Blueshift - June 18, 2009

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Sara: Welcome to the June 18th, 2009 episode of Blueshift, brought to you from NASA's Goddard Space Flight Center. This summer, we'll be sharing a series of episodes about something near and dear to every scientist's heart - data. Where does it come from? What does it mean? And what makes it beautiful?

To kick off the series, we wanted to explore the delicate balance between scientific data and pretty pictures. We've all seen the gorgeous images that come down from the Hubble Space Telescope. They've been displayed in galleries alongside work by masters of art. But not every piece of data that comes down from a satellite is so typically "pretty." It all starts out as a bunch of zeroes and ones, and then scientists take it from there.

We asked Nobel Laureate John Mather about what makes data beautiful to him.

Mather: Data are beautiful when they tell a story. When I can see in my mind?s eye, at least, what they mean. I think the main objective that we have is to explain ourselves well so that people can understand it. It's an art form. Especially if something's complicated. So we like to have animations, we like to have graphic artists sketch out what's going on, even if we can't a picture of it directly.

It's interesting to think how the COBE data were presented to the public. When we measured the spectrum of the background radiation, nobody printed it in the newspaper. We printed it in the Astrophysical Journal and astronomers applauded when they saw it. When we measured the map of the background fluctuations, the hot and cold spots in the Big Bang itself, that was carried on the front page of the newspapers around the world. It was an image, we could understand it, feel, picture an image a lot better than we can a graph. Stephen Hawking said it was the most important discovery of the century, if not of all time, so that helped to get a little of attention on it. But basically it's a pretty picture, and we worked quite hard to make sure that the pretty picture explained the thing that we wanted it to explain as well.

It seems to be that we have to do everything we can to give the science to the public that they want. Conveying the information to other scientists isn't so easy either. We need the pictures, we need the movies, to develop our own visceral understanding, our physical intuition about things. I need to see the movies too.

I think it's worth a lot of attention to portraying the information in the best possible graphic way. To make something that I as a scientist think is beautiful. Then I can say, "Hey Mom, this is what I found! This is why

it's so beautiful and exciting!" And so we have to give it the necessary work so that we can explain it. We do after all have computers now. 100 years ago, 50 years ago, we had pencils, and sliderules, and it was really hard to make these animations and illustrations.

One of the reasons, by the way, that Galileo's discoveries were so well known was that he was a good artist. He could draw. So he looked at the images of Jupiter and the Moon and draw the little mountains and then got them published. For centuries now, the ability to do graphic illustrations of what scientists have found has been critically important.

Sara: Dr. Mather is the project scientist for the James Webb Space Telescope, which has been named as the successor to the Hubble Space Telescope. Hubble is almost certainly NASA's most visible space science satellite - so those are big shoes to fill! We asked Dr. Mather - how will James Webb follow in the footsteps of Hubble?

Mather: The Hubble is the only Hubble we have. It's the only telescope that covers the ultraviolet and visible range that we are not looking at with it. And it's upgraded one more time to be better than ever. So we expect the most gorgeous pictures as well as the most important scientific results to be coming back any time now. What the James Webb Telescope will do is to extend the scientific discoveries farther out into the.. .towards the beginning of time, farther in to dust clouds where stars are being born. And so every expectation tells us, from the simulations we've done that it's going to have be beautiful things to show us, images for the public as well.

Sara: Hubble looks at the Universe in the visible portion of the electromagnetic spectrum - the part of light that our eyes can perceive. James Webb will capture infrared light. Will that look different?

Mather: I think the public won't be able to tell that it's infrared. We have to explain it. When we make images, we always use a computer. And the computer always adjusts the colors to what is going to tell the story for us. So we'll have to do the same thing with infrared. We already do. We have infrared observatories in space now, and we'll have some more. And we've learned how to do that, we use false colors. Usually try to put them in the same wavelength order that we see with our own eyes, so that the shortest wavelength in the false color image will be blue, and the longest wavelength in the false color image will be red, so that our minds are accustomed to taking in that information and interpreting it right. But sometimes. we do it different ways for different... just to explain something. But usually that's how we go at it. Try to make it as similar to what visible images would be if we were just able to perceive those wavelengths.

Sara: Some of Hubble's most famous data - both as science and as art - have been its observations of the Deep Field. These were long-exposure observations of a seemingly blank area of the sky, which produced an image of thousands of galaxies and other objects in a spot where we'd previously seen nothing. We asked Dr. Mather how the James Webb Space Telescope will follow or build upon that work.

Mather: The JWST will examine the same place in the sky, will take many weeks of exposures in those places, and what we would expect to see is everything that Hubble saw, plus some things that Hubble could not see. Things that are either too far away, and so therefore they are either very faint, beyond the reach of Hubble, or they're at longer wavelengths than what Hubble can pick up. So we would see the same places, plus some new things.

Sara: NASA has satellites pointed at objects all over the night sky, and looking back down at Earth. They send back terabytes of data. Sometimes it's stereotypically pretty, and sometimes it's the sort of picture that only a scientist could love. But the purpose of data is really to tell a story, to answer a question or unravel a mystery. It's a plus when you also get a gallery-quality picture to hang on the wall. As Dr. Mather said, data is a valuable part of communicating science. And at NASA, we work hard to share our data with you.

To learn more about data, and to see some pretty pictures, check out our website at universe.nasa.gov/blueshift

You can also follow us on Twitter as NASAblueshift. Join us next episode when we continue our summer series about data. We wanted to know - how does data get from the satellites to you?

This is Sara Mitchell, bringing the Universe closer to you with Blueshift.

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