Blueshift - Episode One

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Steve: Hello, I'm Steve Fantasia.

Maggie: And I'm Maggie Masetti.

Steve: Welcome to the March 2007 episode of Blueshift, produced by the Astrophysics Science Division at the NASA Goddard Space Flight Center in Greenbelt, Maryland.

Maggie: Yes, the first episode! Pretty cool. We've got endless possibilities and lots to learn. Such as... what is an Astrophysics Science Division, and what do we do here? I get that question a lot when I tell people I work at NASA.

Steve: Ah, yes, the whole, "That sounds very interesting. Um, what exactly do you do?" routine.

Maggie: Well, when you say you work at NASA, most people think you're either an astronaut or a rocket scientist. Those people certainly do work for NASA, but NASA also does a lot of scientific research about the Earth, the planets, and the larger Universe. That's our Division's main job - we study the Universe beyond the Solar System!

Steve: We also design scientific instruments, balloon experiments, satellites and software that try to answer basic questions about the Universe we live in. We study everything, from the big bang to black holes, distant galaxies to supernovae, using many different kinds of light - from the kind we can see with our eyes to ones we can't see, like infrared, X-rays, and gamma rays. We also study cosmic rays...

Maggie: ...which aren't really rays...

Steve: ...and gravity waves, which aren't even a part of the electromagnetic spectrum! Using satellites like the Hubble Space Telescope, WMAP, Swift, and Suzaku, we are trying to figure out the origins and ultimate destiny of the Universe around us. We are also the home of Dr. John Mather, who just won the Nobel Prize in Physics!

Maggie: Now, we may be able to peer into black holes, but we're just getting our feet wet when it comes to making podcasts.

Steve: So sit back, subscribe, and hold on tight as we explore the Universe!

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Maggie: In this, our first episode of Blueshift, we want to give you a taste of what we actually do here. We're involved in building many exciting new telescopes, and one of them is called the James Webb Space Telescope. We'll tell you about this satellite and talk with a couple of scientists working on this project.

Steve: But to get your brain warmed up before our feature story, we have a challenge for you! Here's Louis Barbier with this episode's cosmic conundrum.

Maggie: Ooh, trivia! Great - let's hear it, Louis!

Louis: Since it's our first show, we thought we'd start with an obvious choice. It's about the title of our podcast. Why do you think our podcast is named "Blueshift"?

Here are the choices:
A. It's the change in the mass of a blue star, indicating it's about to go supernova.
B. It's the early evening shift at a telescope, when the sky is still blue outside.
C. Our normal language would never pass broadcast standards.
D. It is the name for the shift of a star's light toward the blue end of the spectrum.
E. Many of us like the bluesy style of B.B. King.

Think you know the answer? Well, we'll be back at the end of the show to fill you in and make you smarter.

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Dave: Here at Goddard Space Flight Center, some of the most exciting work is on new satellite missions. I'm Dave Thompson. Joining me today are two scientists who will be telling us about the James Webb Space Telescope, or JWST. My first guest is Matt Greenhouse. He's the project scientist for ISIM. That's the Integrated Science Instrument Module on the James Webb Space Telescope. Welcome, Matt. Tell us a little bit about what James Webb Space Telescope is.

Matt: Well, the James Webb Space Telescope is the successor to the Hubble Space Telescope. It's a NASA flagship mission that will allow us to carry on the scientific discovery of the Hubble Space Telescope and the COBE and WMAP cosmology missions. JWST is optimized to work in the infrared portion of the spectrum, from about 1 to 30 microns.

Dave: What are some of the key science goals of JWST?

Matt: One of the key goals is to observe the formation of the first stars and galaxies in the Universe, and then to observe how those early primeval galaxies evolve into the kinds of galaxies that we see in our own immediate surroundings. We then want to understand more important questions about how stars form in galaxies, under what circumstances planets form about those stars, and under what circumstances those extrasolar solar systems have habitable zones where life can form.

Dave: And is this a project that is ready to launch now?

Matt: It'll be launched in 2013. It's a very large, complex flight system that we've been developing since 1996.

Dave: And is this all being built here at Goddard?

Matt: No, it's being built all over the world. But the mission management is headed here at Goddard, and many important pieces of it are being built here at Goddard. However, the science instruments come from the European Space Agency and the Canadian Space Agency, as well as the United States.

Dave: Have there been particular technological challenges in building JWST?

Matt: Oh, quite a few. We've had to invent some significant advances in detector technology for the instruments on the telescope. We've had to do a number of inventions to enable the unique science instruments that are needed to do the particular science investigations that the mission is geared toward.

Dave: Matt, this is a big project. What's it been like working on JWST, and particular in working on it at Goddard?

Matt: One of the unique things that I like about working at NASA is that you're expected to do the impossible. That's very exciting as a scientist and as an instrument builder. You're not dissuaded from taking on seemingly impossible challenges, but rather it's expected.

Dave: I'm sure working on JWST has been obviously a long-term project, but one that has given you a lot of excitement. And I know that we'll all be watching for JWST's launch, and also the steps along the way. So, congratulations on making it this far, and thank you for being with us today on Blueshift.

Matt: My pleasure.

Dave: One of the exciting technologies that's being developed for JWST is the microshutter array. We're excited about this particularly because it's recently completed testing that shows that it will operate successfully through launch and space operations. Joining me now is Harvey Moseley. It's good to have you here. Could you introduce yourself?

Harvey: I'm Harvey Moseley. I'm a senior astrophysicist and I am the principal investigator leading the development of the microshutter system for the Near-Infrared Spectrometer on the James Webb Space Telescope.

Dave: What's a microshutter?

Harvey: Well, one of the primary scientific objectives of the James Webb Space Telescope is to study galaxies during the phase of the Universe where the first galaxies were forming. In order to do this, we have to observe a large number of very, very faint galaxies out at the edge of the Universe. Takes a long time to observe each one of these things, perhaps a day or more. In order to really be able to look at these very faint objects, we have to be able to observe many of these galaxies at one time. And the microshutter subsystem is a new technology that we're developing to allow us to do this science program a hundred times faster than we would be able to without them.

Dave: Wow, that's impressive! So, the shutters sit in front of your camera, or your spectrometer?

Harvey: You can imagine that the shutters are an array of little squares, like a checkerboard, but that each one of these little squares can be opened independently. Imagine projecting this checkerboard onto the sky. Some of the squares of the checkerboard will fall on top of interesting objects, and some of them won't. We will be able to open those that fall on objects of interest, so the light from those objects comes into our spectrometer. And we'll be able to close the others so that the unwanted light is rejected.

Dave: So how big are the squares on your checkerboard, of this microshutter array?

Harvey: Each of these little squares - they're actually rectangles and not squares - they're 200 microns wide and 100 microns high. The 200 microns is roughly three times the width of a typical hair you might pull out of your head.

Dave: That's tiny! How do you possibly open and close so many of these things?

Harvey: Well, the shutters can be opened magnetically. We put a magnetic coating on them so we can sweep a magnet across it and open them. Once open, we can capture them electrostatically and hold them open, and also then release all those that we wish to close.

Dave: So you've already built some of these. Who is actually doing the fabrication? Is it being done here right at Goddard?

Harvey: Yes, it's actually being done at Goddard, in the Goddard detector development lab.

Dave: Are there other applications that you can imagine for such developments?

Harvey: The same idea could be used in a number of other areas. I have no doubt that with an interesting new capability like this that there are very clever people out there that will find lots of applications that I haven't thought of.

Dave: Harvey Moseley, it's been a pleasure to have you here. Thank you for joining us on Blueshift.

Harvey: Thanks a lot, Dave. I enjoyed being here.

Dave: You can learn more about the microshutters, and all of the other cool new technology being developed for JWST, on our website. For Blueshift, I'm Dave Thompson.

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Steve: In future episodes of Blueshift, you will hear headlines about the latest research and technology in astrophysics. We'll pick one of these breakthroughs and explore it in more depth.

Maggie: You'll also hear interviews with the people who work around here. They're a multi-talented group whose abilities range from doing Nobel Prize winning scientific research to producing musicals in their spare time!

Steve: We will also challenge you with a new trivia question each episode. And in our mailbag segment we will answer your questions - so visit our website and write to us!

Maggie: We're filling our website with plenty of other resources. We've got transcripts, pictures, links, and all of the other stuff that we can't fit into a podcast. We've also got a feedback form, where you can send us your questions and suggestions. We'd love to hear from you about what you'd like to hear more about in future episodes! You can find our website at: astrophysics.gsfc.nasa.gov/podcast

Steve: Hey, Maggie, aren't we going to give the answer to that trivia question?

Maggie: I guess it's about that time, isn't it? Are you ready, Louis?

Louis: Here's our cosmic conundrum, once again. Remember the question: why is our podcast named "Blueshift"?

The choices were:
A. It's the change in the mass of a blue star, indicating it's about to go supernova.

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E. Many of us like the bluesy style of B.B. King.

Well, have you heard an ambulance passing by? [siren sound] As the vehicle approaches you, the pitch of the siren sounds higher. But then after it has passed, the pitch of the siren sounds lower. This is the result of a phenomenon called the Doppler effect, named after the Austrian mathematician and physicist Christian Doppler.

We observe the Doppler effect on sound and all sorts of electromagnetic radiation, or light. You might have heard of "redshift," a term commonly used in astronomy. When an object is moving away from you, the radiation emitted by it is stretched out, or "redshifted," and its wavelength appears to get longer. In sound, this is what makes the ambulance siren sound lower after it's passed you.

Blueshift, as you may guess, is the opposite of redshift. When an object is moving toward you, the radiation emitted from it is squeezed, or "blueshifted," and its wavelength appears to get smaller. This is why the ambulance siren sounds higher pitched as it comes toward you!

So the answer is D: it's the name for the shift of a star's light toward the blue end of the spectrum. We chose the name "Blueshift" because our mission is to bring the Universe closer to you.

Though many of us do like B.B. King, of course. Well, this is Louis Barbier, and I'll be back next time with another cosmic conundrum.

Steve: For Blueshift, I'm Steve Fantasia.

Maggie: And I'm Maggie Masetti. Thanks for listening to our first episode of Blueshift. We look forward to bringing the Universe closer to you each month with new stories and interviews.

Steve: And don't forget to visit on the web at: astrophysics.gsfc.nasa.gov/podcast

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