NASA SCIENCE MISSION DIRECTORATE ORAL HISTORY PROJECT
EDITED ORAL HISTORY TRANSCRIPT

ALPHONSO V. DIAZ
INTERVIEWED BY SANDRA JOHNSON
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JOHNSON: Today is April 12, 2017. This interview with Al Diaz is being conducted at NASA Headquarters in Washington, DC for the Science Mission Directorate Oral History Project. The interviewer is Sandra Johnson, assisted by Jennifer Ross-Nazzal. We want to thank you for joining us today and walking the maze to find the room.

DIAZ: It's no problem.

JOHNSON: I want to talk about when you first came to NASA. You actually came to NASA as a co-op [cooperative education student] at Langley [Research Center, Hampton, Virginia]. Do you want to talk about that time period and how that opportunity presented itself?

DIAZ: Yes. I remember when I went to college I had a couple of choices about where to go to school, and decided on going to Saint Joseph's University in Philadelphia [Pennsylvania]. I recognized that I was probably going to need some financial assistance to get through college. We weren't poor, but we certainly didn't have a lot of money. I had a scholarship to Saint Joe's but I needed some money to finish school.

During the second year of school, I knew that I wanted to go into the co-op program because that was a way to offset some of the cost of the education. A fellow from Langley Research Center came up and talked about NASA and the fact that they were initiating a co-op

program with Saint Joe's for the first time. Saint Joe's was looking for volunteers to sign up for that, and there were two of us that were willing to do it, and I was one of them. That's what started me down the path of working for NASA, and actually I never stopped. I took a little vacation and went to graduate school; I took a little vacation and went to industry, but frankly my whole career was NASA.

An interesting thing happened too because up until that point in time, when I went to Saint Joe's, which was in Philly, it was the first time in my life that I had spent any appreciable amount of time away from home in New York. While in the past I had been a pretty decent student, when I got to Saint Joe's, it just fell apart because I had other things on my mind. Despite the fact that I had a scholarship, I had been warned that if my grades didn't improve they were going to pull the scholarship.

I will tell you the thing that NASA did most for me at that immediate point was to provide the motivation that was necessary to go from being a C to C-minus student to an A-plus student for the rest of my college career. It really did make a difference to me to realize what opportunities existed at NASA. So that's how I got started.

JOHNSON: What were you working on when you first went?

DIAZ: When I first went to Langley, in fact for most of the time that I was a co-op, I was assigned to the Instrument Research Division. The instruments we were working on dealt more with test measurements in the facilities at Langley, the wind tunnels and the shock tubes as opposed to spaceflight missions, because Langley didn't have a lot of spaceflight missions. But from the time that I got there and started doing this work in test environments, I really was

anxious to do something in spaceflight as opposed to in the facilities. For the most part I worked in optical instruments, specifically in spectroscopy and radiometry.

JOHNSON: Was that how you started working for the Viking project [unmanned mission to Mars (1975)]?

DIAZ: Yes, in fact that's exactly what it was. The Instrument Research Division had some people that were working on the Viking project on a part-time basis—not immediately when I started there, but soon thereafter. Many of them were held over from the Lunar Orbiter project. They were a pretty motivated bunch of people, so conversations, one thing led to another, and somebody asked me if I'd come over and work in an engineering support role, which is the way I started, and then began my work on Viking.

JOHNSON: Talk about that work on Viking, because you ended up as a manager on the project before it was over with.

DIAZ: Yes, I ended up being the manager of an instrument development, which was the Viking gas chromatograph/mass spectrometer (GCMS), which was a pretty challenging task at the time, because we talked about it in a way of taking several rooms' worth of instrumentation in a laboratory and trying to condense them into a box the size of a breadbasket. It was filled with a lot of challenges. Frankly, there were several times during the course of the project where project management was skeptical that we were ever going to get it done. But we did. It took a lot of resources, both in terms of dollars and people, but we got it done.

JOHNSON: When Viking landed, do you want to talk about that experience? That was a big thing for the entire world.

DIAZ: Yes, I remember I was in California [NASA Jet Propulsion Laboratory (JPL), Pasadena] at the time. We've been through the ravages of the damned, if you don't mind my saying it that way. I've been through experiences that I never ever imagined I would be having. There were situations where we were doing a test in Denver [Colorado] and needed to analyze a failure that required an immediate transport to [NASA] White Sands [Test Facility], New Mexico. I remember being told to get down to Arapahoe Airport [Centennial Airport, Englewood, Colorado], that there'd be a jet, one of these Beechjets [Hawker 400], that would take me to White Sands, New Mexico. I went down there, and sure enough the airplane was there. I got on with this piece of equipment and we flew it out there and analyzed the failure.

There were all kinds of experiences like that. The GCMS was an instrument that had high-voltage parts, and we took it and put it into a chamber that simulated the Martian environment, and turned it on, and sparks went everywhere. It was just incredible. We had to call in Hughes Aircraft [Company] people that were developing high-energy weapons and ask them to give us a hand. They said they would do it, but all they would do was that if we delivered the equipment they would deliver it back to us in a condition that was flyable, and sure enough they did. So that's what we ended up flying, this piece of equipment that, frankly, in terms of some of the processes we didn't have a clue what had been done. But we tested it functionally and environmentally and it worked so we flew it!

Along the way, we got to a place with JPL where Viking project management and laboratory management said, "We're not going to be able to get this done this way."

Jim [James S.] Martin [Jr.], who was the project manager at Langley, said, "We're either going to do it ourselves or it's not going to fly." He turned to me and said, "Are we going to be able to get this done?"

I said, "Yes, we'll be able to get it done." I had no clue how we were going to be able to, but we did. We weren't in the flight instrument development business. And so we learned a lot. Even when we finally got to the Cape [Canaveral, Florida] and the integration team looked at the instrument and they said, "There's no cover on this instrument."

We said, "We didn't know we needed one."

They said, "Of course you need one." It was that kind of a situation where things like that happened. When we got to California, doing the cruise operations, we had to turn the instrument on. Everything seemed like it was going fine, but after all that we'd been through we were really skeptical that the instrument was going to work when we finally got down to the surface of Mars.

We knew that to the extent that we were able to build it to meet a set of requirements, we knew it would withstand that. But we had no idea what was going to be there in terms of the environment, in terms of dust, in terms of whatever. Jim Martin told us, "The morning of the landing"—which was going to happen about 5:00 in the morning West Coast [Pacific] time, "I don't want a bunch of people hanging around just seeing if the landing is a success." He said, "If you want to do that you can watch it on TV. So only essential personnel."

I was not essential for the landing process, so I was at home. I remember waking up, and I turned on the TV, and Tim [Thomas A.] Mutch was describing the Martian landscape. I

actually thought I was either asleep or I was watching some kind of a movie, because I still couldn't believe that we were on the surface of Mars. Then I got a call from a colleague who had worked on the instrument with me, and both of us had the same reaction. It was, "My God, we've landed." It was like, "Now they're going to turn it on, and they're going to find us out for the fools that we are because it's not going to work." But it did. It's one of those things where you do the best you can and then you hope for the best, and it all worked out.

JOHNSON: How many people were on the team that you were working on for that instrument?

DIAZ: Oh, boy. The science team, including all kinds of scientific luminaries, many of whom I probably don't even remember their names, there were a dozen of them, and each of them might have had a graduate student or a colleague that was working with them. Then there was me, maybe three or four other Langley people, and then the contractors. The contractors were pretty numerous from Litton [Industries], Beckman [Coulter, Inc.], and PerkinElmer [Inc.]. My guess is there were a couple hundred working on the instrument at any given point in time. Maybe 200 or 300 people altogether, that's about the size of it.

JOHNSON: Was this the first time you had a management-type position in your career?

DIAZ: Yes, it was the first time. I started out being an instrument segment manager. There was a piece of the instrument that I was responsible for, until they eliminated that piece of the instrument. Then they made me the systems engineer for the whole instrument, then I moved from that to being the development manager, and then the flight operations manager for the

instrument. Yes, it was my first experience with management. Frankly, it led me to develop some new respect for managers, and led me to be motivated at some point in my career to get some formal training, which I did.

JOHNSON: While you were at Langley, were there other things that you were working on before you went to Headquarters? Or did Viking take most of your time?

DIAZ: That was about it. When Viking was over in 1977 and those of us that had gone to California went back to Langley, it was a pretty sobering experience. It was like a microcosm of what you hear talked about and may have experienced throughout NASA which is, "Is that all there is, isn't there something else? Aren't you glad I'm back, don't you have a great job for me?"

We spent a couple years involved in expanding the Flight Projects Directorate at Langley, to what end it was never really clear. I was given the task of building a planning and estimating organization for flight projects, which I did. I think we did some good work, but it was never really the kind of thing that was appreciated much at Langley. I think that that [Viking] project at Langley consumed so much of the human capacity of the Center and management's attention that when we came back—I don't know how to describe it—we went back into a place where there really wasn't anything immediate to follow on.

I remember that when we were in California and the landing happened successfully, the President [Gerald R. Ford] called the [NASA] Administrator [James C. Fletcher]—who was at JPL at the time—and gave him an open book question. He said, "What have you got for us next?" It was almost dead silence, because there really wasn't a follow-on that was immediately

being planned. There were other things in the process, but the immediate follow-on would have been some kind of a rover. We spent a lot of time recovering from not being able to jump on that immediately and say, "We're going to go back to Mars with a rover."

NASA had some other things on its mind at that point in time, and I'm not sure the Administrator felt all that comfortable focusing on another spectacular space science mission. But I think those of us that went back to Langley were surprised at how—we were living in just an intense area of activity at a Center that frankly, I'm not sure it felt very much of it or was associated very much with it. We were probably more associated with stuff that was happening at JPL than we were at Langley.

JOHNSON: Why did you go to Headquarters? How did that opportunity come about?

DIAZ: It was a combination of things. One was the fact that I didn't feel any drive toward doing something at Langley any longer, and I was having some personal difficulties at home, I'll just leave it at that. A move away from Langley seemed to be a good idea for a variety of reasons.

NASA Headquarters seemed like a logical place to go, especially since my mentor on Viking was Gus [Angelo] Guastaferro. Gus was the head of planetary [Director of Planetary Division, Office of Space Science] at NASA Headquarters. I'm not sure whether I went to him, or in the course of a conversation with him he said he had all kinds of exciting things to do. I decided I'd give it a try.

JOHNSON: So '79 is when you went to Headquarters, and you were the program manager for the International Solar Polar Mission [ISPM]?

DIAZ: Yes, I went to NASA Headquarters. The first job I had was a filler. I was the manager of mission planning in the Planetary Program office. The guy that was the head of that office did mission and systems planning, and that was Danny [Daniel H.] Herman. He's still alive and well here in Washington. He was one of those guys that couldn't imagine that there was anything that couldn't be done. If you wanted to do a mission to someplace, Danny could figure out how to do it. It was really an inspiration for me to work with him.

But he was tough on people, he was really tough on people. People were always coming and going. He'd have detailees from JPL would come for three or four months and then they're gone. He'd have people come from Langley and they're gone. But somehow Danny and I managed to click. He was always very supportive of me, so when opportunities presented themselves, Danny and Gus were always thinking about me as a solution.

I went from the planning manager to the manager of the International Solar Polar Mission, which was an international mission that was to be done by the European Space Agency and the United States. We each were going to develop a spacecraft, then NASA was going to launch them both, until NASA decided it was too expensive to launch them both, so we were just going to launch our own. It actually didn't work out that way.

What the original hope had been was that they'd be launched together. When it became clear that wasn't going to be possible, it had to be split up. Then it was going to take two launches, and that just wasn't in the cards because we would have had to pay for the launches. So at one point the whole mission was cancelled. There was a big to-do about that, a big international incident. Ultimately, the European mission was restored with a US launch but it was tough sledding for a while. That was my introduction to NASA Headquarters.

JOHNSON: I know some of those joint missions, like you mentioned, it can be interesting with the international relations. If one partner doesn't have the funding, then it's difficult.

DIAZ: Right. That was the first experience I had with that kind of arrangement. Since then, I think both the European Space Agency and NASA have gotten a lot more mature about the relationships. If they are going to do a joint mission like that and they're going to be launched together, they're looking for some mutual dependency so that they can't be easily cleaved. That was the way it was on future missions like Galileo [mission to Jupiter] and Cassini[-Huygens mission to Saturn], missions like that where the involvement was a lot more intimate than it was in ISPM.

JOHNSON: Did you stay the program manager all the way through the launch, because the launch was delayed a couple times.

DIAZ: I'm trying to remember, I think I did. I think that was a secondary responsibility while I was doing something else. I don't recall exactly how that worked, but that mission did afford me the opportunity to get to know the European Space Agency at the level that I did and gain an appreciation for their capabilities and a lot more respect for them.

JOHNSON: I know you worked on Galileo, too.

DIAZ: I did. Until Hubble [Space Telescope], Galileo was probably one of the best examples of the capability of the NASA space science organization. It had all kinds of difficulties getting developed, but it was done, and then it had postlaunch issues that were resolved in flight that I think exhibited a lot of the kind of ingenuity that NASA has. I've often said, though, that while Galileo demonstrated the kind of competency that NASA has, Hubble demonstrated the full capabilities of NASA, both human and robotic sides. Galileo was a great mission. I worked with a guy who has become a very, very good friend of mine. The project manager on Galileo was John [R.] Casani, and John and I have long since been friends. I'll never forget my first meeting with John.

The biggest problem that Galileo had early on was unfulfillable expectations with respect to the budget. There was just no way we were going to get it done. John recognized that there was also no way that we were going to stay on schedule, largely because of the Space Shuttle. The Space Shuttle development, which Galileo was dependent upon, at least for accommodating our kind of mission, was not going to happen. John recognized that there would always be another opportunity to get well from a budget standpoint when the mission slipped.

He and his team put together a framed small poster, about 8-by-12 [inches]. I think I still have it. On one occasion, one of the many parties that they had out there, they gave me this sign and said, "We want you to hang this on your wall, because we want you to know what your job is." The sign just said, "Get the money." I was always proud to have that sign. I recognized as the program manager in fact that was part of my job, to make sure that the project had the resources that were necessary to be successful.

They did a great job with the money that we gave them. It was a great mission. It involved very intimate collaboration with the Europeans. The propulsion system was coming

from the Germans [German Aerospace Center], and there wasn't any way we were going to do the mission without the Germans. The participation of the Germans is what earned the European Space Agency the opportunity to fly science on the mission. It was a good partnership.

JOHNSON: I also have that you were manager of the Planetary Advanced Programs. What did that entail?

DIAZ: Yes. That's where I started, that was with Danny Herman. I guess that's what the title was, Advanced Programs.

JOHNSON: Deputy Director of the Solar System Exploration Division, was that all part of that?

DIAZ: Right, that was the former Planetary. When I went up to NASA Headquarters it was the Planetary Division, then it became the Solar System Exploration Division. I guess some people started thinking maybe there were planets outside the solar system.

JOHNSON: You were also the Assistant Associate Administrator for Space Station within the Office of Space Science and Applications.

DIAZ: Right. Sometime during the course of the early Space Station [Freedom] formulation stage, it became pretty clear that there was going to have to be some attention paid to assuring that the scientific community felt like they had a stake in the outcome of the Space Station. I think it was felt that that wasn't going to happen if the human spaceflight program simply

opened its arms and said "come," it just wasn't going to happen. There was going to have to be a lot of acculturation being done, and some resources being spent on having people think about how best to use it, and that's where I started. I ended up migrating that to the Space Station office during the early development stage. There was this formulation stage where people were thinking and talking and maybe conceptualizing, then there was the development stage where people were actually designing things.

During the development stage, I actually became the director or manager of Space Station Evolution in the Space Station office, which was in some measure a response to the way—we were supposed to be developing these paths for the Space Station to evolve over that would provide increasingly greater opportunities for science to use the Space Station. It seemed like a logical thing to take my office and activities and move it. We did a merger of some Space Station evolution elements, some people that had been doing that during the formulation stage, and we combined it all into one organization. It wasn't a big organization, but it was an organization.

JOHNSON: That was before you were the Deputy Associate Administrator of the Office of Space Science. That was '89 to '96.

DIAZ: That's correct, right. I'm trying to remember now when I was at General Electric [Company (GE)].

JOHNSON: I read something about you being at GE in 1988. I couldn't find any other information.

DIAZ: In 1986 I ended up going to the Sloan School [of Management] at MIT [Massachusetts Institute of Technology, Cambridge]. I'll never forget that experience either, because I remember interviewing with people, and I think it was [NASA Administrator] Jim [James M.] Beggs who said this, but I could be wrong. It could have been someone else that told me that they were really sorry to hear that I wanted to go to the Sloan School. I said, "Why is that?"

He said, "Because we only send two kinds of people off on these kinds of assignments. People that we shouldn't, because when they return they don't really capitalize on it at NASA, and people that could capitalize on it at NASA, but after the school are going to leave."

I said, "That's an interesting perspective. I really don't have any motivation to leave NASA, but I do have a motivation to go for formal training." About a year after I got back I said, "I've got to leave."

JOHNSON: So they were right.

DIAZ: That's right, that's why I remember the comment. They were absolutely right. That experience, and being a year with people in very high levels, or in midcareer in industry that you had every reason to believe were going to be leaders in industry, there was a lot of motivation to do some things that NASA probably didn't offer the opportunity to do. So I left and went to work for General Electric. That was in 1988 to '89.

I tell people this all the time, too—it took me a year to figure out that GE makes great refrigerators, but I wasn't in that business. The reason I say that is because it was exactly at that point in time that GE was in the process of reevaluating what businesses they were in. And it did

affect some of the businesses that NASA dealt with because GE Valley Forge [Pennsylvania] was building these nuclear RTGs [radioisotope thermoelectric generators] that we used in spaceflight, and it wasn't clear that that was going to survive after that.

The GE business that was most affected was aerospace, which is what I was part of. And, wouldn't you know it, they sold the aerospace business. I'm losing a little bit on the timing here. I don't think they sold it while I was there, but while I was there it was pretty clear that it wasn't a business that was going to flourish the way it had in the past. I left, and they did ultimately sell the aerospace business. I think it was after I left.

GE was a great company to work for, a really great company, and I learned a lot working there, but I really, really wanted to get back to NASA. The opportunity presented itself to do that when Len [Lennard A.] Fisk became the Associate Administrator for Space Science and asked me if I'd be interested in coming back. I definitely was.

JOHNSON: No second thoughts on that?

DIAZ: No.

JOHNSON: Talk about what was going on during that time period when you first came back.

DIAZ: This was in the wake of [1986 Space Shuttle] *Challenger* [STS 51-L accident] by several years. In fact, I'll never forget this either—I was at the Sloan School when *Challenger* happened. At the Sloan School they used to—I don't think they do it anymore—do two field trips a year. One midyear to Washington, DC, and then one at the end of the year that was an

international trip. We were on the Washington, DC trip and the host for the Washington, DC trip was always one of these think tanks in town, the name of which I've forgotten.

We would have speakers coming in to talk to us. At the moment of the *Challenger* accident, one of my classmates—in fact George Weyerhaeuser of the famous Weyerhauser wood and paper products company—had gone out to the bus to get something, came back, and whispered in my ear, "The Space Shuttle just exploded in flight." This guy had a reputation for being a cynical kind of jokester.

I turned to him and I said, "George, that's the worst joke imaginable."

He said, "No, I'm not kidding." I ran out to see what had gone on and realized that he was telling the truth. I came back over to NASA Headquarters to see what was going on. From that time until the time that I left the Sloan School, I was on a trajectory back toward NASA. Frankly, I couldn't imagine doing anything else but coming back to NASA, because I needed to be here. Now I had not left NASA, I was just off at school, but I skipped the international trip, which was a trip to China, because it was a couple weeks at the end of the period—I didn't have to do it, so I came back to work.

From that point on, we were dealing with redesigning missions that were previously intended to be flown on the Space Shuttle, either to fly on the Space Shuttle or to move them to something else. The highlight of that time period I will always remember as being the time that we actually got to know the astronauts, that we actually got to work with them and appreciate the fact that they were more than test pilots. That's when I got to know Bob [Robert L.] Crippen really well, still a good friend. I got to know Sally [K.] Ride really well, and she was a good friend until she passed away, and several others that we really got very close to.

I think it was a period of time that I think NASA could have died right then. My sense is that a big element of the recovery was associated with the astronauts not simply finding things to do, but actually becoming part of the leadership of the Agency, which up until then wasn't obvious.

JOHNSON: In '93 you became the Deputy Associate Administrator responsible for the management and oversight of space science flight program policy. You did a lot of work during that time, including leading a committee chartered by the Administrator to study proposals related to science institutes. If you don't mind, talk about that three-year period of time.

DIAZ: That was another interesting period. The [Hubble] Space Telescope was under development still at that point in time. Early on in the Hubble telescope program development, there was a discussion in the science community about how the science on Hubble ought to be managed. It was really a profound discussion because it focused on who did the Hubble Space Telescope really belong to? It became clear that while NASA was the development agent for the Hubble Space Telescope, the group that had the largest stake in the outcome and could make the largest contribution to the effective use of it was really the science community. They had spent years getting used to the fact that the NASA science program, because it was embedded in a bureaucracy, needed to deal with a variety of issues that, frankly, they were trying to remove themselves from.

The decision was made to embed the operation of the telescope—not the flight operation but the scientific operations of the telescope, what to point at, what experiments to select—in a university-like environment. They put out a solicitation, and lo and behold, AURA, the

Association of Universities for Research in Astronomy, came in with a proposal to build and operate this [Space Telescope Science] Institute embedded in Johns Hopkins University [Baltimore, Maryland], and they won. By the time of this institute study, they had been able to demonstrate that that really was a very effective way to manage that kind of an asset. [Institutional Arrangements for the Space Telescope: Report of a Study at Woods Hole, Massachusetts, July 19-30, 1976]

The question became, "Is NASA the organization that's best suited to managing the science that NASA facilitates? Or should we look to some other kind of organizational construct to do the program?" That's what led to the institute study. The feeling was that the alternative that was most logical was the institute kind of alternative. We started looking around NASA at the various scientific program elements and seeing whether or not they were better suited for a different kind of construction.

There were a lot of influences on it, not the least of which was the fact that in many government organizations that dealt with supporting science, they would not support NASA scientists because the expectation was that NASA would do that. If NASA scientists made a proposal, the proposal might be selected, but the funding for it would be expected to come from NASA. NSF [National Science Foundation] was that way, and I think to some extent NOAA [National Oceanic and Atmospheric Administration] was in the Earth sciences.

The idea was "Why not migrate to this construct where NASA would manage the missions, but the scientific community would manage the science?" Do it through an organizational construct that was like the institutes. That was the study that we did. Interestingly enough, the motivator for that was France [A.] Córdova, who was then the NASA Chief Scientist [1993-1996] and who is now the director of NSF. I worked for her at both the

University of California [Riverside] and Purdue [University, Lafayette, Indiana]. Another longtime friend.

JOHNSON: While you were there, Hubble was delayed before it finally launched [in 1990]. Then they found the problem with it. Once you moved to [NASA] Goddard [Space Flight Center, Greenbelt, Maryland] and through your career, Hubble is something that you were involved with. It was always there.

DIAZ: It was there all the time, that's right. It was there forever. From the time that it was in development until the time that I left NASA it was there. It's still there to some extent.

JOHNSON: Talk about when the problem was discovered and what was going on during that time, any of your memories of that period.

DIAZ: Let me digress for a second. One thing that you suggested might be a good subject is the relevance of the Science Mission Directorate. I wanted to talk about that a little bit. Up until the time of the establishment of the Science Mission Directorate in its earliest form under Len Fisk—up until that point in time there was the National Academy [of Sciences] that did studies in scientific areas and came up with concepts for scientific missions that NASA could implement, and then it was a free-for-all. Each element of the scientific community in the United States aligned itself with one of these subcommittees or committees of the Academy and they would promote their own interests, supported by the individual divisions at NASA Headquarters.

When the Science Mission Directorate started, it started with the proposition that all of space science needed to be as organized as any individual discipline was, and that there needed to be some discipline put into the process of determining what's the most important, what's the next most important, establishing priorities, and establishing the parameters for designing the program. Balance between large missions, medium missions, and small missions. Balance between the university involvement and government involvement.

I think it was when Len Fisk came to NASA Headquarters that the Science Mission Directorate actually took on some significance that rivaled anything else in the NASA program, including human spaceflight. But it wasn't until then that that happened. It wasn't until then, either, that it was recognized how much of NASA's budget was actually going into the integration of all of these elements. That's when the rule came up that said that NASA was going to spend 20 percent of its budget on space and Earth science. That's been a figure of merit that's been used on and off throughout the history of the Science Mission Directorate.

The reason that was important with respect to the Hubble discussion is that Hubble was born out of a National Academy study that really was well thought through and well-organized that made Hubble the centerpiece of the NASA science program, to the exclusion of everything else while it was going on. There wasn't a lot of discussion about alternatives. Hubble was the thing.

It developed to the point that it was obviously bigger than life. We all anticipated the launch of Hubble like the Second Coming. It was really huge. When those first pictures came back—you can imagine. When we went to the launch of Hubble there were cases of commemorative champagne, a bottle of which I still have, that were brought on the NASA

aircraft for celebrating the launch of Hubble. Of course we celebrated because it was a successful launch.

But boy, when those first pictures came back it was like "Oh my God, what happened?" The political—the Space Telescope Science Institute being at Johns Hopkins in the state of Maryland, Goddard Space Flight Center being in Maryland—the Maryland delegation was just wrapped up in Hubble. Of course Senator [Barbara A.] Mikulski was on the Appropriations Committee at the time. I thankfully didn't have to go to that meeting where it was conveyed what was actually going on.

But, unlike other missions, we didn't have the opportunity to condition people to understanding what was going on and what we were going to do to fix it. In the case of Galileo, we spent a lot of time trying to figure out what had happened. During the course of that, we took the time to figure out what the alternatives might be in terms of fixing it.

In the case of Hubble, we didn't have the opportunity to do that because of the intensity of interest and the expected first light [first image sent to Earth] and all this. We had to just lay it out and say, "This is not going to work the way we thought it should. We don't know what's wrong with it but the pictures are terrible." Immediately, we went from being the centerpiece of the universe to being the albatross around NASA's neck. It wasn't a very pleasant feeling. But I will say that it didn't take very long for us to start in typical NASA style saying, "We can fix this." Once we knew what was wrong, it didn't take long. The fact that it had been designed to be serviced, the fact that there had been missions planned to service it, really did help a lot.

As I said, I think that the Hubble Space Telescope was the demonstration of what NASA's full capability was—from instrument design through human spaceflight operations. I do think that the context that this was discovered in was important. We had finally reached a

level of respectability and concentration that would have really been amplified by an immediate success. But I think in the end NASA will be remembered and rewarded more for the fact that we were able to overcome that than space science might have been for launching a perfect telescope.

JOHNSON: When those first pictures—the good ones after the repair came out—I think a lot of people forgot about the problems.

DIAZ: That's right. In the case of Galileo, we knew we had months and months and months of cruise, where nothing was going to be going on, to diagnose the problem. We had a stepwise process to figure out what was going on. In the meantime, in the background we were figuring out what we could do "if." As a consequence, at the point in time when we could finally acknowledge that there wasn't any way that we saw that we were going to be able to unfold this high-gain antenna, we knew what mission we would fly, and that it would be a good mission.

JOHNSON: You did move on to Goddard. What brought that about from being at Headquarters? Why did you become the Deputy Director at Goddard?

DIAZ: [NASA Administrator] Dan [Daniel S.] Goldin called me up one day and said, "Have I got a job for you." I was really excited about it. From the earliest part of my NASA career until the day that I left, I saw the Director of Goddard as being the job in the Agency for a person like me. For a person in human spaceflight, it's probably the JSC Director. But for me, the Director of the Goddard Space Flight Center was the ultimate opportunity.

When the opportunity presented itself to go to Goddard as the Deputy Director—which was pretty countercultural. Almost all of the people in that position before me, maybe even all of the people, had actually grown up at Goddard. So there were as many people at Goddard thinking about why I was there as me thinking about why I was there. But it was a great opportunity and I couldn't miss it. I've forgotten exactly what the circumstances were.

There wasn't anything really negative that led to it. I think that the opportunity presented itself because somebody left and Dan thought that it'd be a good opportunity to have somebody from outside of Goddard go to Goddard, and I had worked with them for a while.

JOHNSON: There were a lot of missions going on coming out of Goddard at that time.

DIAZ: Yes. That was a big part of it, too. There were a lot of missions. That was in '98?

JOHNSON: '96 to '98 you were Deputy Director.

DIAZ: '96 to '98, yes.

JOHNSON: You'd come from Langley, then going to Headquarters and then going to Goddard—talk about the difference in working at a more aeronautic center, then Headquarters, then going to Goddard, which is like a university campus. It's more of a physics center.

DIAZ: That's an interesting point. It really was like going to a university campus because Goddard has the highest concentration of scientists in the Agency, and they have a lot of the

same kinds of attitudes that their colleagues at universities do. Probably because that's where they come from.

It was a curious time, because I hadn't been at a NASA Center for a while, 15 years or so. My last remembrance of a NASA Center was the disappointment of coming back from Viking. I was really excited about being at Goddard. I can remember sitting in briefings about missions and concepts where my only reaction was, "You've got to be kidding." People talking about measuring the temperature of the microwave sky to a hundredth of a degree Kelvin and mapping that so that they could see the impressions of the Big Bang. "You're going to do what?" Sure enough, that's what they were doing. It was a really energizing kind of moment for me. Of course, there were the challenges that we were dealing with.

I noticed in your prep questions for this interview that there was a question about technology and the influence of technology. I thought about that. The interesting thing to me was that NASA went through an inflection point, I'm not sure exactly when it was. We went from being the beneficiaries of technology to being the victims of it. The transition took place when other forms of technology started becoming very popular, to wit, maybe the computer and communications era. I was thinking about it in the context of the attention that we got early on in my career which you can see in this recent movie, the one about the computers at Langley.

JOHNSON: *Hidden Figures*.

DIAZ: *Hidden Figures*. The subplot there is that IBM [International Business Machines Corp.] was going to install the biggest mainframe they'd ever developed at Langley to deal with NASA problems, because those were the challenging problems to deal with. You go from that to being

totally disregarded by the electronic parts industry, who were developing parts for what became these things [referring to smart phone], and didn't want to be bothered with NASA's requirements for hardened parts that didn't flip in space because of the environment that we were in. We really did go from being the beneficiaries where people concentrated on providing us with the best technology to people really disregarding us unless we had money in hand.

So, some of the problems that we were dealing with at Goddard had to do with that latter part. We had gotten to the place where you couldn't buy parts that met NASA requirements. You had to buy parts, and then screen them to the point of accepting them for NASA applications.

We almost got to that point with spacecraft where if you wanted to buy a small spacecraft cheap, you had to buy something from the communications industry that was being prepared for some commercial application where they were going to launch hundreds of them. If one of them failed, "So what, just replace it." If we wanted to buy spacecraft for tens of millions of dollars as opposed to hundreds of millions of dollars, we had to figure out how we were going to take advantage of that kind of a market.

We had some challenges at Goddard that I think were a part of being in this environment where we weren't the sole market for a lot of the high-tech products and industry that we used to be. We had a lot of issues that were associated with that. A lot of issues where we didn't really understand why things were behaving the way they were, and maybe to some degree assumed too much about understanding it, which led to some failures.

JOHNSON: One of the former Directors of Goddard described working with scientists as like herding cats. Did you find that also?

DIAZ: Yes, there is some of that. But another question I was asked at one point in time was, "What was the biggest challenge I had at Goddard?" Frankly, it was providing a safe place for outrageous ideas. Seriously. You had no idea whether or not the stuff that these scientists were bringing to you they could really get it done or they were dreaming. Like I said, it was amazing the kinds of concepts they would come in with. There were a lot of them and they all had different interests. They all wanted to be involved, they were after transparency, and they wanted to have a say in virtually everything that we did. It was a lot like herding cats, but it was an energizing herding of cats.

JOHNSON: The spaceflights—the launches and the equipment and the experiments that were going up—was pretty impressive when you look at the list during that time period. Cassini-Huygens, the Chandra [X-ray Observatory]—there's a whole list of things that were coming out of Goddard at that time that we're still reaping the benefits of.

DIAZ: Interestingly enough—and this was something I was proud of as Goddard Center Director to talk about—in the history of the space program, Goddard had flown more instruments on planetary missions than JPL had. But JPL hastened to add that JPL had flown more instruments on Earth science missions than Goddard had, which was also true.

JOHNSON: We talked about the servicing mission, that first one for Hubble [STS-61 in December 1993], but there were several others while you were there.

DIAZ: Yes. After the first one, the rest of them came a little bit more regularly. I never want to say routine because they were never routine, but they were a lot more well-organized. When we planned the first one—I will tell you, when we first started, we knew we had to fly equipment that was going to fix the problem, but that stuff was still being invented while we were starting to talk about the mission.

Every one of those missions actually exceeded the mission objectives. That's a real credit to, believe it or not, the way that Johnson Space Center planned those missions and controlled the appetite of people to overwhelm them with requirements, which the Hubble team at Goddard had a propensity for. We had a guy at Goddard responsible for servicing Hubble, who still works out there despite the fact he's retired, Frank [J.] Cepollina.

JOHNSON: We've interviewed him.

DIAZ: Oh, have you? Yes, I'll bet that was fun.

JOHNSON: It was interesting.

DIAZ: Frank, he's one of these guys that he doesn't understand "no." Noel [W.] Hinners—bless his soul—when I became the Director of Goddard, he said, "I need to tell you something." He said, "You may have already found this out in your time at Goddard. Every Center ought to have one person like Frank Cepollina, but no Center Director ought to have to put up with more than one." It was absolutely true. Cepollina was one of these people. He was impossible to control, but also the creative genius was just an unbelievable thing.

JOHNSON: When we interviewed him, the young people that he still had working with him—it was just they were like surrounding him, waiting for him, when we were interviewing.

DIAZ: I will say this. When he and I were collaborating on the development of the Hubble robotic servicing mission—which we really thought had a chance of being successful given that the Space Shuttle was going to be mothballed—that got such notoriety that we had people come to visit us at Goddard that I never thought would be interested in the space program.

We were visited by Red [William L.] Whittaker, the robotics professor at Carnegie Melon University who developed the robots that went into Three Mile Island [1979 nuclear power plant disaster in Pennsylvania]. Also one of the Apple [Inc.] founders, Steve [Stephen G.] Wozniak, came to visit us, and Wozniak brought his son with him. He said, "I'm going to tell you how excited I am about this. I've told my son that if the opportunity exists, he's staying here, and he's going to work on this job." Cepollina gave him a job as an intern just to keep him there. And Red came up to me and said, "I don't know what chances there are of this mission ever developing, but if you fly this mission you're not going to do it without me." I said, "That's pretty interesting."

It was Frank Cepollina's vision for being able to do the impossible with robots that really energized a lot of people to believe in NASA. That was the thing that I was most disappointed by. If NASA decides that they're going to fly the Space Shuttle to continue to service the Hubble Space Telescope, that's terrific. But I was disappointed that we had lost the energy that brought those people into the fold. It would have been a great thing to do.

JOHNSON: It was an interesting time. Since we're talking about it—even though you had moved to a different position at that point, [NASA Administrator] Sean O'Keefe announced that that he wanted to use that robotic mission in 2007, but there was a lot of pushback about that. The National Academy of Sciences panel wanted to reinstate the canceled Shuttle.

DIAZ: Oh there was, there was a tremendous amount of pushback. There were two forces that came to bear that I think were difficult or impossible to deal with. One was the Academy was really skeptical, not that we could do it, but that we could do it without consuming all of the resources that were associated with space science.

While I think we were somewhat successful in convincing the Agency that a certain portion of its budget ought to go to space science, it wasn't long thereafter that we realized that some people might consider that a ceiling as opposed to a floor. There were all kinds of trade-offs that had to be made within that fixed level of resources. I think the members of the Academy committee were worried that we weren't going to be able to get the mission done for anywhere near the numbers that we claimed, and I can understand that. Historically, we haven't been very good at predicting that. We did that with Next Generation Space Telescope [James Webb Space Telescope] and look what happened there.

The other thing that I think was going on was there had been a lot of discussion about the future of human spaceflight. I think that there was some concern that, to the extent that robots were seen as viable substitutes for human beings, that might impact on the decisions about the continuation of the human spaceflight program. In the end, I think that the conclusion was that it sounded like a great idea, but it probably wasn't achievable in the time that was being predicted with the resources that were available, and so that was it.

But it was a fun 90 days. It really took me back to the Viking days when we decided the only thing that separated dreams from reality was the passage of time and a lot of money.

JOHNSON: You can say that's true of pretty much any endeavor, right?

DIAZ: Right.

I don't think we have time to get into your report ["A Renewed Commitment to Excellence: An Assessment of the NASA Agency-wide Applicability of the Columbia Accident Investigation Board Report," 2004] then.

DIAZ: No. I would like to talk about that at some length, because I actually think it did the Agency a tremendous service to do that. Not that the report was a service, but that it did the Agency a tremendous service to go through that process. But in the end, I'm not sure that it was widely appreciated. I think it was misinterpreted as being overly critical of an agency that was under some stress, so I would like to talk about that if we get the opportunity to.

JOHNSON: We'll do that. I think this is probably a good place to stop.

DIAZ: Right, I've talked about everything I know.

JOHNSON: We appreciate you coming by today.

[End of interview]