Blueshift - Episode 4

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Sara: Welcome to Blueshift - the NASA podcast that brings the Universe closer to you! I'm Sara Mitchell.

Mike: And I'm Mike Arida.

Sara: And we're coming to you from the Astrophysics Division at NASA's Goddard Space Flight Center in Greenbelt, Maryland.

Mike: And boy, is it hot out today!

Sara: Oh, you're not kidding, Mike - it's like a steam bath every time I step outside.

Mike: I hate the heat.

Sara: You know where I'd rather be?

Mike: Where's that?

Sara: Hawaii.

Mike: Who wouldn't?

Sara: Well, some lucky astronomers were just there a short while ago, for the 210th meeting of the American Astronomical Society - we'll bring you a few choice clips from that meeting.

Mike: Clips of what? Hula music? Clinking glasses by the poolside?

Sara: A couple of those, but also some pulsars and black holes thrown in.

Mike: Now that sounds like a good time!

Sara: We'll also bring you an interview with the hottest scientist at NASA - John Mather, co-winner of this year's Nobel Prize in Physics.

Mike: Kim Weaver asks him, now that you've won a Nobel Prize, what do you do for an encore? His answer - build a bigger Space Telescope.

Sara: And finally, we've got another brain teaser for you - and this time we'll make you sweat for the answer.

Mike: It's Blueshift, Episode 4 - Cool Science for Hot Times!

Sara: But first, here's Caroline Kilbourne with science that's making the news.

Caroline: A galaxy like our Milky Way might produce just one or two supernovae every century. So it came as a big surprise when two stars were seen to explode just 16 days apart in the same galaxy, an obscure spiral 380 million light-years from Earth known as MCG +05-43-16. One of the supernovae was discovered on May 16 of this year. This supernova came from the cataclysmic explosion of a massive star. The other supernova was discovered on June 4, and it was produced by the thermonuclear detonation of a white dwarf. A few weeks ago, NASA's Swift satellite imaged the galaxy, and both supernovae were easily visible. This is first time astronomers have seen a pair of supernovae hit a galaxy with a one-two punch.

And speaking of galaxies - in one fell swoop, a team of astronomers led by Leigh Jenkins of NASA's Goddard Space Flight Center has bagged more than a thousand small galaxies! Jenkins and her team used NASA's Spitzer Space Telescope to target the Coma cluster, a giant cluster of galaxies 320 million light-years from Earth. Spitzer's infrared camera revealed tens of thousands of previously unknown objects, and follow-up studies revealed that about 1,200 of them are dwarf galaxies actually belonging to the Coma cluster itself. But since Spitzer only looked at a small portion of the cluster, there must be thousands more dwarf galaxies awaiting our discovery. Even though such galaxies are less than a tenth the size of our Milky Way, they play a crucial role in cosmic evolution, and they served as building blocks for the larger galaxies we see today.

With new discoveries every day, from extrasolar planets to black holes, we'll keep bringing you the headlines. For Blueshift, I'm Caroline Kilbourne.

[music]

Sara: When most people think of astronomers at work, they probably imagine scientists peering through telescopes.

Mike: Yeah, they probably think of grey-bearded old men, alone on a dark mountaintop at night.

Sara: Right. Those assumptions are way off.

Mike: Yeah, they don't all have beards.

Sara: They aren't all men, Mike. They also come in young and old, and encompass many nationalities.

Mike: And they do a lot more than just look through telescopes. Recently, our own Dave Thompson traveled to Honolulu, Hawaii, for the 210th meeting of the American Astronomical Society.

Sara: For 5 sunny days and 4 starry nights, over a thousand astronomers met for sun, fun, and above all, science.

Mike: And Dave brought us back this audio scrapbook.

Dave: Aloha from Hawaii. This is Dave Thompson, for Blueshift. I'm reporting from the 210th meeting of the American Astronomical Society, being held in Honolulu. I'll be talking to some scientists and other attendees at this meeting about what the meeting is like, what the interesting results are, and why they're here at this particular time.

[ukulele music]

Dave: I'm here this morning with Robin Corbet, from Goddard. Robin, we're standing in a fairly noisy room. Why would you be here, for this situation?

Robin: Well, I'm attending the American Astronomical Society meeting, here in Honolulu, in Hawaii, and there's a lot of exciting results being talked about here, both as presentations and posters. So I've come here to catch up on all the latest news in astronomy.

Dave: And right now, you're in the poster room and lots of people. How many people do you think there are here?

Robin: Probably several hundred, I don't know.

Dave: Several hundred, that would be my guess, too.

[voices change]

Dave: I'm talking to Erin Hudson. Erin, you're a student, right?

Erin: Yes, I am.

Dave: And where are you a student?

Erin: At Rose-Hulman Institute of Technology.

Dave: So you're an undergraduate?

Erin: Yes, I'm just going into my senior year.

Dave: And you're here at the AAS meeting in Hawaii.

Erin: Yes. It's my first meeting.

Dave: Are you enjoying it?

Erin: Yes, I am.

Dave: And you're here with a poster. This looks sort of like a science fair. Is it good to have a poster here?

Erin: Well, it's opened me up to talk to a lot of people, and also to be able to explain it to a bunch of different people with different backgrounds. It's really helped me make sure I know what I'm talking about! I'm following up on the result of Leigh Jenkins. Basically she found a large population of dwarf galaxies in the Coma cluster, and I'm doing some spectral energy distribution (SED) fitting to find out more about those galaxies.

[surf sounds]

Dave: I'm here in the poster hall with George Sonnenborn. George, are you enjoying being in Hawaii?

George: Oh, I love it! This is a great place to have a meeting, and it's a beautiful place to visit.

Dave: And you did your presentation here as a poster. Why did you choose to do a poster?

George: Well, the posters are great because you get to talk and interact with the people that are at the meeting, and have more in-depth discussions. And it's also a little more informal than standing up at a lectern, giving a lecture.

Dave: Sounds good. And your poster is something about O plus O binaries. Could you tell me a little bit about that?

George: Yeah, these O stars are the most massive stars that astronomers know about, and this is a binary system of two stars. So we have two very massive stars in orbit around each other. This system is unique because the two stars that are about 60 and 40 times more massive than the Sun orbit each other in a little over two days.

Dave: Two days?

George: Two days. These stars are dancing around, and they're almost in contact with each other.

Dave: Wow!

George: And this is the type of system that is going to produce a really big supernova at some point.

[explosion sound]

Dave: This morning, I'm talking to Joel Offenberg. Joel, can you tell me what the highlights of the meeting have been for you, so far.

Joel: Well, I think the thing that I most was interested in was an interesting talk about supernovas and the potential impact on life in other solar systems or, in fact, in our own Solar System. There's a big question about the radiation and particles that would come out of a supernova explosion, and what that would do to life forms nearby. It was a different field of astrobiology than I had really thought of before.

Dave: Sounds good. Thank you very much.

Joel: Thank you.

[ukulele music]

Mike: That was Dave Thompson, reporting from Hawaii. We also heard from Robin Corbet, Erin Hudson, George Sonnenborn, and Joel Offenberg.

Sara: Six months ago and half a world away from Hawaii, another scientist did something that no one at NASA had ever done before: he accepted a Nobel Prize.

Mike: The Nobel Prize in Physics for 2006 was awarded to the Astrophysics Division's very own John Mather, along with George Smoot of the University of California, Berkeley.

Sara: Kim Weaver met with Dr. Mather to chat about winning the Nobel Prize and science at NASA.

Kim: John, I'm thrilled to have you with us today. In October 2006, you received the Nobel Prize for Physics for your work with the Cosmic Background Explorer, also called COBE. What was the discovery that was made by COBE that gave you this Nobel Prize?

John: Well, okay, there were two major discoveries that we made with this satellite. One was to measure the spectrum of the cosmic background radiation, which is the heat radiation from the Big Bang itself. And our measurements showed that it exactly matches the theoretical prediction that it would have if it were really the residue from the Big Bang. So, this basically is the strongest proof we now have for the Big Bang theory, and that it was hot at the beginning. The second discovery of the mission was that the Big Bang radiation is not the same brightness in every direction. It's almost exactly the same, but not quite. And so, these little hot and cold spots are considered to be the seeds that would eventually grow into the structures of the Universe that we see now today, with galaxies spread out in gigantic patterns hundreds of millions of lightyears across. And that is all traceable back to the Big Bang and its hot and cold spots.

Kim: How did you feel the first time you saw the temperature data that told you that you had made the discovery that COBE made?

John: Well, I didn't realize yet at that time how important it was, because it was exactly what I expected. I thought I knew what the right answer was. But it certainly turned out to be more important than that, because there had been decades of wrong answers and good theoretical explanations for wrong answers that really did cast doubt on the whole idea of the Big Bang as the story of the Universe. About the hot and cold spots, we didn't know that at the beginning. But by the time that COBE was launched, the theorists were very strong that we had to find them or else something was really bad.

Kim: Well, I want to ask you a question about the Nobel Prize, just a little bit. Most scientists, even myself, think about what it would be like to win a Nobel Prize. What was it about the ceremony in Stockholm, and the experience of the whole thing, that was just as you expected it would be?

John: Goodness, well, they did explain to us in advance what it would be like, and the nobelprize.org website is very good about explaining what the great banquets and the great ceremonies will be like, and what it will be like to meet the King and to have dinner with the Queen of Sweden. But the feeling of being there, it's not possible to convey you the information. And the feeling is much more like you really did something important. Your name is up there with Albert Einstein and a lot of other very famous people that you read about in books and you studied what they did. And the idea that our project and our names are on there, too, is just sort of hard to absorb.

Kim: What about the experience really surprised you?

John: I think the big surprise was enjoying the great party that the students throw at the very end. I was inducted into the Order of the Ever-Smiling and Jumping Green Frog, which is a student organization. And it was so much fun. I now have a small pendant of metal that I can wear on my neck as a member of this little student organization. So they have a good time. This is a fun party they do.

Kim: So I'm interested in knowing a bit about your childhood. You were born in Virginia, and grew up in New Jersey. When did you become interested in astronomy?

John: I think I was about 7 or 8 years old, and my parents took me down to the Museum of Natural History in New York City, where there's a wonderful planetarium show. And in those days there was a model of the Solar System, you could watch the planets go around. Also, Mars was extremely close to the Earth that year, and everybody was hoping that we'd be able to see the canals on Mars, that people still thought might exist. So they didn't turn up. But my father bought a little telescope from Sears-Roebuck, and we brought it home and tried to see the canals on Mars, and, anyway, it was a very exciting time. It was before there was space travel in peoples' minds.

Kim: So when specifically did you become interested in cosmology and the early Universe?

John: Well, I think that happened when I was in graduate school. I knew the basic idea of the Big Bang story, it was already pretty well known when I was a college kid. And I'd even read already some stories in popular books by George Gamow, who had explained it all and worked on it himself. But my thesis topic turned up when I was just wandering around looking for what am I going to do to get a PhD.

Kim: So this was an outgrowth of your thesis project?

John: Yes, in fact the COBE satellite is basically my thesis project on steroids.

Kim: Excellent. So you were in your 30s, then, when you became the Lead Scientist for COBE, right?

John: Yes. Actually, I was 28 when we submitted the proposal. I was only a few months out of graduate school.

Kim: Wow.

John: And so that was one of those great surprises in life. I was not expecting to ever do cosmology again, because my thesis project seemed very difficult. I thought, I'll do something else.

Kim: Sure.

John: But then, NASA had this announcement of opportunity, and it seemed like the obvious thing to do, to pursue this. The big reason the thesis project was difficult was the interference from the Earth's atmosphere. And if we could get an instrument out into outer space, it would be so much better. So it was pretty obvious that we should try this if we could. I didn't expect that we would be chosen.

Kim: So that was my next question - how long did it take for them to approve it? Was it approved the first time?

John: Oh, not at all! In fact, in 1974, it turns out there were three proposals, related proposals on the cosmic background radiation, and none of them were chosen. But in 1976, just two years later, NASA chose a team of six people that included members from all of those three groups, including the one that I had organized. Then we started off in earnest, we had a set of engineers and managers assigned to us to work with at NASA Goddard Space Flight Center, and we actually made a much more detailed plan. And that then survived all challenges. We finally were approved to start construction in 1982. So, took quite a while to get the plan mature, and also for resources to become available.

Kim: Another thing I wanted to ask you about, you were recently named one of Time magazine's "100 Most Influential People in the World." How does it feel to have this sort of popular recognition and acknowledgment now?

John: Well, it's sort of funny, a little bit washes over me because the Nobel Prize is so ultimate that nothing else can really top that.

Kim: Nothing else can top it.

John: And the recognition is for something that was done by a wonderful team quite a long time ago. NASA projects are huge team projects, huge teams of dedicated people give their lives and their time and they accomplish these most amazing things. So, there's something that's magic about that.

Kim: Well, you are the Project Scientist for the upcoming James Webb Space Telescope. How does the cosmology of COBE and the Big Bang that you work on relate to some of the things that JWST will do?

John: Okay, the Cosmic Background Explorer certainly showed us the very first moments of the Universe, and told us through a lot of theoretical calculations what we think the first stars and galaxies might be like. But they've never been seen. So one of the great goals of the James Webb Space Telescope is to see them directly. So it clearly needs a bigger telescope than we've had before. The Hubble has shown us objects back to maybe a billion years after the great explosion. We hope to see the things that led into those objects, the precursors, the subminiature galaxies that eventually would grow together to form galaxies like our Milky Way. So our aim here is now to piece together the whole history of the Universe, from the Big Bang through the first stars and galaxies, to the formation of the Milky Way, formation of our own Solar System and our own planet, and the possibility that life can exist on our little planet. I don't think of it as hard work.

Kim: You have fun!

John: Seems to me that what I am doing is interesting and important, and I like doing it. I work as much as I can, because it's what I want to do.

Kim: Excellent. John, thank you very much for speaking with us today here with Blueshift. I'm Kim Weaver.

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Sara: Dr. Mather is currently the NASA Chief Scientist and the Senior Project Scientist for the James Webb Space Telescope. You can learn more about COBE, cosmology, and NASA's only Nobel Laureate on our website at universe.nasa.gov/blueshift

Mike: Now, here's Steve Fantasia with this episode's brain teaser.

Steve: This time, we've decided to mix things up a bit. It occurred to us that it is easy for anyone to get the answer right when you give it to them. So, we're not going to do it that way this time. No, this time you'll need to flex that brain and get those lazy fingers up off the couch and do some clicking.

Anyway, the brain teaser. Seems physicists are finally getting some recognition outside of their ivory towers in the pop culture world. Many are listed within the 100 Most Influential People, including our own John Mather. There are references to them in some of our most popular television programs. Of course, the ultimate intersection of popular culture and physics would have to be The Simpsons. Didn't know that, did you?

So, our question this time is: what real-life, Nobel Prize-winning physicist has made an appearance on The Simpsons? Think about this one, now. No, not the time-traveling toaster episode. No, not the one with Santos L. Halper. I'll give you a hint - it's not John Mather.

If you think you know the answer, visit us at our website and submit it. If you're the first one to submit the correct answer, you'll win a fabulous new... well, we will announce your name as "the winner" on our next episode. Well, that's all I've got. Teasingly yours, I'm Steve Fantasia. Back to you, S and M. D'oh!

Mike: And that's gonna wrap it up for another episode of Blueshift.

Sara: No actual astronomers were harmed during the recording of this episode.

Mike: I don't know, I think I got heat stroke in here.

Sara: If you can't stand the heat, Mike, get out of the studio!

Mike: Well, you can find us on the Web at universe.nasa.gov/blueshift

And we'd love to hear your comments about the show -- please let us know what you want to hear in future episodes as well.

Sara: And be sure to send us your answers to this episode's brain teaser.

Mike: So catch up with us next time and we'll have the answer, plus a whole lot more!

Sara: From NASA's Goddard Space Flight Center, I'm Sara Mitchell.

Mike: And I'm Mike Arida.

Sara: You've been listening to Blueshift - the NASA podcast that brings the Universe closer to you.

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