so in DUNE I'm mostly working in the low energy physics working group, which is in

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00:05:14,725 --> 00:05:19,945
interested in the physics that you can do with DUNE with neutrinos of up to about a hundred

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00:05:19,945 --> 00:05:25,270
MEV. And so that includes trainers that come from a supernova. So this is where the intersection with astrophysics is

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00:05:25,270 --> 00:05:30,610
if the star's core collapses, it creates an enormous burst of neutrinos in about 10 seconds

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00:05:30,610 --> 00:05:34,600
that can be picked up in different neutrino detectors around the world and DUNE is one of them.

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00:05:34,600 --> 00:05:38,590
It actually has some really unique capabilities for observing

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00:05:38,590 --> 00:05:42,790

those neutrinos, sensitive actually to one of the flavors really especially,

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00:05:42,790 --> 00:05:48,580
the electron flavor neutrino. And so this DUNE working group is, is really interested in trying to

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00:05:48,580 --> 00:05:54,340
improve the sensitivity to this particular kind of physics from the supernova and also neutrinos from the sun,

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00:05:54,340 --> 00:05:57,670
neutrinos from various other kind of sources that are in this energy range, and it actually

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00:05:57,670 --> 00:06:02,230
happens to be the same energy range as is provided by the neutrinos at Oakridge.

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00:06:02,230 --> 00:06:06,910
So there's kind of an intersection between my projects there, is that the, the kind of neutrinos

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00:06:06,910 --> 00:06:11,050
we get at Oak Ridge are kind of like artificial supernova neutrinos in the sense that they're in

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00:06:11,050 --> 00:06:15,700
the same energy range and we can use them to study a lot of the same physics as in DUNE. Yeah. So

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00:06:15,700 --> 00:06:19,510
and then the other collaboration Super-K, that one has a couple of hundred.

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00:06:19,510 --> 00:06:23,680
So I guess that's sort of medium-sized, so I guess I have collaborations that span the

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00:06:23,680 --> 00:06:27,460
the smallish, the medium and the, and the really large size.

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00:06:27,460 --> 00:06:31,450
And then as you kind of like alluded to all these different projects or locations or like in

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00:06:31,450 --> 00:06:36,670
different locations and not by Duke, and so like where do you actually like spend most of your

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00:06:36,670 --> 00:06:42,070
time working? Yeah, that's a good question. Of course during he last couple of years during the pandemic it has not been typical.

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00:06:42,070 --> 00:06:47,575
I have indeed spent a lot more time near Duke than would be normal.

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00:06:47,575 --> 00:06:53,290
So the COHERENT is in Oakridge, Tennessee. So that's about a six hour drive for me

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00:06:53,290 --> 00:06:57,370
and so that's actually kind of far enough to be a tiring day

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00:06:57,370 --> 00:07:01,480
of travel. But it's something where it's, it's possible to get there in half a day, in fact

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00:07:01,480 --> 00:07:06,070
I was just there last week, actually went back and forth a couple of times last week. So uh

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00:07:06,070 --> 00:07:09,580
yeah that one's relatively nearby, and possible to spend

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00:07:09,580 --> 00:07:13,150
to spend time there. Actually, I expect to be, expect to be spending quite a bit more time over the

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00:07:13,150 --> 00:07:16,255

next year because we have four new deployments, you know, lots of stuff going on.

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00:07:16,255 --> 00:07:19,510
Yeah. So then for DUNE, actually a lot of the activity for

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00:07:19,510 --> 00:07:26,080
that is centered around Fermilab, which is near Chicago. So there's usually several meetings per year at Fermilab.

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00:07:26,080 --> 00:07:30,970
Um, actually haven't been there since before the pandemic but I expect that'll start up again soon.

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00:07:30,970 --> 00:07:35,665
There's also activity happening at CERN, you have meetings at CERN in Switzerland. So there's that

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00:07:35,665 --> 00:07:41,080
and then for Super-K, that's in Japan and actually it used to be before

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all the COHERENT activities started, Super-K was really my main activity. And I would go back and forth to Japan usually at least four times a year, maybe more often. Now I

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00:07:45,880 --> 00:07:50,620
don't do that as much because I've got other things going on, but, and I haven't been also

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00:07:50,620 --> 00:07:55,810
since before the pandemic that I'm expecting that that will start up again at least a couple of trips a year

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00:07:55,810 --> 00:08:00,250
trips a year to Japan. And that's that's a long haul. That's a good more than 24 hours to get

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00:08:00,250 --> 00:08:04,210
there, that certainly in the days when I was doing that many times a year it was kind of the got

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00:08:04,210 --> 00:08:07,630
into a bit of a routine a long tiring workday on the plane.

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00:08:07,630 --> 00:08:11,365
Yeah. And so do you consider yourself to be more of an experimentalist or a

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00:08:11,365 --> 00:08:15,130
theorist or care in between somewhere? I consider myself an experimentalist.

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00:08:15,130 --> 00:08:18,910
And I I'm, I tend to be more software and analysis

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00:08:18,910 --> 00:08:22,930
focused, but not a hundred percent. I mean I'm involved in,

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00:08:22,930 --> 00:08:26,080
my group is involved in many aspects of the,

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00:08:26,080 --> 00:08:29,080
all the aspects of the detector, of the different detectors, you know,

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00:08:29,080 --> 00:08:32,140
including hardware construction and so on and calibration.

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00:08:32,140 --> 00:08:35,679
You know, there's there's a whole range of activities in experimental physics

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00:08:35,679 --> 00:08:40,419
spanning designing, to construction, to commissioning

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00:08:40,419 --> 00:08:45,400
to calibration, and then analysis and physics. So it really goes the whole, the whole range.

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00:08:45,400 --> 00:08:48,580
And my group is involved in basically every aspect.

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00:08:48,580 --> 00:08:51,790
It tends to change in the lifetime of the experiment.

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So like Super-K is now pretty much in data taking mode, so there's no construction happening,

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00:08:56,500 --> 00:09:00,955
although there are collaborations, calibrations happening and there's, you know, sort of regular

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00:09:00,955 --> 00:09:04,120
data analysis that has to do with that. DUNE is in,

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00:09:04,120 --> 00:09:07,630
you know, kind of ramp, going to be ramping up construction pretty soon.

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00:09:07,630 --> 00:09:13,270
So far most of the stuff I've done on DUNE has been in physics sensitivity studies. So simulations and,

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00:09:13,270 --> 00:09:18,280
you know, not not hardware related but that is actually will very likely change over the next

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00:09:18,280 --> 00:09:23,170
five to 10 years and COHERENT, is basically everything. The whole gamut, I mean there's data analysis,

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00:09:23,170 --> 00:09:27,280
there's, you know, right now we're in a detector deployment phase, actually a very intense

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00:09:27,280 --> 00:09:33,880
detector deployment phase. Right at this moment we have four detectors getting built right now at Oak Ridge

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00:09:33,880 --> 00:09:38,650
and one of my students is really the main organizer for,

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00:09:38,650 --> 00:09:43,930
I'd say one of the two main organizers for getting the one of

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00:09:43,930 --> 00:09:50,050
the detectors up and up and running. The first module will be is is actually almost almost there.

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00:09:50,050 --> 00:09:55,090
So that's actually that's pretty pretty fun and exciting. So then I also know that you're involved with

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00:09:55,090 --> 00:09:58,960
Snowmass. Can you kind of describe what your involvement there is?

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00:09:58,960 --> 00:10:01,960
Yeah. So Snowmass is a massive activity over the,

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00:10:01,960 --> 00:10:05,560
and it's been kind of extended it, it was paused during for

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00:10:05,560 --> 00:10:09,280
six months during, during the pandemic and so it’s kind of been

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00:10:09,280 --> 00:10:14,050
all drawn out. You know that Snowmass is the big strategic planning activity for high energy

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00:10:14,050 --> 00:10:20,950
physics and involves a huge amount of meetings and discussions and kicking

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00:10:20,950 --> 00:10:26,740
around of ideas and kicking around of ideas for how to prioritize things and discussion of

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00:10:26,740 --> 00:10:30,505
blue sky activities and discussion of, you know, many many many things

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00:10:30,505 --> 00:10:35,500
and I'm one of the three co-conveners of the neutrino frontier.

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00:10:35,500 --> 00:10:40,840
So the whole effort is organized into what are called frontiers, ten basic physics areas within high energy physics, and one of them is uh neutrinos.

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00:10:40,840 --> 00:10:44,725
And so I have two co-conveners for the neutrino frontier and

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00:10:44,725 --> 00:10:48,670
what we have spent the last, I guess it's now

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00:10:48,670 --> 00:10:51,970
almost two years, losing track of time.

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00:10:51,970 --> 00:10:56,200
Time has ceased to have the same meaning since the pandemic pandemic.

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We have organized a whole set of different kinds of meetings, trying to

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00:11:01,810 --> 00:11:05,830
make sure that all of the ideas for what people are interested in for the future,

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00:11:05,830 --> 00:11:11,080
you know, get some bearings. As part of the process there was first a whole set of Lys letters of

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00:11:11,080 --> 00:11:17,590
intent submitted. So we looked through those and now we're in a phase where people are submitting white papers,

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00:11:17,590 --> 00:11:20,980
uh we've we've seen the first round of those but they're still they're still coming in.

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00:11:20,980 --> 00:11:26,560
This is where people present their, their thoughts about what interesting possible future

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00:11:26,560 --> 00:11:32,380
opportunities there are going to be. And what our job as conveners is, is to try to gather all this

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00:11:32,380 --> 00:11:36,760
information and process it and kind of synthesize,

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00:11:36,760 --> 00:11:42,460
a message for what the neutrino frontier

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00:11:42,460 --> 00:11:49,030
aspires to do for the next 10 years. And so Snowmass, it's not really a it's not a

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00:11:49,030 --> 00:11:54,100
specific prioritization exercise in the sense that it's not a,

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00:11:54,100 --> 00:11:58,510
you know, we don't put explicit priorities on what things are more important than other things.

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00:11:58,510 --> 00:12:03,460

that is something that happens down the line um by committees charged by funding agencies who

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00:12:03,460 --> 00:12:08,470
actually have a spreadsheet and are able to apply reality and figure out what, you know how

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00:12:08,470 --> 00:12:12,760
much of the stuff the community aspires to do is actually possible to do, given constraints. We're

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00:12:12,760 --> 00:12:17,935
not at that point yet in Snowmass. The the point of Snowmass is really to try to come up with a

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00:12:17,935 --> 00:12:21,280
story for what we want the future to look like.

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00:12:21,280 --> 00:12:25,375
And, you know, of course, realizing that the reality may be that we won't be able to do all the

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00:12:25,375 --> 00:12:29,380
things we would really love to do, but at least we can express our

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00:12:29,380 --> 00:12:34,450
aspiration for what we we think the exciting things are to do.

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00:12:34,450 --> 00:12:39,130
And so that's that's the stage where we are now, we're kind of

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00:12:39,130 --> 00:12:43,240
coming to the end of gathering the input and we're writing reports.

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00:12:43,240 --> 00:12:49,210
Reports are due in fact very soon, where we really write out our messages to the

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00:12:49,210 --> 00:12:55,270
rest of the community about what the exciting science is for neutrino physics and what the

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00:12:55,270 --> 00:12:58,810
most interesting opportunities are that we we think

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00:12:58,810 --> 00:13:01,930
the community at large, you know, not only including

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00:13:01,930 --> 00:13:05,110
neutrinos, but the community at large is interested in doing.

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00:13:05,110 --> 00:13:08,740
What has your participation within Snowmass kind meant to you?

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00:13:08,740 --> 00:13:11,830
Well, it's uh… sometimes overwhelming.

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00:13:11,830 --> 00:13:16,450
It's it's really interesting. I mean I've I've learned so much about what is going on.

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00:13:16,450 --> 00:13:19,900
New, actually there's really some great creative

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00:13:19,900 --> 00:13:24,925
ideas out there in the community. And it's been actually really interesting learning about that.

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00:13:24,925 --> 00:13:28,120
You know it's it's, you know I think our job is not done yet, I

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00:13:28,120 --> 00:13:31,510
think we haven't come to the point where we have really synthesized everything. We are getting close, so I guess I have enjoyed it. I mean, it’s been a lot of work,

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00:13:31,510 --> 00:13:35,740
huge amount of organizing work and trying to keep track of everything, but it's something that this is

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00:13:35,740 --> 00:13:40,780
actually pretty pretty fun and interesting to learn about what's going on and and try to figure

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00:13:40,780 --> 00:13:46,510
out, you know, how do we navigate the path of, of where we think neutrinos should go. Yeah, for sure.

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00:13:46,510 --> 00:13:51,340
So kind of like maybe going back a little bit, so like what got you interested in physics in the

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00:13:51,340 --> 00:13:54,430
first place? Yeah, that's a great question. I guess I was always

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00:13:54,430 --> 00:13:58,090
interested in science, actually even since I was really, really small.

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00:13:58,090 --> 00:14:02,170
I wanted to be a biologist, actually when I was a kid actually I want it to be

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00:14:02,170 --> 00:14:05,890
an astronomer a really early on, and then I got interested in biology. I wanted to be a

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00:14:05,890 --> 00:14:09,220
paleontologist, I wanted to be all kinds of biologists when I was a kid.

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00:14:09,220 --> 00:14:14,860
Then in high school I took chemistry and I thought that was fantastic. I really loved chemistry

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00:14:14,860 --> 00:14:18,955

and I actually wanted to be a chemist for a while. That was really where I, I thought the

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00:14:18,955 --> 00:14:24,790
exciting stuff was. I took some physics and the first things I learned in physics I wasn't that excited by,

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I liked it but it wasn't, I thought chemistry was better. I liked it a little bit I guess, but you

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00:14:29,170 --> 00:14:33,820
know I really thought the stuff about energy and the stuff about energy and atoms and molecules

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00:14:33,820 --> 00:14:39,070
that was the stuff that was the really most interesting. Then I remember I took this organic chemistry course,

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00:14:39,070 --> 00:14:44,980
I didn't enjoy that quite as much. Uh there were things I did like about it, but it was a lot of memorizing.

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00:14:44,980 --> 00:14:50,980
Um and then I think that was when I realized that the stuff that I really liked about chemistry was really mostly physics.

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00:14:50,980 --> 00:14:55,450
And that's when I think I decided to go into physics and I, I guess I have not regretted.

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00:14:55,450 --> 00:14:58,900
Was your final degree like your bachelor's degree in

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00:14:58,900 --> 00:15:03,310
physics or did you finish with the chemistry and end with physics?

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00:15:03,310 --> 00:15:08,470
I never, I was never a chemistry major. So I went to school in Canada, in Quebec where they have

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00:15:08,470 --> 00:15:13,300
a kind of unusual educational system. So you go up to grade 11 and then you have this two years

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00:15:13,300 --> 00:15:18,820
of this thing it's called SAGIA Yup which is kind of like a college and then you have a three year bachelor's degree.

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00:15:18,820 --> 00:15:22,045
And so the the place that I took the organic chemistry was in SAGIA/

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00:15:22,045 --> 00:15:25,330
So that was before I went to my undergraduate institution,

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00:15:25,330 --> 00:15:28,540
so before I had declared a major or anything like that and so I

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00:15:28,540 --> 00:15:32,410
declared my major when I went to university,
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00:15:32,410 --> 00:15:38,740
which would be the equivalent of sophomore in the US. Okay. And that was when I started as a physics major and

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00:15:38,740 --> 00:15:43,705
my degree was in physics. Okay. And so you were always in that sense like when you're a

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00:15:43,705 --> 00:15:48,880
commissioner, you were always interested in like the actual like molecules and itty-bittyness of

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00:15:48,880 --> 00:15:52,540

everything. Yeah. This sort of

213
00:15:52,540 --> 00:15:57,490
power of simplification which is the, I think the part that I really like about physics, it's

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00:15:57,490 --> 00:16:02,050
it's makes things that seem like they're really complicated and you can kind of extract

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00:16:02,050 --> 00:16:08,770
the simple part of it. It's the the power of summary which is what I really like about physics.

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00:16:08,770 --> 00:16:13,210
Yeah. Were you so, I know you said you were an experimentalist but a lot of your stuff now is

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00:16:13,210 --> 00:16:19,615
it sounds like it's more data analysis or software sort of stuff. Did you like the hands-on

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00:16:19,615 --> 00:16:23,800
hands-on nature of like building things or doing stuff in a lab or

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00:16:23,800 --> 00:16:28,000
do you kind of enjoy doing more kind of like the software side of things?

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00:16:28,000 --> 00:16:34,960
Does that make sense? I actually kind of like all of it. I think I learned how to do more of the

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00:16:34,960 --> 00:16:39,220
hardware stuff in graduate school. Actually, I didn't really do all that much of it in

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00:16:39,220 --> 00:16:43,70
undergraduate. I did mostly data analysis stuff as an undergrad, maybe a little bit of hardware,

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00:16:43,720 --> 00:16:47,770

and actually there was a time I think when I went to grad school, when I started grad school I wasn't

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00:16:47,770 --> 00:16:51,580
sure if I wanted to be a theorist or an experimentalist and but then I joined an experimental

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00:16:51,580 --> 00:16:56,215
group and that's where I started to get involved in various detector construction stuff. I worked

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00:16:56,215 --> 00:17:01,630
on an experiment called MACRO, which was actually a monopole search experiment that was in Italy, France also.

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00:17:01,630 --> 00:17:05,515
And I went there, I was living on site

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00:17:05,515 --> 00:17:09,940
for long periods of time during grad school and I loved that. That was actually fantastic.

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00:17:09,940 --> 00:17:14,935
Uh living in Italy was fantastic and working on the detector was fantastic. I really got to enjoy

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00:17:14,935 --> 00:17:20,710
that kind of stuff when I when I was there. But, you know, I think there's there's fun to be had in all of these

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00:17:20,710 --> 00:17:26,454
aspects of experimental physics. And, you know, the the data analysis is not disconnected from the hardware. I think when you have

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00:17:26,454 --> 00:17:31,690
experience working with the hardware you end up with much better insights into the into the data

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00:17:31,690 --> 00:17:35,710
analysis. You know, you really have much better understanding of what

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00:17:35,710 --> 00:17:39,250
what is wrong with the data. That's kind of what you learn.

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00:17:39,250 --> 00:17:42,610
And that's I think what I learned that during my years in grad school working on MACRO.

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00:17:42,610 --> 00:17:48,970
It also sounds like you get to, or at least have had, many opportunities to travel to many different places around the world.

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00:17:48,970 --> 00:17:54,160
Yeah. Yep, for sure. Yeah, that's that's really cool. So like when you're busy doing all this work

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00:17:54,160 --> 00:17:58,990
like what do you do when you're not at work? Like do you have hobbies when you're not actively

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00:17:58,990 --> 00:18:02,950
doing physics? That's a great question.

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00:18:02,950 --> 00:18:06,820
Not so much, I mean more sort of generic things. I mean I

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00:18:06,820 --> 00:18:10,930
guess what I do to relax is, you know, this sounds totally

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00:18:10,930 --> 00:18:15,010
nerdy and boring but I like to read. I just read stuff. I

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00:18:15,010 --> 00:18:20,230
have a porch. My favorite thing to do to relax is to sit on my porch and read, read books.

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00:18:20,230 --> 00:18:27,010
I read all kinds of stuff. I do enjoy traveling just for fun as well, I mean I typically don't take.

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00:18:27,010 --> 00:18:30,070
very long vacations because I'm a workaholic.

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00:18:30,070 --> 00:18:34,600
But what I do like to do is to take a couple of days off

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00:18:34,600 --> 00:18:40,300
if I go to a conference or something, you know, taking one day to go visit somewhere or you know,

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00:18:40,300 --> 00:18:43,720
see the sights in whatever town it is,

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00:18:43,720 --> 00:18:47,800
that's what I really enjoy. Okay. Very nice.

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00:18:47,800 --> 00:18:54,100
And so then through your kind of journey or career as a as a physicist, if you feel comfortable sharing,

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00:18:54,100 --> 00:18:57,670
like were there any obstacles that you had to overcome along the way

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00:18:57,670 --> 00:19:02,020
during, throughout your physics career? Yeah. Well I guess, I mean the two body problem

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00:19:02,020 --> 00:19:05,485
was one for, for for me. So my partner is

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00:19:05,485 --> 00:19:09,130

also a physicist and, um we met in grad school.

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00:19:09,130 --> 00:19:14,230
And you know, it was many, many years before we found

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00:19:14,230 --> 00:19:17,470
positions really in the same town. And I actually, that was

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00:19:17,470 --> 00:19:20,995
certainly one of the things that led to me being at Duke now

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00:19:20,995 --> 00:19:24,850
is that he had an offer there

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00:19:24,850 --> 00:19:28,900
and I ended up getting one too.

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00:19:28,900 --> 00:19:34,210
And, you know there was actually many many years. We were actually both postdocs in the same institution

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00:19:34,210 --> 00:19:39,070
at Boston university. Then I later moved to MIT as a junior faculty.

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00:19:39,070 --> 00:19:44,680
And, you know he. There were some years where he didn't have a

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00:19:44,680 --> 00:19:48,430
uh a tenure track faculty position and it was, you know…

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00:19:48,430 --> 00:19:55,120
And then, you know so we we didn't have any permanent solution or the rest of the, you know, the rest of our lives.

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00:19:55,120 --> 00:19:59,200
So that was a, you know, that was a pretty stressful time trying to figure that out. So and

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00:19:59,200 --> 00:20:03,130
eventually it did work out, but it wasn't uh you know it took it took quite a few

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00:20:03,130 --> 00:20:07,270
years and, you know, many years of not knowing what

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00:20:07,270 --> 00:20:10,360
what the permanent future would be. I mean, of course that's a general

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00:20:10,360 --> 00:20:13,660
problem if you're a postdoc you don't know what,

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00:20:13,660 --> 00:20:18,160
I think there's a general stress to being a postdoc that you don't know what you're, uh where

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00:20:18,160 --> 00:20:22,570
you're going to land. You might have to move several times, but it did work out.

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00:20:22,570 --> 00:20:28,900
So that that was actually a huge relief when that worked out. Thank you for sharing And then so like you've mentioned,

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00:20:28,900 --> 00:20:34,015
you know, being involved with all these kind of different projects throughout your time. Like

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00:20:34,015 --> 00:20:39,520
where do you can see like your next, next future steps going in terms of your researcher projects

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00:20:39,520 --> 00:20:43,720
that you may be interested in getting involved with? Um yeah that's a great question. I there's I

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00:20:43,720 --> 00:20:48,190
think not likely to be any immediate change just given the time scale of the projects I'm

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00:20:48,190 --> 00:20:52,060
involved in. I mean DUNE is something that is certainly going to be going for at least the next

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00:20:52,060 --> 00:20:57,310
10 years or so. I am actually getting interested in some other different aspects

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00:20:57,310 --> 00:21:02,320
of some of the projects that I, data analysis and data acquisition so that I'm

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00:21:02,320 --> 00:21:08,140
um the networking on, but I you know I'm imagining that DUNE is going to keep going for awhile.

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00:21:08,140 --> 00:21:13,270
Um as for COHERENT, we've certainly got several years of…very good data ahead of us.

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00:21:13,270 --> 00:21:18,865
So that's also not finishing soon. And in fact there are pretty exciting opportunities for

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00:21:18,865 --> 00:21:21,955
expanding that. There's what's being built at Oak Ridge is a second target station of insulation

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00:21:21,955 --> 00:21:25,720
neutron source, which will be an additional neutrino source for us.

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00:21:25,720 --> 00:21:30,730
And there's actually some really interesting possibilities for building new neutrino detectors,

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00:21:30,730 --> 00:21:34,825
actually possibly an optimized location to do really expanded

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00:21:34,825 --> 00:21:38,920
physics. So you know, I'm envisioning for the future a

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00:21:38,920 --> 00:21:43,780
much expanded and enhanced physics program really extending the reach of what COHERENT can do

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00:21:43,780 --> 00:21:48,520
now. In fact in, you know, where, we are far from maxed out, what can be done with with CEVNS

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00:21:48,520 --> 00:21:51,940
physics and related physics for low energy neutrinos. So

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00:21:51,940 --> 00:21:55,690
I can see a good couple of decades of exciting

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00:21:55,690 --> 00:22:00,070
physics ahead for that. And you know you never know there's new ideas, pop up.

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00:22:00,070 --> 00:22:03,490
I can't, I can't say that I won't find some other

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00:22:03,490 --> 00:22:07,180
interesting idea to work on in the meantime, but I certainly see

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00:22:07,180 --> 00:22:11,200
a good program for the near and medium term future for sure.

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00:22:11,200 --> 00:22:17,650

Yeah. Very cool. And then like sort of wrapping this up a little bit, what type of advice

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00:22:17,650 --> 00:22:24,385
would you have for, say students or young researchers kind of pursuing physics as as

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00:22:24,385 --> 00:22:30,580
a career? Yeah. I guess I guess maybe my my biggest advice would be have fun.

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00:22:30,580 --> 00:22:36,415
You know, I guess that one thing I think that is really important for success long-term, is also

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00:22:36,415 --> 00:22:42,370
to make sure you're in a supportive social research environment

301
00:22:42,370 --> 00:22:46,450
or you know a group where you are are happy.

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00:22:46,450 --> 00:22:49,480
You know, I think that actually makes a huge difference and, and in fact the

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00:22:49,480 --> 00:22:54,010
institution is less important than you know, can matter.

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00:22:54,010 --> 00:22:58,360
But it's less important than the local research group that you're in, you know, and I think I've

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00:22:58,360 --> 00:23:02,050
been fortunate throughout my whole career starting in in undergrad

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00:23:02,050 --> 00:23:05,560
and going into grad school that I was always in a research group where I felt

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00:23:05,560 --> 00:23:09,910

comfortable and, you know, things were actually it was actually fun.

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00:23:09,910 --> 00:23:15,070
You know, I think some people end up in research groups where it's super stressful.

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00:23:15,070 --> 00:23:21,880
and their advisors are constantly making life stressful for them. You

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00:23:21,880 --> 00:23:28,660
know, I certainly, when I advise students that is not my goal. I do not advocate at all

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00:23:28,660 --> 00:23:33,670
putting pressure on students such that they feel miserable. It's just, there's just no point to

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00:23:33,670 --> 00:23:37,150
that. I mean it's it's just not, no.

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00:23:37,150 --> 00:23:41,680
Okay I mean, when you're doing research there are times when you have to work hard.

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00:23:41,680 --> 00:23:44,980
And, you know, it's, that's where you get the rewards from. If you

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00:23:44,980 --> 00:23:48,370
work hard and you succeed in something, that's the best, right?

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00:23:48,370 --> 00:23:55,180
But it's not worth it to work so hard that you make yourself ill, you know, that you destroy

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00:23:55,180 --> 00:23:59,440
your personal life, you know, or or you you know you you

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00:23:59,440 --> 00:24:03,730

suffer in some some way. So I, it's just not worth it you know?

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00:24:03,730 --> 00:24:08,110
My philosophy is if it's not fun then why why bother?

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00:24:08,110 --> 00:24:12,670
And so I guess that would be my advice is is to try to find yourself

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00:24:12,670 --> 00:24:19,420
a research environment where there is, where the point is to enjoy the research, you know, to

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00:24:19,420 --> 00:24:24,640
really make sure that you're you you have an environment where you're going to,

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00:24:24,640 --> 00:24:27,280
where you're going to thrive. And, you know, people are also different, you know, there's some

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00:24:27,280 --> 00:24:33,310
people who just thrive on working really hard and getting a lot done all the time. And

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00:24:33,310 --> 00:24:37,960
that's okay. That's also fine. I also don't believe in enforced

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00:24:37,960 --> 00:24:42,280
recreation. Or you know, it's, some people are perfectly happy working all the time.

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00:24:42,280 --> 00:24:45,895
I'm one of them. But most people many people don't thrive that

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00:24:45,895 --> 00:24:49,900
way, you know, they need time off and that's totally fine.

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00:24:49,900 --> 00:24:55,540

And I think everybody has to kind of find the rhythm at which they're your most productive and happiest.

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00:24:55,540 --> 00:25:01,870
So, I guess I guess that would be my advice is to find the place, find the research environment where you

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00:25:01,870 --> 00:25:08,410
where you have the space to optimize your own productivity and, and life. Yeah.

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00:25:08,410 --> 00:25:11,770
So then kind of on that note, I'm curious like what do you find

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00:25:11,770 --> 00:25:15,790
fun or fun or enjoyable in like the work that you do? Yeah.

334
00:25:15,790 --> 00:25:20,380
So a lot of things. I mean it's not just one thing really. I mean I think one of the really best

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00:25:20,380 --> 00:25:26,470
things is when you work really hard on something and try to figure it out and it's all, doesn't make any sense

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00:25:26,470 --> 00:25:30,190
and there's often a whole period where it's really frustrating and nothing nothing works. And

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00:25:30,190 --> 00:25:34,255
then when suddenly it works and you figure it out, you know, that that's really, that's really

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00:25:34,255 --> 00:25:39,340
great. I mean I really enjoy actually working on physics and I actually unfortunately have to say

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00:25:39,340 --> 00:25:43,990
in my life these days, there's so much overhead,

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00:25:43,990 --> 00:25:48,700
you know, Krantz and reports and letters and all these kinds of things that I have to do and

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00:25:48,700 --> 00:25:53,080
the older you get the more you have to do with these things that I tend to have very very little

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00:25:53,080 --> 00:25:57,355
time for actually really sitting down and doing some physics. But for me those are the best times

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00:25:57,355 --> 00:26:01,870
I can actually do that. If I can actually sit down and work on something and, and figure out some

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00:26:01,870 --> 00:26:07,060
some physics problem or solve a problem that a student is having, or the problem that I'm having

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00:26:07,060 --> 00:26:10,570
or whatever. Those those are the best the best times and I actually do

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00:26:10,570 --> 00:26:14,440
make some effort to try to make some, make some time for that.

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00:26:14,440 --> 00:26:18,340
Although unfortunately it's, it's… not nearly as much as I would

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00:26:18,340 --> 00:26:24,040
as I would love to have. I feel inspired by your answer… Yes.

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00:26:24,040 --> 00:26:29,980
And maybe that's another piece of advice to students is that there are times when it feels like everything is a mess.

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00:26:29,980 --> 00:26:35,335
It's not working. You don't understand anything. It's it's it just seems like, you know,

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00:26:35,335 --> 00:26:40,960
we're never going to figure this out, we're never going to get it to work, but it does. It always does. There's always some way to

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00:26:40,960 --> 00:26:44,080
to solve the problem. Yeah. Yeah. Well thank you for

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00:26:44,080 --> 00:26:47,650
coming on and talking about your experiences and your work.

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00:26:47,650 --> 00:26:52,540
It was great talking with you. Yeah. Thanks for thanks for having me and thanks for doing the series.

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00:26:52,540 --> 00:27:11,448
We hope you enjoy today's episode. This podcast was created by Bryan Stanley and Professor Huey-Wen Lin. Season two was edited by Varalee Sakorikar. Thank you for listening.