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Press Conference:

"SHUTTLE RETURN TO HUBBLE"

SPEAKERS:
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BILL GERSTENMAIER, Associate Administrator for Space Operations
MARY CLEAVE, Associate Administrator for Science Mission Directorate
PRESTON BURCH, Project Manager, Goddard Space Flight Center
DAVID LECKRONE, Senior Project Scientist, Hubble Space Telescope Project

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P R O C E D I N G S

MR. ACOSTA: Good afternoon, and welcome to our Shuttle Return to Hubble press conference.

Let me introduce our participants today. To my left, the NASA Administrator, Dr. Michael Griffin; to his left, the Associate Administrator for Space Operations, Bill Gerstenmaier; to his left, Science Mission Directorate Associate Administrator, Dr. Mary Cleave. To her left, we have Preston Burch, and then to his left, Dave Leckrone.

All right. We are going to go through some short prepared remarks by our individuals and participants, and then we will open it up to questions. I ask that you please identify yourself and identify who your question is for before asking it.

All right. Dr. Griffin?

ADMINISTRATOR GRIFFIN: Well, I don't really have any prepared remarks. So I will skip on down the line, and we can go to Gerst.

MR. GERSTENMAIER: Okay. I don't have any prepared remarks either. So we will just move on down the line.

[Laughter.]

MR. ACOSTA: I shouldn't have said prepared remarks. Just remarks in general, if you have anything to say.

MR. GERSTENMAIER: I would like to say it is great to be here representing the Shuttle team that is ready to go do this mission. Again, I think through the Return to Flight activities that was just done, we have proven the basic concepts and the basic techniques that are needed to go do the Hubble mission, and it is great to be able to be here today and to be able to be in the process of starting the plan and starting to train for the Hubble mission that is coming up.

MR. ACOSTA: Mary?

DR. CLEAVE: Well, on behalf of the scientists in the area, we are thrilled at the opportunity to potentially have 4 more years of science out of Hubble, brilliant science out of Hubble, looking forward to the new instruments, looking forward to potential repair, and I would just like to thank Bill and his team and Mike and everyone for providing this opportunity. We really didn't think it was going to happen, and we are thrilled that it is.

MR. BURCH: I can say that looking back on the last 4 years, without reservation, today is my happiest day to be at the office, and I think the same is true for everyone who works on the Hubble Space Telescope.

We owe an enormous debt of gratitude to the folks at the Johnson Space Center, Kennedy Space Center, the Marshall Space Center and others for their hard work in making the needed improvements to the Space Shuttle, so that we can now go back to Hubble safely and make the upgrades and repairs that will enable us to continue our amazing voyage of the scientific discovery with the Hubble Space Telescope.

This next servicing mission can be likened to those extreme make-over reality shows on TV that are so popular today.

On Servicing Mission 4, we are going to give Hubble another extreme make-over. This make-over will be the best one yet because we will outfit Hubble with the most powerful and advanced imaging and spectrographic instruments available, and we will extend Hubble's operating lifetime for 5 additional years, which should keep us operating until well into 2013 and possibly longer.

Work on these new science instruments and the replacement hardware has been underway for several years. The Congress and our NASA Administrator asked the Hubble team to continue working on the mission during the past few years to enable us to do this mission as soon as possible, if and when the Space Shuttle became ready again, which we now know it will be.

All of the Hubble servicing missions make extensive use of the Shuttle's enormous cargo bay and spacewalking astronauts. Servicing Mission 4 will be the heaviest servicing mission to date. We will be carrying approximately 22,000 pounds of hardware up to Hubble to do Servicing Mission 4.

We will be using four carriers inside the Shuttle cargo bay to carry all the new science instruments, replacement hardware, and tools for the astronauts, and to attach Hubble to the Shuttle while the astronauts are working on it.

One of these carriers utilizes an advanced design and composite materials to save weight, so that we can carry even more equipment.

We will install two new science instruments on

Servicing Mission 4, the Wide Field Camera 3 or with C-3 as the bullet, and the Cosmic Origins Spectrograph, the COS.

We will also change out all six gyroscopes, change out all six batteries and add thermal insulation under the mobiles, new outer blanket layers, to three of the electronic space on Hubble.

One of the fine guidance sensors will be replaced. An over-voltage protection device will be installed, and a flow-up capture mechanism will be attached to the back end of Hubble to facilitate the future deorbiting of Hubble at the end of its useful life.

Finally, we will attempt to repair one of Hubble's science instruments, the Space Telescope Imaging Spectrograph, or STIS, which stopped working in August of 2004.

Servicing Mission 4 will be similar to the previous Hubble servicing missions.

Servicing Mission 4 will require four astronauts to do spacewalks over a period of 5 days. The astronauts will operate in teams of two, and the teams will go spacewalking on alternate days, so that they can rest up between spacewalks.

Each day of spacewalking is planned for 6 hours of work, upgrading and maintaining Hubble. This work is physically and mentally very demanding, and it requires a lot of planning, training, and other preparations.

Each day after the new hardware is installed and the astronauts return to the Shuttle's crew cabin, the Hubble team on the ground of Goddard Space Flight Center will perform tests to ensure that everything works properly.

Although we do a lot of astronaut training at Goddard using the actual tools of a flight, hardware to training the astronauts, we also do a lot of training at the Johnson Space Center and facilities such as the neutral buoyancy laboratory, which you can see here on the video, to simulate the environment in orbit.

The attempt to repair the STIS (Space Telescope Imaging Spectrograph) will be the first time on Hubble that we will open up a complex piece of hardware to fix it in situ. This will be a very intricate piece of work. The Hubble team has built some clever and unique tools to meet the challenges of this task, and the astronauts worked closely with the Hubble servicing engineers to make it feasible to repair STIS within one EVA day.

When SM-4 is completed in 2008, Hubble will be ready to probe deeper into the universe to make more exciting discoveries.

Here to tell us about the exciting future science that will be enabled by Servicing Mission 4 is Hubble's Chief Scientist, Dr. David Leckrone.

DR. LECKRONE: Thank you, Preston. Good afternoon.

The first thing I want to do on behalf of the literally thousands of scientists around the world who used the Hubble Space Telescope regularly is to give our thanks and gratitude to NASA, to the Administrator, to the Johnson Space Center, to the people who work on the whole program every day, to have stuck with it so long and to have worked so hard to lead to this very happy day for the future of science.

I would like to briefly talk about why we are doing Servicing Mission 4 from a scientific point of view, what is important about this.

It is pretty simple to answer that. Up to this point, Hubble has not approached the limits of what it is capable of doing, and with the new instruments that we are going to put on board and the restoration of this fifth instrument and buying ourselves an additional 5 years of lifetime, I think we can begin to approach the ultimate limits of what Hubble was originally designed to do.

At the conclusion of this mission, after SM-4 is over and the astronauts have left, Hubble will literally be at the apex of its capabilities. There will not have been a time in its history when it has been as capable as it will be at that moment.

For one thing, we will have on board, we hope, six fully functioning scientific instruments for the first time since 1993. The Hubble is a general purpose, public facility, observatory, and it takes a whole tool bag full of instruments to provide the various tools needed to attack all kinds of astronomical problems, and that is the way Hubble has worked, and that is one thing that has made it so successful, its versatility.

Two of those six instruments will be the crown jewels, in my opinion, of this mission, the two new scientific instruments, the Cosmic Origins Spectrograph and the Wide Field Camera 3.

Cosmic Origins Spectrograph is the most sensitive ultraviolet spectrograph when placed behind Hubble optics. You have to have a good telescope in front of it, but then it is the most sensitive scientific spectrograph ever flown in space.

The Wide Field Camera 3 will enhance our survey capabilities on Hubble. Today, we have a wonderful camera, the Advanced Camera for Surveys, that was designed, as its name suggests, for that kind of objective, and I will show you an example coming from that in a moment, but it is limited primarily to visible and red light, light that you can see with your own eyes. With the Wide Field Camera 3, we will take that same surveying power and efficiency and extend it all the way from the ultraviolet out through the near infrared, of about 200 nanometers up to 1,700 nanometers, continuously covered with wide field, very precise, very high-resolution imaging.

What I would like to do in closing here is to offer two examples, one from each of these instruments, of what will make them so powerful.

So we have a video to show here for a moment, and if you in your mind's eye could take an imaginary trip across the present-day universe, this is what it would look like. You notice it is not uniform. It is not homogenous. It has the structure of what we call a web or cosmic web, sort of like a three-dimensional spider web. This is what is observed in surveys from the ground and elsewhere. This is what it theoretically predicted is coming out of the big bang.

What you see are filaments and filaments intersecting each other and voids amongst the filaments in this web-like structure.

The underlying skeletal structure here is composed of dark matter, and it is the gravity of dark matter that creates this structure, but coming along for the ride gravitationally is voluminous matter, galaxy, stars, and the gas between, and basically, the Cosmic Origins Spectrograph is intended to probe through the individual filaments or through the voids in the cosmic web and determine not only physical properties, but how those properties have changed with time, chemical composition, the pressures, densities, velocities, and the overall underlying structure of the cosmic web.

It will use the background, as background light sources, quasi-stellar sources or quasars, essentially as cosmic flashlights shining through the cosmic web, and then on this, the receiving end, that Earth, COS will take that light and spread it out and analyze it.

The second example -- and this pertains to the Wide Field Camera 3 -- I mentioned our Advanced Camera for Surveys, and we have a graphic that shows a fairly, routinely acquired survey field with the ACS in the sky, but embedded in this particular field in the sky is the deepest image across the cosmos ever made by humans, and it is the very famous Hubble Ultra Deep Field.

If we could bring that up next, I would appreciate it. There we are.

As I say, this is the deepest core sample ever acquired, and it required about a million seconds of exposure time, about 400 orbits of telescope time to acquire this, but this is a visible light image. To go deeper than this image goes requires this to go to the near infrared.

Let me show you an example of what has come just from the visible light image. This is the same field with the little blue squares in it, and you see the little postage stamp images to the right there.

Over 500 proto galaxies have been discovered in this image that emitted their light when the universe was between 700 million and a billion years old. They are among, or probably are, the most distant proto galaxies ever observed.

Again, to go deeper than that, we would have to go from visible light to infrared light because the universe is expanding, stretching the wavelength of light and so forth.

This final graphic is a little cartoon that illustrates why this is important. Think of time as moving from the right to the left, and over on the right, just off scale, is the big bang, which I haven't tried to display here, and then there is a period of time in the history of the universe where it was basically a dark place. It was filled with warm hydrogen and helium gas, but no sources of light as yet, and in any event, light had not passed through that very opaque medium, so Dark Ages as we call them.

You will notice on the bottom label, two times, 400 million years after the big bang and 700 years after the big bang. Right now, those are our best estimates of the interval of time during which the universe went from darkness to light. Essentially, that is the period of the nursery phase of the universe, when the very first stars were being formed, congealing into galaxies, into clusters of galaxies, and those stars and galaxies heated up the surrounding material, allowing it to go from being opaque to being transparent, so that light could pass through, and then we see the luminous, brilliantly lit universe that we see today.

Now, those 500 images that I showed you a sample from in the prior illustration from the Hubble Ultra Deep Field really sampled going from left to right to about that 700-million-year point. So we are just starting with Hubble to push into this region of re-ionization. We want to go deeper, and with the WF-3, the Wide Field Camera 3 and its infrared channel, we will be able to push even deeper, poking into this region.

Now, why is this very important? We are the scouting parties in the James Webb Space Telescope. The latter part of 2013, James Webb will fly. It will be a significantly larger telescope than Hubble, and it will go even farther into the infrared than Hubble can go. What we are hoping to do with this kind of a survey with Hubble is to set the foundation, set the stage to help guide the James Webb as it goes off into this unchartered region.

Thank you.

MR. ACOSTA: Thank you, Dave. Good lesson there for us.

All right. Let's start off with questions, and I ask that you please identify yourself and who your question is for.

We will start off on the front row here and go right here.

QUESTIONER: Hi. Jeff from [inaudible] magazine. I guess this question may be for Bill Gerstenmaier.

You described what is involved with having a longtime need capability. Are we talking about having a second Shuttle sitting on another pad, or what exactly are you going to have to do?

MR. GERSTENMAIER: Okay. In terms of Launch on Need, our current planning is we would have another orbiter ready to fly on Pad B, on 39-B, ready to launch in case some problem occurred that was not repairable or needed the rescue flight, and then it is available in a standby mode.

If it is not used for the rescue flight, then that same orbiter would then be outfitted with Space Station equipment and would then fly to Space Station kind of its normal mode. So that is kind of the ground configuration.

The challenge is that we were planning on passing that pad off to the exploration group to start modifying that pad for Constellation for a demonstration flight in 2009. So we are still going to do that. We are still going to give them the pad to start working on, but they are going to have the constraint now that they have to keep that pad essentially in launch-ready configuration.

So some of the modifications they were going to do, they are going to have to cut back and not make some of those mods, but they will still be able to do a lot of the work to get prepared for the exploration missions that are coming down the road.

So, again, we are still doing the planning for that, but that is the basic concept that we are putting together for the Launch on Need pad configuration.

MR. ACOSTA: Seth?

QUESTIONER: Seth Borenstein, Associated Press, for Preston Burch.

I know you have had the crew here oftentimes during the summer. Can you go through what kind of training you have done informally, how you have managed to do that sort of without having a mission technically, and has that saved any time to allow you to do it in May of '08 as opposed to whenever it would have been otherwise?

MR. BURCH: Okay. Basically, what happens is in the course of putting these missions together, we go through two phases with regards to the astronauts. We go through a development phase, and then we go through a training phase. The phase that we are currently in and starting to approach completion of is the development phase. So this is where we are trying out new tools and new techniques for the first time, and we are trying to make major advances in terms of getting the amount of time that it takes to particular tasks reduced.

When we get into the hard-core training part, at that point the emphasis shifts from developing new stuff to refining the choreography and making fine adjustments.

During the past several months, we have been focused pretty heavily on the STIS repair work and a lot of these tools that need to be developed for that, a pretty complex task. These are things that are all well within the capabilities of astronauts and humans to do on orbit, but we have had to develop some new tools and techniques, and there were some things that we needed to understand better about the electronics box on the STIS and its serviceability. So we are doing some new stuff here, but it has really come along very well.

And it has also given the astronauts an opportunity to get themselves reacquainted with the facilities here and some of the standard tools and facilities that we have at Goddard for servicing missions. The last mission was back in March of 2002. Folks get a little rusty, you know, after a 4-year layoff like that. So that has been what we have been focused on.

Did that answer the question? Okay.

MR. ACOSTA: Bob?

QUESTIONER: Bob Zimmerman, Freelance.

Actually, I have two questions. One, could you go into the details of what is the difficulty of preparing STIS, what the astronauts have to do?

And secondly, I would like to understand a little bit about the two gyro mode. Are you using the two gyro mode here on in, even after the gyros are replaced, or is there going to be some policy with intention of going to --

MR. BURCH: Okay. Let me start with the last question first.

We are currently in two gyro science mode. Hubble has six gyros that are capable of supporting the science mode. Two of them have failed, and they are off. Two of them are powered off and are spares, and so we are operating on two gyros at the present time.

Our plan is to continue to operate on two gyros from now until the Hubble Servicing Mission is accomplished. Actually, we are working on something that is kind of neat at one gyro science mode, and that will be ready in the spring of next year. We expect performance of that to be very comparable to what we have today with the two gyro science mode, but it hasn't been proven or demonstrated yet on orbit.

Once servicing is accomplished, then we have six brand-new gyroscopes, and we have them all checked out. At this time, the plan is to go back to three gyro science.

Three gyro science does give us more flexibility in terms of being able to schedule the astronomy target that we want to look at with time, but we are constantly reevaluating the benefits of things like that versus stretching the useful life of the HST.

As far as the STIS repair goes, there were two major challenges facing us. In order to get at the failed electronics board that is inside the STIS main electronics box, we need to take the cover off the box. We are very fortunate in that when the astronauts open the doors to the [inaudible] and they look at this instrument, that cover is sitting right there in front of them. So they can get relatively easy access to it.

The challenge was the 111 screws that are holding it on, and the screws are not captivated. So they have to go in there and take all these screws out. Well, you can imagine what went through a lot of people's minds when we first started thinking about this, you know, the 111 screws floating all around inside Hubble. That was unacceptable.

So we came up with a very clever device called the fastener capture plate which is basically made out [inaudible]-type material, and this plate goes over top of the MEB cover that is aligned and fastened on there. Then this fastener capture plate has a series of little holes in it that line up little screws. The holes are small enough to allow the tool bit to go in, so you can turn the screw, but they are small enough to keep the screw from falling out. So, once you get all 111 screws taken care of, the cover stays attached to the fastener capture plate and moves the whole thing out. So all the debris and all the screws is captured in there.

And then we have come up with an astronaut-friendly replacement cover. Once we are done servicing, they take the new cover, put it on, and there are two latches. They just throw the latches, and Bingo, it is on there, and then there is a third latch that they throw that has some fingers that grab the electronics board and mates them to the cover because this cover also acts like [inaudible].

Okay. So that was challenge number one. Challenge number two is actually getting the electronics board -- I hope I am not scaring Mike about this.

Have you heard this story?

[Laughter.]

ADMINISTRATOR GRIFFIN: Actually, yes.

MR. BURCH: Oh, okay. I haven't gotten, you know, the gaff yet.

So the second thing is the electronics board that has the power supply on it is pulling that out, and if you have ever fooled around with your desktop computer, those things usually aren't much of a challenge, but the way these instruments are built on Hubble, these boards slide into slots in the box, but they are held in place by things called wedgelocks, and the wedgelocks are designed to keep the boards from rattling around, and they also provide a heat path to reject waste heat up, the sides of the box, so things stay nice and cool.

Unfortunately, these wedgelocks have a property like these Chinese finger handcuffs that you may have played with as a kid. You know, you put them on, and the harder you pull, the tighter it gets, and you can't get your fingers out. Well, the wedgelock has this kind of a property, and when you loosen the bolts on them, sometimes you can slide the board right out. Sometimes you have to wrestle with it for a half hour or an hour to get it out.

We have one guy who is a technician at

[inaudible] Aerospace who knows how to do this really well, but we are not planning on putting him in a spacesuit and taking him up there. Even he, I think, is a little mystified about why sometimes he has problems and sometimes he doesn't. So we obviously needed a tool to overcome this problem.

So we have a hard extraction tool that was developed, and we went into a small research program to see. Even if these wedgelocks jammed in their worst possible way, could we pull the board out without having the board disintegrate and leave a pile of debris all over the place, and I am happy to report, we have come up with a tool that enables us to do exactly that.

So those were the major challenges. There are a few other things that need to be done too, before you take the 111 screws out. There is an astronaut handle and another small plate.

MR. ACOSTA: Okay.

MR. BURCH: Well, there are four different types of screws, and I have forgotten offhand what they are, but I think they are like [inaudible] and some slotted [inaudible]-type screws, that sort of thing.

I think right now, the astronauts can actually get all 111 screws out in 45 minutes.

PANELIST: Forty-five minutes.

One of the early worries was how long would it take and would they get the teeth and so forth, and now we envision a NASCAR wheel-changing operation.

MR. BURCH: Yeah. I actually bumped into a guy who is sort of, I would say, a minor wheel on the NASCAR, but anyhow, this guy is heavily involved. So I explained to him the problem. There are some similarities there when you see these guys come into the pit and they can take five lug nuts off in 2-1/2 seconds and refasten it. It is pretty impressive. So that is the goal, sort of.

MR. ACOSTA: NASCAR will appreciate the plug, I'm sure.

[Laughter.]

MR. ACOSTA: Let's go over here. I think Brian Berger has a question.

QUESTIONER: Brian Berger with Space News and Space.com.

I have a question of Mike, but anybody can chime in. That's fine.

You described a $900-million cradle-to-grave estimate for this mission as a lot of that being some cost. How much of that $900 million is money left to be spent, and what is the rough breakdown between Bill's budget and Mary's budget?

ADMINISTRATOR GRIFFIN: I don't have a breakdown for you between Bill's and Mary's budget, but cost to go is basically from now until May of '04 at 12 million a month to support the SM-4 team, so, what, 18 months, that is 12 million a month. I don't have my calculator. Plus, of course, the marginal cost of expended Shuttle hardware, as I said, around $100 million for a tank and a set of SRBs (solid rocket boosters) --I am not trying to put too many decimal places on it -- and then the cost of the actual launch processing operation itself, and then, of course, there will be a certain amount of processing for the Launch on Need Shuttle.

Now, notice that the Launch on Need Shuttle is not [inaudible] Station Shuttle. So you don't get to book-keep the cost of the Shuttle to the Launch on Need Mission, but any extra processing that would go on for the Launch on Need operation that in the end will not take place would be book-kept against Hubble.

So I hope that helps you, Brian.

MR. ACOSTA: Go ahead.

Brian has a follow-up.

QUESTIONER: As a quick follow-up, there was talk before about grandfathering in this plan that Space Operations Mission Directorate would pay for the Shuttle for this mission. Is that still NASA's plan, or will the Science Mission Directorate pay for the use of the Shuttle?

ADMINISTRATOR GRIFFIN: We will talk to you later on the breakdown between space ops and space science. Okay?

MR. ACOSTA: Okay. Next question. Let's keep it right in the next row, Mark Kaufman.

QUESTIONER: Hi. Mark Kaufman with The Washington Post. This is for the Administrator.

ADMINISTRATOR GRIFFIN: I enjoyed your article the other day, by the way. Good job.

QUESTIONER: Thank you.

The first question is about we know that there was a long process here of looking at whether or not to do the Hubble mission and that you had a lot of your people in on Friday, and I was wondering were there people who recommended against going.

ADMINISTRATOR GRIFFIN: Well, first of all, they are not my people. They are people who work for NASA, and we got together to discuss it. I didn't have them in.

[Laughter.]

ADMINISTRATOR GRIFFIN: I try really hard not to behave in that fashion. My mother would have disapproved.

We did have two meetings last week that were, to be honest with you, deeply technical in nature and somewhat extended. They were good discussions.

I don't believe I have talked to anyone in the agency, from flight crew to flight ops managers to even budget guys -- I don't believe I have talked to anyone who thinks that we shouldn't do this.

There was an earlier question, was there unanimity in the astronaut office about Launch on Need. No, there wasn't, and there is not unanimity among the engineers about Launch on Need or among the policy folks.

Part of why I exist is to resolve situations where there is not unanimity. If there is unanimity, you don't need me. So we resolved that by deciding that we would do the Launch on Need, and there will be some extra cost for that. I mean, life is hard, but you got to do what you got to do.

QUESTIONER: And a second question, the Senator was saying today that she was going to be sponsoring and promoting the idea of a billion-dollar supplemental, where you have been saying here the cradle-to-gave for Hubble is 900 million, or very close obviously, and I know that they are kind of apples and oranges to some extent, but when this is discussed in Congress, will there be an argument that this money is in some way needed for Hubble?

ADMINISTRATOR GRIFFIN: It is well above my pay grade to say what it is that Congress should or will discuss.

I serve the President and support the President's budget. Senator Mikulski was making a point that there was in the aftermath of Challenger a supplemental to pay for at least part of the cost associated with that loss, but there has not yet been one for Columbia, and many other programs in NASA were damaged to pay for Columbia, and it is her desire to make up for some of that.

If her amendment, her and Senator Hutchison's amendment passes, I am sure there will be some guidance from the Congress on how to apply it, but I don't have any comment on matters that at best could be speculative at this point.

MR. ACOSTA: All right. We are going to do one more question here before we go to Johnson Space Center, and of course, we will come back to here at Goddard. So bear with us. We will go right here for the last question before we go to Johnson.

QUESTIONER: Hi. This is Mark Mathews with the Orlando Sentinel. The question is for Preston.

What shape do you expect the Hubble to be in? How many gyroscopes will be working? How many batteries will be in order? What is the general shape of the Hubble?

MR. BURCH: Okay. Again, this is a little speculative too about where we will be with gyros.

ADMINISTRATOR GRIFFIN: Don't speculate.

MR. BURCH: Yes.

According to our best estimate of gyro availability, we think that the two gyro science mode is viable up until approximately October of 2008. So the planned window for this servicing mission is consistent with our ability to continue to operate in two gyro science mode.

Now, we are dealing with small-number statistics. Nobody can tell exactly when the next gyroscope is going to fail and which one it will be. Sometimes you get lucky, and sometimes not so lucky.

So the point in time that I was giving you the October 2008 is the 50/50 probability point, but inasmuch as we have got potentially a one gyro science mode coming online, I think we will be able to continue to keep science going until we get the service.

As far as the batteries go, for the first 2 years following Servicing Mission 3-B in March of 2002, we experienced an extremely deep loss of battery-charged capacity. We embarked on a program to try to understand and try to improve or try to bring into operation improved techniques that would ameliorate that.

Our measurements over the last 2 years seem to point to success in this area. The loss of charge capacity has pretty well flattened out over the last 2 years, but once again, it is like you trying to predict when is the battery in your car going to die. Batteries are basically a big electrochemistry experiment, and there are a lot of things going on in there that people don't fully understand, but we think right now the batteries will be fine, well into 2009 and probably longer. And then there is a lot of other stuff going on, but I think those are the main things that we are most concerned about.

MR. ACOSTA: Thank you, Preston.

All right. We are going to go to Johnson Space Center. I believe we have a couple of reporters with questions.

QUESTIONER: Mark Carreau from the Houston Chronicle for Mike Griffin.

I noted the challenge in the assembly of the Space Station and those missions. If you run into difficulties and that schedule gets stretched out, how long can you put off the Hubble mission until you would have to sort of give up on it? Do you have any idea on that, and what is your thinking on what takes priority?

ADMINISTRATOR GRIFFIN: Well, clearly, in both Presidential policy direction and law, the Space Station takes priority.

We strongly believe that we can accommodate the

Hubble mission without -- frankly, without significant stress to the Station manifest or we wouldn't be doing it.

We are trying for a launch in early May of '08. You know as well as I that missions slip, and as Preston just indicated, even if we slipped to October of '08, we will probably still be doing science operations, and if we are not, it is not a big deal because the telescope is emphatically not in any danger of degradation simply because if it would be unable to do science operations and is waiting for a repair, it is perfectly healthy and perfectly stable, and that is a real concern.

So we have a 6-month window there that we are planning in the manifest, and we are pretty sure we can get a flight off in that 6 months. If it would go longer, we would just do the mission at a later time.

It is very, very unlikely at this point that the telescope would become damaged before we can get to it, and that is part of our plan.

MR. ACOSTA: Gerst, do you want to add to that?

MR. GERSTENMAIER: Yes. The only thing I would add a little bit is we are kind of targeting for spring of '08 through fall of '08, and today, we currently sit on

Discovery, but we may very well move to a different orbiter as the manifest plays out. So we reserve the right to kind of change and move the manifest around as the Shuttle flights and Station flights occur and as the situation deems necessary on Hubble. So, if some things move on Hubble that are going and turning in a wrong direction, we will move some things around in the manifest to try to get the Hubble with more assuredly than we would if we were naturally in that sequence.

If we see some things on Station move around, you will see some things move around.

So I think at this point, you need to give us the degree of freedom that our manifest is going to move around. So don't think that there is a particular vehicle and a particular flight that is aimed. We want the ability to be flexible over the next year or so to kind of move that manifest around to optimize the needs of Hubble and to optimize the needs of Station. So, again, we will react to what life gives us, and we will change the manifest as accordingly to optimize for both programs.

MR. ACOSTA: Mark, I believe you had a follow-up.

QUESTIONER: Thank you very much for the first answers.

And for Dr. Leckrone, could you talk about what the improved telescope could do with dark matter and why that is sort of an important area of investigation at this point?

DR. LECKRONE: Right. As I indicated, the -- well, let me back up a second with something I wanted to say and didn't even take the time to do it.

The reason the Nobel Prize in physics that went to John Mather and the COBE (Cosmic Background Explorer) team here at Goddard and also to their colleagues in California was that work led directly to this picture of the universe as having kind of a cosmic web structure, a skeletal structure. That is dark matter. You can't see it. You don't know what it is, but you do know that it is about 24 percent or so of the mass energy budget of the whole universe. Whereas, the ordinary hydrogen and helium and other matter and so forth that make up you and me are roughly 4 percent of the mass energy budget of the whole universe. So this is a dominant source of ordinary gravity in the universe.

There is that ordinary gravity, starting at the time of the initial big bang and the tiny fluctuans in the cosmic microwave background that evolved into this skeletal structure that looks like a three-dimensional cosmic web.

So the short answer belong that extended prolong is that we will not learn directly very much at all about the nature of dark matter. That is going to be up to the highest energy particle accelerators and so forth. No one knows as of today what dark energy us -- sorry -- dark matter is. We don't know what dark energy is either, but what we will learn is more about the structure and particularly how it changed with time and particularly how its composition changed with time.

So the dark matter, I would like to think of it like a Christmas tree where the branches of the tree are dark in a darkened room, but the illuminated stars and galaxies are like the Christmas tree bulbs that you see. So they give you the shape of the dark matter, the shape of its structure, although you don't see the dark matter directly.

MR. ACOSTA: All right. I believe there is another question at Johnson.

QUESTIONER: Gina Sunseri, ABC News, for Bill

Gerstenmaier.

Bill, could you go into a little more detail? I am still not quite sure how far along processing will go on a Shuttle for Launch on Need. It will be on the launch pad as SM-4 launches when you have gone through TCDT (Terminal Countdown Demonstration Test)? Give me a little, if you can talk me through that process a little more, please.

MR. GERSTENMAIER: Okay. I think we are still putting all of the details together, but if you think about it just basically, we have about 25 days of on-orbit lifetime of the Shuttle that is up at the Hubble Space Telescope. So, if we need a Launch on Need, we have to be essentially within 25 days or so of being able to go launch that next Shuttle. So we will take it fairly far along in the count. We will probably be out at the pad. We will probably be fueled at this point. We probably will have done some kind of TCDT to be ready, and then we will be in that process.

And again, if you think about it, we are protecting for a fairly low probability event, but we are doing it in kind of a clever way. We are not going to be wasting that orbiter in any way, shape, or form. All of this activity we have done, all of the fueling, the TCDT, all of that activity will apply directly to that next Station mission. So all we will have is an empty cargo bay. That is a difference between a Station mission and this rescue mission is in a Station mission, you will have the Station cargo in the bay, and in this mission, you will just have an empty bay, and you will be going to a different inclination. So we will have to do the flight planning for a different inclination, but we will take it pretty far along in the sequence, in the processing.

The exact details of that will come over the next couple of months as we see how all of this folds together and we get more detailed planning together and see where it is, but, again, the goal is to optimize the use of this Launch on Need with the next mission that is coming, which would be the Station mission. So we will find lots of commonality between the two and minimize the impacts of this Launch on Need mission.

MR. ACOSTA: Plus, I think we should remind folks that we made the announcement of the decision today. We still work details. That is not unusual to --

ADMINISTRATOR GRIFFIN: Let me add a comment.

That is exactly the point.

What we required in order to make this announcement was to see a path through the wilderness to get -- as I had said earlier in my remarks, to get the yes, to get to a point where we knew we could do this.

The guys have got 18 months between now and when we launch to figure out smarter ways, and we expect them to do so, and we want a pat on the back for that, not a criticism if we change, you know, puppy to small dog.

We expect people at NASA to be flexible, creative, intelligent, and bold in their thinking on ways to be efficient and at the same time be careful, and I think that is what you will see.

MR. ACOSTA: All right. From Johnson, now we will go to Kennedy Space Center for a question.

QUESTIONER: Thanks. This is Todd Halvorson of Florida Today for Preston Burch.

Preston, what percentage of the original charge capacity do the batteries have at this point, and how fast would systems freeze up and a servicing mission become undoable if you have lost charge capacity completely?

MR. BURCH: Right now, it is approximately one-half of what we had -- it is a little more than one-half of what we had at launch 16 years ago.

Current Hubble system capacity is approximately 297 amphours. I think we had somewhere around 550 amphours at launch.

The batteries obviously are needed to support Hubble's electrical load when we are in the nighttime portion of the orbit which is approximately one-third of each orbital period, or about 35 minutes.

What happens when the batteries die is that we will most likely lose control of the observatory. We won't be able to -- systems won't be functioning, and things will start getting cold, and once that happens, in approximately 2 days, we estimate, temperatures will drop to a critical point where the metering truss, which has hardware mounted to it using titanium pads that are bonded on there, those bonds will become compromised. So we will not be able to guarantee the alignment of the various instruments and guidance sensors and other optical pieces on the metering truss. So we have about 2 days once we lose power on the observatory before it will probably become useless as a fine precision instrument.

MR. ACOSTA: All right. I believe, Todd, you have a follow-up.

QUESTIONER: Yes. Thanks.

For Dr. Leckrone, will this mission bridge the gap between Hubble and the James Webb Space Telescope, and can you talk about or elaborate on what you think the two or three cosmic mysteries you will be able to address are when you have six fully functional instruments?

DR. LECKRONE: Sure. Well, as I tried to imply earlier, yes, it absolutely will bridge a gap. It is good to know a little bit in advance about the territory in which you are embarking for the first time, and so we are hoping to provide basic information for the sciences who will be using the James Webb-based telescope that will allow them to ask the most intelligent questions or the most penetrating questions about the subject matter, and in particular, a major objective of the James Webb Space Telescope program is to thoroughly explore and understand this nursery of the universe when the first stars and galaxies were just coming into being, or proto galaxies.

So, yes, we will provide a bridge. I should comment, of course, we are not only slated here for a

5-year extension of our mission. Typically, in the space program, space observatories don't fail precipitously. They generally fail rather gracefully, and I think there is some hope that we might have a year or two as overlap with the James Webb Space Telescope, and that would be just terrific because we still do ultraviolet and optical in the James Webb that an infrared telescope is not able to do, and I think we could hold hands very nicely as a tandem set of scientific tools.

Let's see. Your other question, what are the major things we could do. I haven't said very much about the Space Telescope Imaging Spectrograph, but if we can repair it and bring it back online, it is a bit of a different instrument than the Cosmic Origins Spectrograph.

The Cosmic Origins Spectrograph is intended to focus on getting as far across the universe as quickly as possible, to be as sensitive as possible.

The STIS spectrograph is a much more versatile instrument. It has many different tools and capabilities for different kinds of science.

The STIS has the honor of having been the first instrument to directly detect and measure the atmosphere of a planet around another star, and we did that. We detected sodium. We detected oxygen. We detected hydrogen in one of the so-called "hot Jupiters" around a particular star.

Shortly thereafter, this failed, and it turns out now that there is a rather long list of candidate stars or candidate proto planets or candidate planets around other stars, XO planets, that scientists would really like to have a look at with STIS to see if they can do similar analyses and at least similar detections of their atmospheres.

In fact, in a very short time, just within a couple of weeks or so after STIS failed, Dave Charbonneau of CalTech, who is a principal investigator in this kind of work on Hubble, was lamenting, "Hey, I have got two more I was planning to look at with STIS, and now it's gone."

So I really believe that we should be able to get up to perhaps 10 or 12 XO planets whose atmospheres have been sensed if we can repair this instrument.

I think we will continue to make significant progress on the dark energy front. It is a statistics game. You just need to observe more and more of the [inaudible], the standard flight sources, the standard candles to tell you how far away a galaxy is in order to sample over different periods of time what has the expansion rate of the universe been, and simply the more systems like that you can detect, the tighter your error bars will be on the parameters that we are currently using to describe dark energy, and in particular, is dark energy changing with time or is it truly a constant, as Einstein's cosmological constant implies? And I think we can help answer that question with Hubble.

There are plans in the works for future dark energy missions. I think those are very valuable. I think those will be paradigm-shifting. Hubble has already shifted the paradigm by being a major contributor to the discovery of dark energy and helping to narrow down the range of possibilities for what dark energy is, but I think it is important that those future missions ask the right questions, and I really do believe we can push this field significantly farther with Hubble, so that when the time comes to build a dark energy mission, we are actually asking the right questions.

MR. ACOSTA: All right. We have one last question from Kennedy, and then we are going to go to

Headquarters, and then we will come back to Goddard.

Kennedy?

QUESTIONER: This is Stephen Young with SpaceFlightNow.com for Preston.

I am just wondering in the 18 months between now and the launch if you see any unexpected failures. Do you have any capacity to incorporate any additional equipment, repairs on this mission, or would it be a case of having to drop something else if you needed to add another task?

MR. BURCH: I think it depends on what fails. We have had this happen on two prior missions.

The particular device that failed or became anomalous was a reaction wheel, and we have a spare handy, and we were able to put that on our manifest late in the game and get it ready.

We do have some spare time available to us at the moment in the EVA (extravehicular activity) schedule. If you look at the time over the 5 days, there is potentially additional time to do some small tasks.

We do also have potentially additional room and additional weight capacity to take additional hardware up to Hubble. So if it is something very large and very heavy and very time consuming, then we would probably be faced with making some tough choices. We haven't had that happen to us in the past, but we are certainly well aware that that sort of thing could happen.

So we have an expensive long-term trending program analyzing performance of all the components and subsystems on the observatory, and at the moment, there is no indication of anything like that.

Hubble also has tremendous internal redundancy in all of its systems, and that would be another tradeoff of how much redundancy do we want to keep in a particular area versus the benefit to be gained.

MR. ACOSTA: Thank you, Preston.

Let's go to Headquarters. Traci?

QUESTIONER: Traci Watson, USA Today, for the Administrator. I'm sorry I missed your earlier discussion before this press conference started about the cost of the mission, and I am wondering about that $900 million.

Do you have that in hand? Where would that come from?

ADMINISTRATOR GRIFFIN: That was asked and answered. We have not in detail identified the particular sources within the agency, but obviously, it comes from the existing science astrophysics program and existing Shuttle space flight lines, and how that will be broken down is not yet determined.

MR. ACOSTA: All right. Let's come back here to Goddard. Any questions?

QUESTIONER: Thank you, and a follow-up for Preston Burch.

What does it mean to you to have veterans like Mike Massimino and John Grunsfeld working on this mission? What do they bring to it?

MR. BURCH: Well, obviously, they bring a wealth of experience. John has been up there twice before. Mike has been up there once before.

In addition to being familiar with Hubble, they are familiar with all the tools, the facilities that we have here, and so that really helps us to make the training more efficient. They can focus more effectively on the new things, the new challenges that are unique to this particular mission, and they can also act as mentors to the rookies who will be flying with them.

So we have generally tried to do that on previous servicing missions to have at least one or two astronaut that are doing the EVAs, the spacewalks, to be on the next mission to reduce the risk and to make things more efficient.

So we are extremely pleased to have John and Mike back with us. They have been working with us for the past several months on the STIS repair as well as other things we will be doing on this mission. So we think that is a great decision.

ADMINISTRATOR GRIFFIN: Well, I think also you would want to point out the value of having Scott Altman as the Shuttle Commander who has also been to Hubble, is familiar with the unique proximity operations concerns that are associated with flying around Hubble.

MR. BURCH: Yes. That is certainly very true, and somebody was reminding me this morning about all of the non-piloting stuff that Scott does in supporting servicing once we are on orbit and Hubble is docked to it.

Scott gets in there and does a whole range of other duties that are directly in support of servicing. So he knows Hubble very well.

MR. ACOSTA: Great. All right. Now I am

serious. Now we are coming back to Goddard. All right. So now let's go. Who hasn't been able to ask a question? Let's go to the back row, and then we will go over to Alan after that. We have about 7 or 8 minutes.

QUESTIONER: David Gaines, Independent.

A question for Dr. Cleave and also Dr. Griffin. An opportunity for you, I think, now to maybe respond to the scientists and the scientific community who have often expressed their skepticism over the past few years over the priorities and commitments to science by the Presidential administration and then by extension, of course, to NASA's budgets as the funding pie, if you will.

DR. CLEAVE: Well, this is a great demonstration I think of the agency commitment to science. I think it would have been probably easier for everyone just to stay the course with not doing a Shuttle servicing mission, and it took real commitment on behalf of the agency in order to put this science extension back on the table, and we are hopeful we will get it done. So it is a very good example of that.

Mike?

ADMINISTRATOR GRIFFIN: Thanks. I will follow up.

I am bothered by the basic premise of the question. The fact is that 32 percent of NASA's budget right now is science. It is $5.3 billion this year or this past year. We are doing pretty well.

There may be a few individual scientists whose hope for influence over the program will not materialize in the way that they would have personally hoped, but the influence of the science community as a whole at NASA and among the Nation's policy-makers is enormous.

The premise of the question is that the administration has not been friendly to science, and yet, I had the full backing of the administration in changing our plans for the use of the Shuttle in its fly-out phase to do this mission.

There is absolutely nothing at NASA that is not science-friendly. We exist in part to do the kinds of things that you can't do without being in space, but notice that I said exist in part. There are other things also that we do at NASA.

We have a robust aeronautics program, and we would like it to be more robust. We have international commitments going back 20 years to finish assembling the Space Station. That simply must be done, if we are able to do it.

We want, once again, to go beyond low-Earth orbit in exploring with human beings, and if we are to have a future, as pointed out by the Gehman Commission, that too must be done.

The art is in balancing all of those things. No one enterprise at NASA gets all at once, of course, and yet the art is in balancing it to see that no one enterprise within NASA is unduly harmed in relationship to others.

It would be nice. It would be very nice if I could see throughout the entire space community the kind of teamwork that I have seen displayed between and among the mission directorates in trying to pull this Hubble servicing mission together.

MR. ACOSTA: All right. Let's go over here to Alan.

QUESTIONER: Alan Boyle with MSNBC. I had a question for Bill Gerstenmaier.

There had been discussion during the buildup to the recent Space Station mission that this was going to be the most complicated series of operations of spacewalks that we have seen in recent times. How would you compare the spacewalks required for the Hubble repair mission with the Space Station spacewalks? Would you say that Hubble is actually more complicated?

MR. GERSTENMAIER: Well, it is really hard to compare the two. I think they are both complicated, but maybe in different ways.

In the Station world, the complication is it is not one mission. The missions are all linked together. So the four EVAs or three EVAs that we are going to do on this next mission are then followed by three-stage EVAs when the Shuttle is gone, staged out of Space Station. So the complexity is the Shuttle EVAs then impact the EVAs that are done during the period when the Shuttle is not there, and then those EVAs are then necessary for the next Shuttle flight to go fly.

So the complexity is not only in the individual mission, but it is in the assembly of missions and the way they are interlinked.

Hubble as a mission itself is very complicated with the five EVAs and the planning, but, again, I think they are complementary.

What I see here that is kind of neat is that we have been doing this assembly stuff in Station. We have been doing the inspection techniques. We have been using the boom. So the things that we are going to have to do on the Hubble mission, we have already demonstrated to a small extent on the couple Station flights we have done so far. We will do more of those before the mission flight. So it is a neat kind of complementary action back and forth.

The other thing I find very interesting is when Preston described to you the EVA to go replace the card outside. If you look at what we are doing on Station, doing very similar things on the inside, you know, I repaired a gyro where I removed 70 fasteners and popped off a bearing instead of replacing the 75-kilogram instrument, very analogous to what Preston is going on the outside.

What I find intriguing is how we are complementary. He has this clever technique to capture screws. Well, this is a neat technique. We are going to use that on Station. So you are going to see this little plastic overlay show up on some Station stuff, where we have not capped the fasteners.

So we are going to learn synergistically or complementary with what they are doing on Hubble and fold it right back into Station. As we learn new techniques on Station, we will fold those right into Hubble. So they are not distinct or competing, but I think we have got a tremendous chance here to keep learning and moving forward.

MR. ACOSTA: A good point to highlight.

All right. Anybody that hasn't had an opportunity to ask a question that wants to ask a question? All right. We have time for just a couple more. Let's go up front here. We will go to Bob first and then Seth, and that will be the last question.

QUESTIONER: Bob Zimmerman, Freelance again.

I asked this question of the Administrator earlier, and you punted, probably rightly, but can anyone give me any specific information about at least your goals or your plans for this soft capture mechanism? Is it going to be comparable to a docking mechanism that is on ISS, and what will its capability be? At least your goal as to what you are installing, anything you can tell me at all would be appreciated.

DR. LECKRONE: Do you want me to field that one?

Okay. The soft capture mechanism utilizes the low impact docking system technology that is being developed for CEV. So what we would like to have is a system that is very general purpose that could be used by either a CEV (Crew Exploration Vehicle)-type vehicle coming back to Hubble to install the propulsion module to the orbit Hubble or potentially by an unmanned robotic vehicle that would be launched on an expendable launch vehicle.

Right now, Hubble is a tough vehicle to grasp onto. It was really designed to be launched, serviced, and retrieved by the Space Shuttle, and it has these grapple fixtures on it, but they are located in an area that is difficult for anything other than the Space Shuttle to use.

And then we have these, what we call "towel bars," these small racks that are on the [inaudible] heads. Those are, again, not made to be grappled by an arm or by an automated device. So, by attaching the soft capture mechanism to the back of Hubble, we are going to make it a lot easier, a lot less costly, and a lot less risky for a future mission to go to Hubble when it comes time to go to Hubble when it comes time to deorbit it.

MR. ACOSTA: All right. Thanks, and then we will go --

DR. LECKRONE: And one last point, it is a totally passive system. There aren't any -- once it is installed, there are no active devices on it. So whatever comes up to it would have the active side to it.

MR. ACOSTA: Okay. Seth?

QUESTIONER: Seth Borenstein, AP, for Dr. Leckrone.

Just a little more specifics. The furthest back you have been able to gaze with Hubble now and how much further in light years, however you want to put this, will you be able to, if everything works out well -- you talked about what you will get, but in terms of the actual quantity, distance.

DR. LECKRONE: Okay. Well, as I mentioned, right now, the universe is estimated to be 13.7, plus or minus, .2 billion years old. That's a result primarily out of W map. So, when we are talking about something that emitted its life when the universe was, say, only 700 million years old, that was about 13 billion years ago.

And right now, we think we have detected objects in visible light that emitted their light at around that time, around 700 million years ago, redshift to 6 or greater, if you are familiar with that jargon.

How much more deeply we could go depends on the properties of what the universe was like at that time, how opaque was the material, how expensive was the re-ionization process, had it fully completed or only partially completed or so forth, and I really can't give you a quantitative answer. You will really have to do the experiment to see.

All I can say is that in principle, since we are going now from visible light to near infrared light, we are going to, in principle, be sensitive to objects that emit most of their light in the infrared that is not really sensed very easily or at all as visible labeling, and that corresponds to higher redshifts, maybe 7, maybe 8. If we are very lucky, the most luminous objects there, the brightest output objects, we might even get to a redshift of 10, but that is common-order speculation, and we really have to do the experiment to see.

I guess if I were setting a goal for us to get to a redshift to detect one object in a redshift to 10, that would be an interesting goal.

Well, I am talking about -- again, I can't do the calculations off the top of my head, but I am talking about the first stars coming into being, about 400 million years, and the end re-ionization period, about 700 million years. So you are not talking about a very large -- I mean, things compress in time during that period. Very large delta Z corresponds to very small delta T, and so we might be going back to 700 million years from the origin, maybe 4-, 5-, 600 million years. Again, it depends on the nature of the object, the opacity, how easily light transmits through the material, how extensive re-ionization has been, and frankly, those are all questions. Those aren't statements. Those are things that we don't know that we want to find out about.

ADMINISTRATOR GRIFFIN: Well, I think part of the point is that without regard to how far back you go or whatever, it is a very dynamic period --

DR. LECKRONE: Yes.

ADMINISTRATOR GRIFFIN: -- when things are changing rapidly, and to probe a little further back into it gives you an enormously advantaged concept or view of what was going on.

DR. LECKRONE: Right. Could you help me write a proposal?

[Laughter.]

ADMINISTRATOR GRIFFIN: You probably, actually wouldn't want that.

[Laughter.]

MR. ACOSTA: Well, on that note, we are going to go ahead and close out our press conference today. Any final thoughts or comments?

[No response.]

MR. ACOSTA: I didn't think so.

Just a reminder that the Shuttle crew press conference will be coming up at 2:30 Eastern. So you will have that ability to watch on NASA Select.

Also, all the video and images that were shown today during our press conference will be available right after this press conference. We will have it on NASA Select, and of course, if you wanted any more information, go to www.NASA.gov/Hubble for all the information on today's announcement and about Hubble.

We thank you very much, and have a great afternoon.

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