- Since I was a kid, I was interested in astronomy, but when you are a kid, you don't know much. So for me at that time, my struggle was just with that, and I was like, "Oh, I'm interested in that." To be honest and to be like very truthful, I was interested in being an astronaut, because, well, which kid isn't? But-

- I know that feeling.

- Then after a while I figured out that being an astronaut is a dangerous business. So then I just decided to stay on Earth and study the stars. I was like, "I can stay on the planet."

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- Welcome to another episode of "Further Together: The ORAU Podcast." As ever, it's me your host, Michael Holtz, in the communications and marketing department at ORAU. And it is my pleasure to be speaking with a number of NASA Postdoctoral Program fellows. And I have another one of those spectacular people with me today, Abhishek Desai. Thank you so much for joining me and for sharing a little bit about your story today. I'm so glad that you're here.

- Thank you for inviting me. Yeah, I'm happy to be here.

- Awesome, thank you so much. So let's just jump in, and Abhishek, if you would, tell me a little bit about who you are, your current role with the NASA Fellows program, and then a little bit about your background. How did you get here?

- Sure, so I am, like, I originally came from India, and I did my bachelor's in India in engineering, actually, electrical engineering. And then I went from being an electrical engineer to coming to USA to do my master's in astronomy because I always had an interest in astronomy, and then I went from there. Basically it was physics and astronomy. So I went there to do, from there, to Clemson University to do my PhD in physics and astronomy again. And then I went to do a postdoc at IceCube. So basically that was in Wisconsin-Madison. And then from there, now I'm here at NASA to continue my work with IceCube, like neutrino stuff and high-energy astrophysics. So basically I've been all around the US and a little bit India, but yeah.

- I was just gonna say you've hopped all over the country from the south, from the south to the north.

- And all the weathers.

- Yeah, right. Right, so talk to me, if you would, about what your fellowship, what your research focuses on. You mentioned neutrinos and IceCube. Talk a little bit about what that means.

- Sure, so basically, neutrinos are these highly elusive particles which just travel large distances or actually just travel without being attenuated or without interacting with anything. And even if there is an interaction, it actually doesn't destroy the neutrino. It just keeps on going. So these are these particles that you can actually not detect like light. So basically if you're looking at light from like a distant galaxy or star, you can just measure it and say that, "Oh, okay, we observed something." But with neutrinos, it's very difficult. So just to give you a scale, there are about like a trillion neutrinos passing through us right now at every second. And like, we actually cannot even see them. We cannot even feel them.

- Right.

- And there is this huge detector called the IceCube Neutrino Detector at the South Pole. And what it does is basically it has, these light detectors are inside the ice, and when the neutrino passes through the Earth and passes through the ice, it creates some particle interactions, which causes them to just create like this flash of light. And IceCube, this IceCube detector, picks up that flash of light, and then it says that, "Okay, we found a neutrino from this particular direction." And my job-

- Oh, wow.

- Yeah, it's very amazing because it's something that you actually can see, but there is this huge detector. It's a cubic kilometer detector inside the ice, and that can actually find something. And my job is to try to figure out if these neutrinos are coincident with light that we can observe from NASA telescopes and see if there are distant galaxies that are emitting them or actually our own galaxy that is emitting them. So my work at NPP is going to focus on that too, study AGNs, which are like distant black holes, and then try to figure out if neutrinos are coming from them or not.

- Wow, so basically it's sort of origin of black holes where-

- Sort of, yeah.

- Where did they come from, where are they coming from.

- Yeah, so it's basically these black holes have huge jets that are coming from them, and there are different type of black holes. There are some black holes which will be not emitting jets, but they are just rotating at really high speed, and there is this dust and gas around it. And they might have a jet, they might not, but basically this is why we need the NASA telescopes. So then we can figure out the observations, like the photon observations from them. And the neutrino detectors would just figure out that, okay, there is some more neutrinos coming from that particular direction.

- I got you.

- And I have actually simplified it a bit because the neutrino detectors that I'm talking about, it basically has a really huge background from our atmosphere. So what happens is when the IceCube Neutrino Detector is detecting the neutrinos, it sees about like 100,000 neutrinos per year. And out of that, about say, 100 neutrinos would be actually coming from outer space, so like from the astrophysical. So it has to separate out those 100 from the 100,000. So there is like a huge background. So it's a bit complicated also, but like that's how it is.

- So it's almost like weeding out the interference from-

- Yes.

- From the background noise from what you're actually trying to see or detect.

- Exactly.

- Okay, gotcha. That I can understand. But it generally sounds complicated, and it sounds really interesting and like important research to figure out, you know, where those particles are coming from. So it just sounds fascinating. Abhishek, have you always been... You mentioned earlier that you've kind of been interested in astronomy, you know, for a long time. Has that always been an interest for you?

- Yeah, so since I was a kid, I was interested in astronomy, but when you are a kid, you don't know much. So for me at that time, my struggle was just with that, and I was like, "Oh, I'm interested in that." To be honest and to be like very truthful, I was very interested in being an astronaut because, well, which kid isn't?

- But-

- I know that feeling.

- Then after a while, I figured out that being an astronaut is a dangerous business, so then I just decided to stay on Earth and study the stars. I was like, "I can stay on the planet." I don't wanna leave the planet. And then I went from there to like, okay, I want study astronomy, but I don't know which field. So like the country, I have been in all astronomy fields also. So I started from stellar astrophysics, so basically just looking at stars, to high-energy astrophysics to go into these black holes, to neutrino astrophysics, which is basically particle physics, and then coming back to a combination of high-energy astrophysics and neutrino astrophysics. So in that manner also, I have been all around studying both extra-galactic and galactic. But yeah, I think I'm focusing on now the black holes and neutrinos.

- But yeah.

- Gotcha. So studying space from Earth, I like that.

- Yeah, in a safe zone.

- Well, exactly.

- With a computer, I'm happy with that.

- Absolutely. So where are you in your fellowship? What year? Have you started? What year?

- Yeah, I just started it, so technically this is my second week.

- Oh, so brand-new.

- I'm very new because that's why I'm taking the call from outside because my apartment is not set up yet. I'm that new. But-

- I gotcha.

- But thankfully I'm not new to the field because I have already, I've already been because when you are doing an NPP fellowship, we do submit the whole project description and the proposal. So there's already some work that we do about about it. So for the work that I'm going to do at NASA, there is some stuff. So basically you need observations from NASA telescopes, like I said, so I had submitted some proposals earlier, last year basically. So I am using like x-ray data from the NICER telescope, and I already started analyzing the x-ray data using NASA tools. So basically those things have already started, but not as an NNP fellow.

- I gotcha.

- But now I'm going to do it as an NPP fellow with more NASA expertise, yeah.

- More officially, right?

- Yeah, more officially and with more help because I do need the help from the x-ray experts here.

- Right, right, and that's an important point and question for me, is, you know, obviously you can't do this alone. So talk about the importance of collaboration in the work that you're doing and that you will be doing, yeah.

- It's extremely important because I'm collaborated with a lot of people. So basically because I'm working with the IceCube Observatory, I am technically collaborated with the whole IceCube collaboration. I forget how many people are there, but, I don't know, more than three or 400. But like there are quite a bit of people in the collaboration. Plus I am also going to use camera data from the Fermi telescope. So that is also, again, a huge collaboration, so the Fermi-LAT collaboration. So those two are like the external collaborators. The more close collaborators which are really focused on my work are people from my PhD, so the university where I got my PhD from, so, Clemson University, the professors and students that I worked with during my postdoc, my first postdoc, so basically at University of Wisconsin-Madison and basically the collaborators that are here. And it's important because all of them provide a different expertise. So for example, my postdoc advisor gives me expertise for the high-energy astrophysics part. My PhD, so my postdoc, the professor that I was working for with my postdoc, he gives me the expertise for the neutrino stuff. The students give me an expertise for writing the proposals because, well, they're grad students, so I can use them. But jokes apart, like, it's very helpful because they are really hard-working and motivated, and it helps me also learn how to mentor students. So I'm already working with two of the students from University of Wisconsin-Madison, and they are part of like pseudo projects that have come out of this main big project.

- Okay.

- So, they're all-

- Collaboration is huge. Like, you're working with a lot of people on this project.

- Exactly, yeah. It's huge because the IceCube collaboration and the Fermi-LAT extends all over the world, I think.

- Right.

- I'm not sure about the countries, but definitely a lot from Europe and, well, America.

- Right.

- But like, yeah, these are all huge collaborations. And because IceCube is at the South Pole, obviously there'll be more collaborators which I don't even know about, but like, yeah.

- Right.

- But it's a huge one.

- Do you ever hope to go to IceCube and see it in person?

- Yes, but not work there as a winter-over, so that is also again an extreme. Yeah, safely, because you can visit IceCube for a week or two and then come back, which is perfect.

- Right.

- But if you want to work there as a winter-over, you'll be stuck there probably six to eight months without any way to come back, which is something that I don't want to do, but like, yeah.

- No space, no outer space.

- Yeah, no South Pole.

- No Antarctica for six to eight months, but I like that.

- The thing is I do want to go to IceCube. One of the more reasons is not because of the observatory because the observatory is inside the ice. There's nothing I can see. But more because of the auroras because you see like amazing auroras there.

- So, if you see-

- Oh, yeah.

- If you see IceCube pictures, you'll be amazed at the pictures that they have seen. Like, it's crazy. So the sky is amazing there, so that's the only reason I want to go.

- I bet it's gorgeous, so that would be worth a visit anyway.

- Yeah, exactly.

- Abhishek, are there elements of working in STEM that you have found to be particularly empowering for you?

- Yeah, so basically collaboration is the biggest element because like, it's like collaboration is the main thing that keeps them going. And when we are working together, it's like... Because the thing that I like about STEM and STEM researchers is that whatever is happening in the world, because science is the main importance for us, in the end, people come together and makes sure, like, the science survives, like these journal articles, journal publications, other public, like ORCID maintainers and stuff like that. All of these things are important because they all like come together, and they make sure that the science is still alive.

- Right, okay.

- And I like that because that way as a scientist, whatever you are getting paid, you still are motivated to continue the science and move forward in life. So that is something that I find really encouraging. Plus, discoveries help.

- Yeah, right.

- The smallest of the discoveries is like, oh my God, there is something new happening, and you get that excitement that, yeah, I need to work on this.

- Right, and you get to be part of that and then continuing to find hopefully new discoveries.

- Yeah, exactly, so it's like you can build up on discoveries, and that's again the part of sort of a collaboration and sort of the whole STEM, is you cannot do anything alone.

- Right.

- Whatever you have achieved, we cannot say like, "Oh okay, I am the one who has done everything alone." It's always like building upon the work that has been done, and then you can achieve more and more stuff, but like, yeah.

- Right.

- It's just the drive to find the new things.

- Right, sure.

- And to learn more stuff, yeah.

- Absolutely. Abhishek, have there any obstacles that you've had to overcome? I mean, I realize you grew up in India. You're in Eaton now, so I don't know if that, you know, part of it maybe is cultural or part of it's just life in general, you know?

- Yeah, yeah, there were quite a few actually. But, so like it ranged from a lot of stuff. For example, like when I came from India, I didn't know about the PhD programs here, so I didn't know that you could do actually a directly master's plus PhD and get a tuition waiver. And I enrolled in a master's-only program, and I ended up with a huge loan on my head, which is like something that no one wants when they start.

- Right.

- So that's something that has been a bother because like when you are in a science field and going from master's to like a PhD student, you get paid like a low stipend. So you cannot pay off a tuition loan with that.

- Sure, sure.

- So it keeps on... You keep on getting that thought that, "Oh, I want to leave science, and I want to go to, say, data analysis, go into industry, just pay off everything and then continue." But the thing is like, that's what I was saying because that's where the STEM researchers come into play because when you are talking with your collaborators, when you talk with people who have done amazing research, you see that, okay, you just have to continue working. Like, it will take a long time, but like after some time, the problem goes away, so.

- Right, right.

- And it's something that my dad had always said that was actually sort of also an obstacle because sadly, my dad passed away between when I was in my PhD. But my dad himself had always said that whatever happens, you need to like, keep on going because it's like, you have worked so hard to get here. So all you need to do is just keep on working hard and not give up, basically.

- So-

- Right.

- Yeah, that is something that has also helped. So there have been obstacles, but you just need to keep on going, in my opinion.

- Right, absolutely. I know that mentorship is really important in science as well. Are there specific mentors that you can point to that have helped you get to where you are today? It sounds like even just getting your NPP proposal, you know, there were folks who mentored you to get to, you know, the fellowship itself.

- Yeah, yeah, for sure. So for the mentorship, I would start from the non-scientific engineering mentor because it's my dad. So he was my first mentor because he taught me how to write stuff basically.

- Okay.

- So, my first statement that I've ever written is so crappy. Like when I read my first statement, it's really bad. Like it's like, "Oh, I dream to be a scientist." But like my dad had always given me like good scientific suggestions about how to get forward. My mentor here at NPP, Regina Caputo, she has also helped a lot trying to make sure that my proposal is more NASA-centric. So the problem is again, like I said, that I am talking about IceCube Neutrino Observatory, and because I've been working with IceCube so long, my proposal turned out to be an IceCube proposal rather than a NASA proposal.

- Okay.

- While I'm trying to say something that I want to use NASA thing, it is still reading in a different manner. So Regina gave all of these tips that, okay, you need to adjust the way you write. And say, my postdoc mentor and both my PhD mentor, Marko Elo and Justin Vanderbrook, both of them also kept on giving me suggestions for like different proposals. So whatever proposals I've written with all of them have actually helped me get to this stage and write the proper NPP proposal, which actually got accepted. So I don't think any mentor is small. Every mentor is important.

- Right.

- And there are many that I have not mentioned. Actually, even the students. So students I would not consider as my mentors, but we have still circulated small, small proposals to students. And that is something that we have a drawback with because like, my background is from India. Sometimes some of the stuff that I write might not be perfectly clear, or it might be in a twisted line or something. So, native English speakers or basically speakers who are from like USA, they will give you suggestions that, "Oh, okay, this line, we are not getting what you meant by this line." And it helps because we are so used to it, we don't see it, but like if an undergrad says that, "Oh, I don't understand this line," it's like, "Oh thanks, I never knew you could not understand this line." So then I would just modify it, so stuff like that.

- So you can make it better, yeah. That makes perfect sense. Abhishek, have you had the opportunity to mentor? It sounds like with working with undergrads, you've had the opportunity to be a mentor to other students. What is that like from your perspective?

- It's a very different experience. So basically I've mentored grad students and undergrads, and it's a very delicate balance of trying to give knowledge while also trying to stay cool. Because by cool, I don't mean cool in the literal sense by cool. I mean in a temper state because sometimes some students can be, not challenging, but like, they would be hesitant to work in a particular direction or work in a particular manner or with the speed that you are interested in working with. So basically you learn from your advisors about how to deal with students because they are not you, right? So you cannot expect the same thing. Like, okay, they're not going to work like I'm going to work with. And it's a different thing because you need to find their strengths and then work with their strengths. And it works sometimes-

- Gotcha.

- Because like in the beginning, I had some issues where I would be like, "Oh, okay, why are not working like this? I would not say that, but in my brain I would think that, "Okay, they can do better." And then I figured out that, okay, their strength is something else, so I can way much more out of them if I work with their strengths rather than trying to make them like me.

- Right, choose to work on.

- So it's basically a learning experience for me and for them, basically. So I feel it's important to mentor also because it improves ourselves, not the students, ourself basically.

- Right, it improves you as a mentor.

- Yeah, exactly, so it's important.

- Abhishek, if you were to talk to someone, to a young and up-and-coming researcher who's following in your footsteps, what would you tell them?

- So if anyone who is just following, I'll just say that don't give up, for sure. Don't give up on science. Science is worth it.

- Awesome.

- And I would just say that, just keep on going, basically. Like, if you are writing a proposal, if it didn't get accepted, don't worry. Just keep on writing. Like, to be frank, this is my third NPP proposal that I had written, so two of them were already rejected. The first one was for a project that, well, it was long time back, and then basically I didn't give up on the project, but it's not that big of a project, I just found a bigger project. So we are still working on that on the side. And the second one for the project was like, was the same thing that I talked about, like Regina mentioned that, okay, it's more IceCube-centric. So it was literally the same proposal I had written, but it was more in an IceCube manner.

- Got you.

- So, it can be something very simple like this. It can be just modifying some statements, trying to get some more observing time on a extra telescope. Just don't give up. Just keep on working hard. Just keep on writing proposals. Keep on just doing whatever your field requires you to do, but don't give up. That is the only thing I'll tell people.

- I love that. That's perfect. And last question, Abhishek, what brings you joy?

- Traveling. So, I love traveling.

- Okay. Really?

- Yeah. Well, people would expect me to say science, but like, traveling brings me more joy, I'm sorry. And for that, actually science is the best field because if I am a researcher, and if there are conferences, I can travel around the whole US-

- Right.

- Which I have done actually because the last conference was in Hawaii, so.

- Okay, nice.

- If you stay a researcher, you can go to Hawaii for free.

- Right.

- So yeah, I needed some fresh air.

- Awesome. Well, Abhishek Desai, thank you so much for spending this time with me and telling me a little bit more about who you are and about your research as a NASA NPP fellow. I really appreciate it.

- Thanks, thanks for having me.

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