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Sara: Welcome to Blueshift, brought to you from NASA Goddard Space Flight Center. I'm Sara Mitchell. When you think about astronomy, and looking out into the universe, a lot of objects probably come to mind - twinkling stars, swirling galaxies, mysterious black holes, and wispy nebulae. But I bet you don't spend a lot of time thinking about something even more common, more universal... dust. Yes, dust. There's plenty of dust in space, and unlike the annoying stuff here on Earth that you're always trying to clean up, it's actually a valuable resource out in space. We interviewed Dr. Christina Richey to learn more about interstellar dust and her research here at NASA and out in the field.

Sara: Hi, Christina. Thank you for joining us at Blueshift. Can you tell us a little bit about what you do here at Goddard?

Christina: Yeah, sure. So, I am a NASA Postdoctoral Fellow. Postdocs are a type of position that you get right after you get out of grad school before you become a career-level scientist. I study optical properties of interstellar dust grain analogs. Let me tell you what that actually means in English.

So, what I study are analogs that are produced in a lab of interstellar dust grains. Interstellar dust grains are these tiny little grains of either silicates or carbonaceous materials that form from late evolution stars in their stellar winds or come out of supernova explosions. And they go kind of off into space, they get extremely cold, ices condense on them. By ice, I don't just mean water ice. I could mean carbon monoxide, carbon dioxide, and all these different molecules. These ices from on top of these interstellar dust grains in this area called, "molecular clouds," and when those molecular clouds gravitationally collapse down, they form protostars, baby stars.

So, what I study is the formation of stars, planetary systems… but I do that via silicates we make here in the lab at Goddard. So, the way we study them is we take spectra of them. We look at the silicates in different wavelengths of light. I look in the infrared, and we compare that to what we see from observational data via SOFIA, ALMA… James Webb will be one of the future ones, Herschel, Spitzer… So all of these different space telescopes that are out there that will take spectra of silicates, and we'll see those observations back, we'll compare our data with that data to tell us what those interstellar dust grains are made out of, what temperature they're at, different compositions of say, irons or magnesium within them so we just look at particular properties within them.

Sara: What's useful about this or what's important about this in the study of astronomy?

Christina: I like to say, "this is what we all came from." Interstellar dust grains are where the building blocks of pretty much life, everything comes from. So, when they collapse down and

form that protostar, you also have these interstellar dust grains nearby that will be within the planetary debris disc that will form. Some of the types of interstellar dust grains we see now, we can trace directly back to cometary grains, so grains on comets.

It's important for not only the formation of stars, but of planetary systems. So, pretty much the formation of the universe, our solar system…

Sara: Just that.

Christina: Yeah, just little things like that.

Sara: So you're studying really small stuff to figure out how bigger stuff was made?

Christina: Yes. I study stardust.

Sara: It's a useful thing. This seems like a pretty rare thing that a lot of astronomers don't get to do, studying something in person with an application to astronomy. So, how is that different, you know, what makes that a different way to explore the universe?

Christina: It's very different compared to what you see from your typical astronomer because pretty much most of the people I know here at Goddard are observational. So, they actually study stuff that's coming back from space.

The thing is, there are some unique properties in space that are different than the system we have here on earth. Namely, we have gravity affecting things here. We have an atmosphere. So the amount of pressure within the system is much lower in space, and we can actually simulate that in the lab.

So, I'm different in that I'm kind of one of the… I don't want to say mechanics of astronomy… but lab astrophysics is very different in that we're doing hands-on stuff. To go with that, though, we have to change pump oil, we have to know how systems operate within a mechanical way. I have an aeronautical electrical engineering background. My Ph.D. is actually in Physics; it's not in astronomy. So, it's using Physics and using engineering aspects to study a lot of the astronomical sciences.

Sara: What's the most exciting thing you've found so far?

Christina: The most exciting thing I've found so far has been actually in my Ph.D. work. So, before I did interstellar dust grains, I would study the ice that formed on top of the interstellar dust grain. And, we used to study how objects would irradiate those ices. So, sorry, not objects, stellar objects nearby. So, baby stars, how they would affect these ices on top of the interstellar dust grain. And, I was working in the Cosmic Ice Lab here at Goddard with their group, and we used proton bombardment on a water and carbon dioxide ice to create carbon monoxide. And

when we did a UV photolysis experiment, so another type of radiation on that same ice, we formed carbonic acid, which is kind of like the fizzies in your pop.

So, it's really cool to be able to create this type of chemistry with just easy, basic building blocks. And the reason why we're able to do that is because of the temperatures we operate at. So, I work everywhere from room temperature all the way down to 5 Kelvin, extremely cold. So, the other really cool thing about my job is I get to play with liquid nitrogen and liquid helium on pretty much a daily basis. It's dangerous, especially liquid helium, but it can be a lot of fun, too.

Sara: You like it cold?

Christina: Yes. I'm a chill kind of person.

Sara: I don't know. You have pretty good intensity. You've gotten to go to some really cool places because of the things you do. Can you tell us about some of your adventures.

Christina: There's the typical conferences that scientists get to go to, and I typically go to planetary sciences conferences. The Division for Planetary Sciences actually just got back was in Reno, Nevada, but we were there to learn about the Dawn project, which just left Vesta, and I learned a lot about the Kepler Mission, and about some of the other upcoming missions such as the James Webb, and how the James Webb will actually study solar systems. That was pretty cool.

But some of the other cooler places I've been have been directly to do science work. So, I just went this past summer to Reykjavik, Iceland and to other parts of Iceland as part of the NASA Noric Astrobiology School for Water, Ice and the Origin of Life in the Universe. And it was basically a two-week long program where they brought in guest lecturers, the world's experts in geology, biology, physics, chemistry and astronomy.

We learned everything about what is life, how do you create it, and what type of hostile conditions can life handle? And then we tried to find life, which is relatively easy in Iceland, but you can find it in the craziest of places. We studied hot springs, we went onto a glacier… and the coolest one for me when we were doing this life analysis… we studied the different biomarkers, biosignatures for life, One of them which is called ATP. And we were looking for it in basically all of these hot style conditions, and the one really cool place where we found it… we were on top of E15, which is the volcano that went off in 2010. And I will admit right now, I cannot say how it's pronounced, but when we were on top of E15, on the volcano, in the lava field, which is still steaming two years later, we found a baby fern growing in the middle of the lava field. And you saw all the astrobiologists and geologists get so excited. And to know that life can survive in that, and actually prosper in that, we've gotta be able to find it elsewhere.

Sara: That's really profound.

Christina: Yeah, that was the craziest scientific adventure of my life.

Sara: Hopefully just so far.

Christina: I hope so.

Sara: You've got a lot of adventures to come, I'm sure.

Christina: Yeah, I'm trying to get it that way.

Sara: So, looking towards the future, as a postdoc, this is sort of an intermediary step between grad school and I guess the real world. Where do you hope to be after this? What do you hope to be doing?

Christina: One of my main goals is to become a permanent scientist somewhere continuing to study dust grains. And I want to go back to doing some ice work, too. So I want to do a combination of the both and really study how these things combine to form things where we can end up finding a planetary body or the rubble pile… how you go from these little crumbs to a rubble to a boulder to a planet.

So, I want to keep studying my science, but one of my big things that I'm passionate about too is outreach and trying to get young kids, especially girls motivated and interested in the sciences, so that's always going to be a part of my career from here on out. I'm hoping to stay with NASA. I love it here. It's been a good fit so far.

Sara: I think you've been a really good fit with our team.

Christina: Thank you!

Sara: Thank you very much, Christina.

Sara: Not long after we recorded this interview, Christina accepted a position as a scientist on contract to NASA's Planetary Science Division. We were sad to see her leave, but we're also really excited about the adventures her new job will bring!

To learn more about interstellar dust, and to read Christina's guest blogs about her research, visit our website at: http://universe.nasa.gov/blueshift

You can also keep up with us on Twitter or Facebook, where we're NASABlueshift. That's all one word. We always welcome your feedback, comments, or ideas about what you'd like us to talk about in the future!

I'm Sara Mitchell, bringing the universe closer to you with Blueshift.

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