Discovery Dispatch

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A Note From the Program Manager

The excitement is building as the launch of Genesis, the fifth Discovery mission, approaches. On July 30th, a Delta rocket carrying the Genesis spacecraft will lift off from Cape Canaveral Air Force Station on a mission to collect solar wind and return it to Earth for analysis, shedding new light on the birth and evolution of our solar system.

In this issue, we take a close look at Genesis: how it started, who made it happen, what it hopes to accomplish, and the products and activities that have been created to involve students and the public in the mission.

We interviewed three key individuals: Principal Investigator Don Burnett, whose curiosity and perseverance have been the main force behind the mission; Project Manager Chet Sasaki, whose leadership at JPL kept the team focused and motivated through each challenge along the way; and Deputy Project Manager Lloyd Oldham, the person responsible for leading the team at Lockheed Martin Astronautics that built the spacecraft and the sample return capsule.

In other Discovery news, both the MESSENGER and Deep Impact missions passed their Confirmation Reviews this spring and were approved by NASA Headquarters to move into the implementation phase. Deep Impact, the first mission to impact a comet, has begun work to complete the design of its two-part spacecraft, scheduled for launch in January 2004. MESSENGER, a scientific investigation of Mercury that will orbit the planet for one full Earth year, has begun full-scale spacecraft development. Planned for launch in March 2004, MESSENGER is the most complex and challenging Discovery mission to date.

Thank you to the Genesis team for all the hard work. Best of luck for a successful mission.

Dave Jarrett

Inside

The Genesis Mission...In the Beginning

The Genesis mission really began decades ago in the mind of a curious young boy named Don Burnett. He looked up at the sky and wondered if the Sun held the secrets to the solar system and how the planets were formed. He grew up to become a professor of geochemistry at Caltech, where he continued his quest to learn more about our origins.

"I have been interested in the chemical composition of the solar system for years," Burnett says, "It has always fascinated me. I sort of grew up with the problem. I followed the literature and watched the sources of information ebb and flow. I have a strong desire to make an improvement in what is known."

Scientists believe that nearly five billion years ago clouds of dust and gas called the solar nebula evolved into what became the bodies of our solar system. Today it is believed that the material that made up the original solar nebula is preserved in the outer layers of the Sun. This material, mostly electrically charged atoms called ions, steadily flow from the Sun into space in a constant stream called the "solar wind."

As far back as 1983, Burnett was talking to colleagues such as scientist Marcia Neugebauer at JPL about the possibility of collecting pure samples of solar wind and bringing them back to Earth to answer questions about how the solar system was formed. By comparing the elements and isotopes that made up the original solar nebula to the elements and isotopes in the planets, moons, asteroids and comets today, scientists will gain a new understanding about the birth and evolution of the solar system.

How Genesis Became a Discovery Mission
Burnett and Neugebauer were co-conspirators throughout the 1980's, plotting and planning their concept to collect solar wind and return it to Earth. They found that such a mission was perceived as interdisciplinary, without a logical place to get funding. However, in 1989 and 1990, the seeds of the Discovery Program were being sown (see Discovery Dispatch, January 2001, "A Look Back at the Beginning").

"As soon as Discovery was announced in 1992," remembers Burnett, "we jumped in. There was this San Juan Capistrano concept conference, and eleven concepts were selected for a little bit of additional funding. I think we came in as number 11 then. The extra funding was very important. It allowed us to put together a proposal; it gave us a certain

Discovery Home Page

http://discovery.nasa.gov

amount of status with both JPL & Lockheed Martin."

The design of Genesis was evolutionary. "The obvious difference with us," said Burnett, "is we're a sample return mission, so we had to bring something back through the atmosphere. We were told at the time that General Electric Space Division had the expertise in that, but at about that time the company was acquired by Martin Marietta. I knew Ben Clark at Martin Marietta (now Lockheed Martin), so I called him and said we have a sample return mission. He said he'd be very happy to collaborate and that's how we got started."

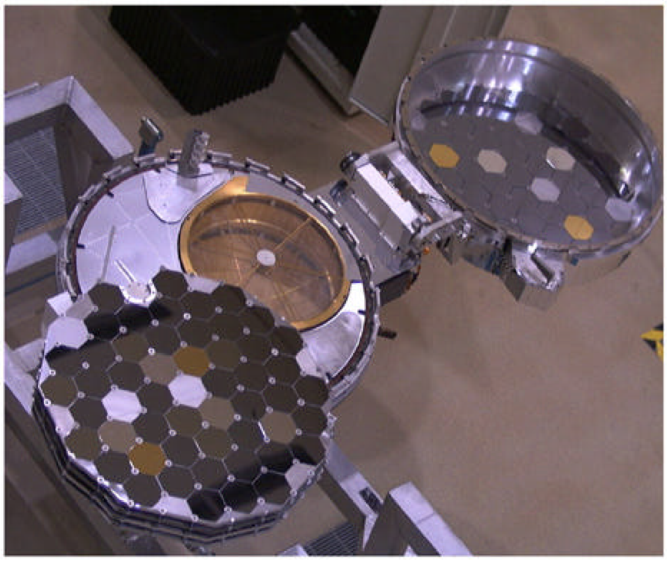


Photo Credit: Jet Propulsion Laboratory
This photo, taken during pre-flight testing, shows the entire science collection canister, including the lid with its collector array. The Genesis Payload Canister was manufactured by JPL.

The JPL connection was already in place, with Neugebauer (a pioneer in solar wind research) having worked on the concept for a number of years. Roger Wiens (another JPLer) came on board shortly thereafter.

"Once we had the instruments in mind," Burnett recalls, "Marcia said the obvious place to get our instruments was Los Alamos National Laboratory. They had the best expertise in doing this kind of thing. That was certainly true of our solar monitors. That's the kind of instrument they've built and flown before, and they were quite happy to join us. Then we approached them about going the next step with this concentrator, which is an entirely new type of instrument that had never been done before, but it still involved expertise that they had. Their response was to hire Roger, who's now the LANL team lead for Genesis."

Burnett submitted his Genesis proposal in the first full Discovery competition in 1995, but at that time Lunar Prospector was chosen as Discovery 3 and Genesis finished a close second to Stardust as Discovery 4. At the next opportunity, Genesis was proposed again and was selected in December 1997 as Discovery 5. Work on the mission began early in 1998.

"For this mission, I can say quite strongly," Burnett says, "Discovery was the only game in town. It was perceived as an interdisciplinary thing that did not have a welcome home in any of the mission programs before that. Discovery is the vehicle where a mission can speak on its own merits. It was the only way for us to go. Had it not been for Discovery, we wouldn't be here today."

A Model in Partnering

Discovery missions are led by a Principal Investigator, or PI, who is responsible for the overall success of the mission. Discovery encourages partnerships among universities, industry, small businesses, and other government agencies. Each organization brings their unique technical expertise, providing maximum benefits within the Discovery cost and schedule constraints. The Genesis partners are:

- California Institute of Technology, Pasadena, CA, the home of Principal Investigator Don Burnett.
- Jet Propulsion Laboratory (JPL), Pasadena, CA, provides project management and is responsible for developing the collector arrays and the payload canister, integrating and testing the payload, and designing and conducting the mission. JPL's Deep Space Network will provide navigation once the spacecraft is launched. Chet Sasaki is the Genesis Project Manager.
- Lockheed Martin Astronautics (LMA), Denver, CO, is the industrial partner with responsibility for designing the spacecraft and sample return capsule, integrating the spacecraft and science components, testing the entire flight system before it is launched, operating the spacecraft while in space, and recovering the sample return capsule when it returns to Earth. Lloyd Oldham is the Genesis Deputy Project Manager and the Program Manager at LMA.
- Los Alamos National Laboratory (LANL), Los Alamos, NM, developed and built the ion and electron spectrometers and solar wind collector. LANL also designed the robotic logic that controls the arrays and concentrator and is in charge of monitoring the payload during flight. Roger Wiens leads the work at LANL.
- NASA's Johnson Space Center (JSC), Houston, TX, built a new Class 10 clean room for Genesis samples. JSC is responsible for safely maintaining the returned samples and preventing contamination of the collectors. Eileen Stansbery leads the work at JSC.
- Mid-continent Research for Education and Learning (McREL), Aurora, CO, handles education and public outreach efforts. They develop and disseminate a wide range of materials for educators, students and the public via the Genesis website.

In addition, the Genesis science team consists of about 15 co-investigators from universities across the country, JPL, and LMA. All are active participants with major mission design and development responsibilities.

The Science of Genesis

Genesis will collect data on almost all of nature's elements and

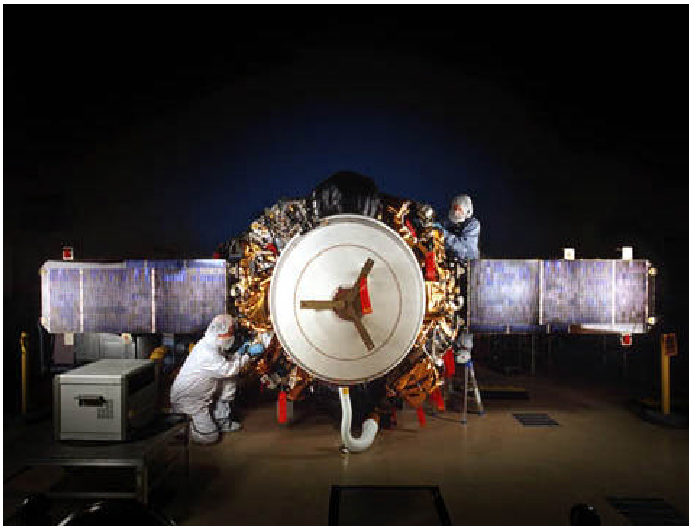


Photo Credit: Lockheed Martin Astronautics
LMA technicians work on the Genesis spacecraft, seen in the configuration it will be in as it travels through space. Solar arrays are extended but the white sample return capsule (SRC), facing the camera, is closed. The SRC is mounted to a flat equipment deck wrapped in thermal insulation. After cruising in this configuration for three months to reach the L-1 point in space, the SRC be opened to expose the payload canister and its collectors to the solar wind.

isotopes and allow scientists to determine the average composition of the solar system with high precision so that the composition of current solar system bodies can be compared.

Genesis will focus on determining the ratio of isotopes of different elements in solar matter. There are small but important differences in the relative abundances of isotopes of some elements, most notably oxygen and nitrogen, among the various samples of solar system materials available for study today. These differences are not explained by the standard model for the origin of the solar system. Observations from the ground and from past spacecraft have provided a baseline set of data that Genesis' studies will greatly improve.

Objectives of the Mission

- Provide data on the isotopic composition of solar matter sufficiently precise for planetary science studies.
- Significantly improve our knowledge of the elemental composition of solar matter.
- Provide a reservoir of solar matter sufficient to meet the needs of 21st century planetary science.
- Provide independent measurements of the different kinds of solar wind.

Collecting Solar Wind

About 80 days after launch, Genesis will open the lid of its science canister, expose the collector arrays, and begin to collect particles of solar wind. The collector arrays are circular plates which are covered on one side with palm-sized hexagonal tiles made of various high-purity materials such as silicon and sapphire.

The solar wind concentrator was designed to concentrate the solar wind into a set of small collector tiles made of diamond and silicon carbide. Both the collector arrays and the concentrator tiles will be exposed to the solar wind throughout the collection period, as long as the lid of the science canister is open.
Once the solar wind collection is completed, the collectors will be stowed over the concentrator and the science canister will close, sealing the solar wind samples inside the capsule. Then in early 2004, Genesis will begin its five month journey back toward Earth.

Sample Recovery

After releasing the sample return capsule, the main spacecraft will enter the atmosphere and burn up over the Pacific Ocean. The sample return capsule will enter the atmosphere over Oregon, slowing as it moves across Nevada and into Utah. A drogue chute and then a parafoil will deploy, bringing the capsule down at about 5 meters per second (10 miles per hour), to be captured and retrieved in mid-air by helicopter.

The landing site at the Utah Test and Training Range (UTTR) near Salt Lake City is a vast, unoccupied salt flat controlled by the U.S. Army and Air Force. The landing will be at approximately 9 a.m. local time (Mountain time zone).

The capsule will be transported to a staging area at the UTTR where the sample canister will be extracted. Eleven hours after Earth entry, the sample canister will be transported to its final destination, the planetary material curatorial facility at NASA's Johnson Space Center, Houston, TX.

Analysis

The exciting part of the mission for the scientists begins when the materials arrive back on Earth. The science analysis phase of Genesis continues through 2007.

"We don't get samples back until Sept. 2004," says Burnett, "but we have a lot to do in the meantime. We have to really pin down exactly how we're going to analyze these things. We have to build some facilities for doing that which don't exist right now. That's going to be the major activity for the next few years. We have an enormous amount to do."

And In the End……. The Final Phase

The path of Genesis has covered decades — from a dream in a young boy's mind, to a conceptual idea refined by a number of prominent scientists, to a proposal adapted to fit within the cost and schedule constraints of the Discovery Program. The spacecraft and science instruments have been built, tested and are ready to go. It will launch on July 30th, travel 1.5 million kilometers (1 million miles) from Earth to L-1, and collect solar wind particles for 29 months. The samples will return to Earth and be brought to facilities built especially for them. All that to get to the real work, the most exciting and interesting part—analyzing the tiny pieces of the Sun. The results will be significant, whatever they are. The reservoir of solar matter returned from Genesis will be available for future studies by tomorrow's young scientists to answer questions that haven't yet been asked.

Genesis Products Reach Out with New Approaches to Learning

Education and public outreach (E/PO) are important aspects of each Discovery mission to enhance public awareness of space exploration and to incorporate educational activities into planetary science investigations. The goal is to inspire America's students and communicate the excitement of NASA's missions. This effort includes a special emphasis on pre-college education and building strong partnerships between the space science community and science, math, and technology educators.

The Genesis mission partnered with Mid-continent Research for Education and Learning (McREL) to produce education and public outreach products and activities. McREL, located in Aurora, CO, is a private, nonprofit organization whose purpose is to improve education through applied research and development. With a staff of 100, McREL provides products and services, primarily for K-12 educators, to promote the best instructional practices in the classroom.

Genesis E/PO products embody research-based approaches designed to get everyone involved—students, teachers, parents, and the community. Using a Web-based delivery mechanism, Genesis brings the science of the mission into classrooms and communities nationwide with quality materials that enhance and extend learning.

Education Modules

Genesis offers nine web-based education modules that are print-optimized and feature teacher guides, student texts, and student activities that are aligned to the National Science Education Standards. Education modules are also available on a CD titled "Genesis in Education" and include a Cosmic Chemistry series and a Dynamic Design series, and an interdisciplinary, culturally-responsive module that explores theories of origins. Modules contain technology applications that enhance learning both in and out of the classroom. Interactive learning exercises include a periodic table modeling simulation, available as a full software download, and an electronic field trip featuring four interactive simulations based on working in the cleanroom at NASA's Johnson Space Center.

Public Modules

Public modules center on the science of the mission, and "Genesis Kids" features online children's learning activities including an interactive stickerbook and Ask Blast, whereby children submit questions about the mission science and receive an answer from a mission scientist. Additionally, the web site offers materials for community youth organizations, including the Boy Scouts and Girl Scouts.

Evaluation data is an integral part of Genesis E/PO product development for further modification and improvement of educational materials. Genesis has multiple nationwide formal development networks in place in which teachers field test materials in their classrooms in California, Texas, Kansas, Virginia, New Jersey and Florida. This input and feedback from teachers is integral to creating products with optimal learning value.

Genesis mission E/PO products present a unique opportunity for educators and the public to learn about the mission and the science that drives it and to meet some of the people who are working to make the mission a success through online interviews and video footage. To access Genesis products and activities, go to the Genesis home page and click on "Education."

Genesis Principal Investigator Don Burnett

Don Burnett, the Principal Investigator for Genesis, grew up in Dayton, OH, where he recalls as a sixth grader enjoying the feeling of accomplishment after getting a science kit and discovering how things work. He found satisfaction easy to come by in the world of science. Burnett joined the Caltech faculty in 1965 after receiving a B.S. in chemistry at the University of Chicago and a PhD. in nuclear chemistry from the University of California at Berkeley. He is a professor of geochemistry in the Division of Geological and Planetary Sciences, where his research interests include problems of nucleosynthesis, elemental abundances and chemical evolution of the solar system, meteorite and lunar sample analyses and laboratory synthesis experiments. He teaches classes and has a NASA cosmochemisty research grant.

On the Science of Genesis

"We all assume that the Sun and the planets formed from the same cloud of gas and dust," Burnett says, "but the Sun and planets are very different, and all the planets are different from one another. Why? Many things must have happened within this cloud of gas and dust to create all this diversity. A major clue is the differences in what the Sun is made of, and the similar differences among planetary materials (what technically is referred to as "chemical and isotopic compositions"). A simple example is the Sun is a ball of gas; the Earth is a rock. That is a big compositional difference. Comparing differences in what the Sun and the Earth are made of yields interesting conclusions. Genesis will measure what the Sun is made of, one half of the many important comparisons like this one.

"The direct benefit will be to help scientists understand the way our solar system formed: what the input materials were, what events took place to form planetary materials, and what processes took place during these events. This is an example of fundamental research. We won't make any direct changes in most people's lives, but greater understanding of our origins should make everyone's life more satisfying.

"We are doing some very specific things that amount to providing unique data that no one has ever had before. Regardless of what the answer comes out, it will influence people's thinking, particularly on issues of isotopic composition. Every number tends to raise questions, but I think we will settle some issues as well and certainly constrain things considerably."

"I have been actively studying this for 14 years," Burnett says, "thinking about it, planning for it. We have 19 specific studies that we want to do, and all are important. I'm fairly greedy right now. I want them all. I can't predict what will be most fascinating when the information comes in three years from now. But I don't need to wait that long for satisfaction. The day-to-day activities of the mission are interesting to me."

Collaborating at the whiteboard are, from left, P.I. Don Burnett, Project Manager Chet Sasaki, Deputy Project Manager Lloyd Oldham.

Validation of the Mission Design

It turns out that many of the basic concepts developed in the very early days of planning for the mission remain. Burnett says, "The basic ideas we identified in the early 1990's have held. We believed that semi-conductor grade silicon would be our best material and that has turned out to be true. We embellished it a lot and optimized it for other types of measurements for which silicon was not suitable, but that's still basically what I call our 'universal solvent' in terms of the collector material.

"The idea of collecting the different solar wind regimes was put forth back then, also the whole idea of the concentrator. In terms of the basic spacecraft design and the instrument quota of the mission, it's not changed much in 10 years."

Approach to Analyze Samples

The Genesis science team will meet regularly from now on to determine exactly how to analyze the samples after they return. The mission does not end when the samples are recovered in 2004. The science analysis phase goes on through 2007. The major activity for the next few years will be to upgrade the instruments to do the job. The philosophy going in was that the instrumentation today is good enough to verify that the materials are pure, but not sufficient to actually analyze the collected solar wind. They need to go to the next step, which is building the next generation of analytical instruments.

What does the future hold?

What kind of mission would Burnett like to see his students propose in the future? "I think both Genesis and Stardust have demonstrated a major point — that you can do sample return missions within even a Discovery Program budget. If you look back at the conventional wisdom of the 70's and 80's, everyone said sample returns produce excellent science, it's really what we want to do, however we can't afford it. They were thinking of astronauts and Apollo-type programs. But the Discovery Program has allowed us to show that isn't true. In fact there is a lot that can be done with robotic sample return missions, particularly with the small bodies in the inner solar system. I think the floodgates have opened. I would anticipate that my successors will carry out some of these in the first twenty years of this century."

Words of Wisdom

Does he have any advice for new PIs? "It's the obvious thing—you've got to really want to do it, to fight it through. There's a lot of work to organizing things and getting it selected. It's got to be something you really want to do."

All these years after he first imagined this mission, he says the greatest challenge was getting it all to work. Don Burnett's greatest satisfaction will be getting it off the ground, marking a new mission phase. "That will be very satisfying," he says, "to see it go up and away."

Genesis Project Manager Chet Sasaki

Hawaiian-born Chet Sasaki was always good in math and science as a student, and since he liked working with cars as a teenager, he majored in mechanical engineering when he began college at the University of Hawaii. He transferred to the University of Illinois where he received his B.S.M.E. He belonged to ROTC and got his commission in the Air Force, where he earned his Master of Science degree through the Air Force Institute of Technology program at Arizona State University. He did doctoral work at Kansas State University.

Sasaki was a captain in the Air Force for 12 years, where he worked as a project engineer, flight test manager and taught aerospace studies. He came to JPL initially in 1976, working on Voyager, Viking, Galileo, and managing the Defense Space Technology Programs Office. He left for a short time to start his own business and teach engineering design, but returned to JPL in 1986 and became the assistant project manager on the Scatterometer project.

Sasaki got involved with Genesis when it was being resubmitted as a Discovery proposal in 1997, becoming the project manager upon selection as Discovery 5. The role of the project manager is to manage the resources, schedules, and costs to achieve the objectives of the mission. To some degree, he also acts as a systems engineer, performing high level reviews to assure requirements and designs are consistent and optimized across system interfaces.

Chet in front of the Genesis spacecraft

In the final weeks before launch, Sasaki has been preparing for numerous reviews and following the work going on at the Cape. "It's been fairly routine," he says, "so it hasn't required a lot of attention, primarily monitoring schedules. It's been going very smoothly so I haven't had a lot of anomaly resolution." Sasaki will continue working on Genesis at least through orbit insertion, which is about 3 months after launch. After that his role will diminish as the project moves into its next phases.

The JPL primary role ends at sample return. The science work will be done exclusively by Don Burnett and JSC. A NASA Research Announcement to build the Advanced Analytical Instrumentation Facility (AAIF) to analyze the samples returned by Genesis has been released. According the Sasaki, the plan is to select two bidders to build different types of facilities that will probably be housed at universities in existing facilities to maximize the benefits to the instrument.

Many Partners; One Team

Genesis has the unusual situation of having the project manager at JPL and the deputy project manager, Lloyd Oldham, at LMA. "We elected to do that for a couple reasons," says Sasaki. "One to economize on the project here at JPL and the other because Lloyd controls most of the resources associated with the spacecraft and the SRC. It made good sense that he be responsible for all of the technical resources on the project. I think the relationship has worked very well, not only because of the natural division of work but also because of the personalities involved. I think we work extremely well together. While we have similar styles, Lloyd tends to be a lot more hands-off. I can honestly say, I don't think there has been a single decision that Lloyd has made that I disagreed with."

How have Sasaki and Oldham been able to assure good communication among the team, with partners in so many places? "I think it's a team effort, it's more than what Lloyd and I can do," Sasaki says. "I think it's the entire team looking to keep the communication paths open. We have several vehicles. We have email, which is the obvious one; we have shared servers, where we get the same data they do but on separate servers. Very early on we saw the benefits of getting "meet me" lines for conference calls, so we have dedicated "meet me" lines within the project that we can share. We do have periodic meetings where all team leads get together, either virtually or in person. When we first started, we spent quite a bit of effort in team building, and I think getting a good start at communications has been preserved pretty much." The project had hoped to use desktop video conferencing as another communication tool, but it didn't work out. The people and the technology were not quite ready.

Sasaki believes there are definite benefits to having many mission partners. "We bring a large diversity of expertise, and I think we cover each other well," he says. "I believe that LANL is the premier electron monitor/ion monitor house in the United States, and I don't think we have that capability. LMA brings us a spacecraft with high heritage and a background in SRCs that I don't think anyone else in the NASA community has. We all bring the best we have to the table, and the more partners we have, I think the better the overall quality of the work. Communication is hampered on one hand, on the other hand the overall quality of the work is a lot higher."

The Challenges of Genesis

Genesis was originally scheduled to launch in February 2001, but NASA Headquarters imposed a delay, to assure a secure launch date for the Mars Odyssey mission in April. If Mars Odyssey didn't launch in April 2001, it would have had to wait 26 months for the next launch window to open. The two missions shared some personnel resources, and it was deemed most prudent to delay the Genesis launch, which did not have such a limited launch opportunity. Also, after the two Mars '98 losses, NASA imposed additional reviews on upcoming missions.

From the manager's perspective, the most challenging thing has been staying within the budget. Because of the delay, the Mars flowdown activities, and the add-ons to the project as a consequence of those increased cost concerns. Sasaki says, "I think we recovered from that situation on the one hand. On the other hand, early on that was our primary difficulty. There were the usual technical difficulties, flight software is always a problem, star tracker is always a problem, parts are always a problem, so there were the usual complement of technical things, but our biggest challenge over the better part of the project has been cost."

For Sasaki, the most gratifying part of the mission has been the overall project interaction among the team. "When we launch," he says, "when everything operates well, I think that will probably be the crowning glory on what I consider a fun program, something that I have enjoyed for the past three years."

On managing a Discovery mission, Sasaki says, "Overall, I think the Discovery Program is the right paradigm. It's focused science, minimum cost, relatively low risk. They try to promote partnerships in technology which is good for industry. I think Discovery is in fact the way to do business, particularly if we're interested in doing small focused missions. I think the Discovery paradigm is the paradigm that everybody should use."

Genesis Deputy Project Manager Lloyd Oldham

Lloyd Oldham was born in Jerome, ID, and grew up mostly in a little town called Black Foot, where he stayed until he graduated from Idaho State University in Pocatello. He was a typical boy, interested in sports, having fun and enjoying life. His motivation for college was mainly just wanting to get out of the family business. His father owned a tire store, and he was sure that was not what he wanted to do. Oldham says he went into engineering for the wrong reasons—so he wouldn't have to take speech. Not because he wanted to avoid giving speeches, but because he had already given so many in church since he was twelve years old that he felt he didn't need it. But his school only had a two-year engineering program, so he switched to physics as the next closest thing because he couldn't afford to change schools. He worked to put himself through college, earning both a B.S. and an M.S. in physics.


Lloyd Oldham

Oldham went to work for Martin Marietta (now Lockheed Martin) in Denver right out of school and has been there ever since. He's worked as both a scientist and an engineer on many NASA projects. He was asked to be the proposal manager for the original feasibility study that was done for Genesis. "You've got to realize that Don Burnett had been working this for two or three years," Oldham says, "and he spent years before that with all the different studies and things in order to try and win. Before we actually had a winning proposal, it was proposed 3 or 4 times." After Genesis was selected, Oldham competed to become the flight system program manager at LMA, responsible for the spacecraft assembly, test, and operations in Denver and at the Cape. He was also named deputy project manager. He feels this was done to emphasize a team environment, improve communication and enhance the cooperative team effort. "JPL wanted to have a closer partnership with industrial partners than they had on previous missions," he says. "so when Chet is not available, I can act for him with the JPLers, the science team etc. Everyone has respected that position. It's just understood and it's worked out quite well."

As launch approaches Oldham is still responsible for the flight system and oversees the test of the spacecraft at KSC. He has responsibility for the integration, test, and the project side of the launch operations and will have that responsibility through a month after launch. Once Genesis gets into space and things are going well 30 days after launch, he will be available on a consultation basis on a very limited amount of budget.

The Challenges and the Satisfactions of Genesis

To Oldham, the most challenging aspect of the mission has been to be able to have everything fit within the constraints of the Discovery Program. "You have to fit everything into schedule and cost constraints and mission success is number one. When you put the emphasis on mission success, that's not always consistent with making sure that you meet the cost constraint as well as the schedule constraint. It's the overall management of the priorities to assure that we have mission success and still keep the program within the funding and the schedule limitations.

"I think that we have an extremely talented group of people across the project. I think that the satisfying thing is to have the team work together and see things come together and go smoothly. They've really come together in the last six to eight months. We were basically ready to launch in February, but they kept the team spirit and responded when there were delays that were not our fault."

How has he instilled the need for good communication among the team and ensured that it actually happened? "Because of the need to not waste people's time in travel and make them more tired, we've done a tremendous amount of our communications across the project in telecons. It's kind of an interesting dichotomy because face-to-face communications are really important, but at the same time we have probably less face-to-face communication than we would have on typical spacecraft built by LMA but not atypical of Discovery because Stardust was also that way."

LMA built the Stardust spacecraft which launched in 1999 and is on its way to a comet to collect and return pieces of cometary dust. Genesis used as much of the Stardust processes, hardware, and software as possible to make it a low risk mission. It also a had a sample return capsule, so LMA used as much of the Stardust SRC design as they could. Also, both missions fly essentially the same electronics. "We used a lot of their test activity for qualification of hardware so that we didn't have to do that," Oldham says. "It's really a mission that we have most lessons learned from and can use most of their design. Our company spent a lot of internal research and development dollars and continues to do that in order to keep us as one of the leaders in the technology of returning things to Earth."

From his views of Stardust and close involvement with Genesis, what are his thoughts on the Discovery approach? "I believe that it worked pretty well for us," Oldham says. "that the way that we put it together, it was a good program. It was a cost challenge because of the cap. It was very difficult with some of the development items to make those happen within the costs. I would say it worked out fairly well, but I think the missions probably are marginal in terms of having enough dollars to complete the mission if you have very much development to do.

"To me, this mission is very exciting. It is a significant challenge to do the mission within the schedule planned and the budget available. It is exciting because it is a relatively small, fast mission with science that is at the forefront of space exploration and an outstanding principal investigator. Achieving challenges are always exciting to me. It is all a matter of attitude. We have worked hard for this opportunity. The challenge and commitment is to achieve 100% mission success and do it within the technical, schedule, and cost constraints."

Quick Facts

Spacecraft

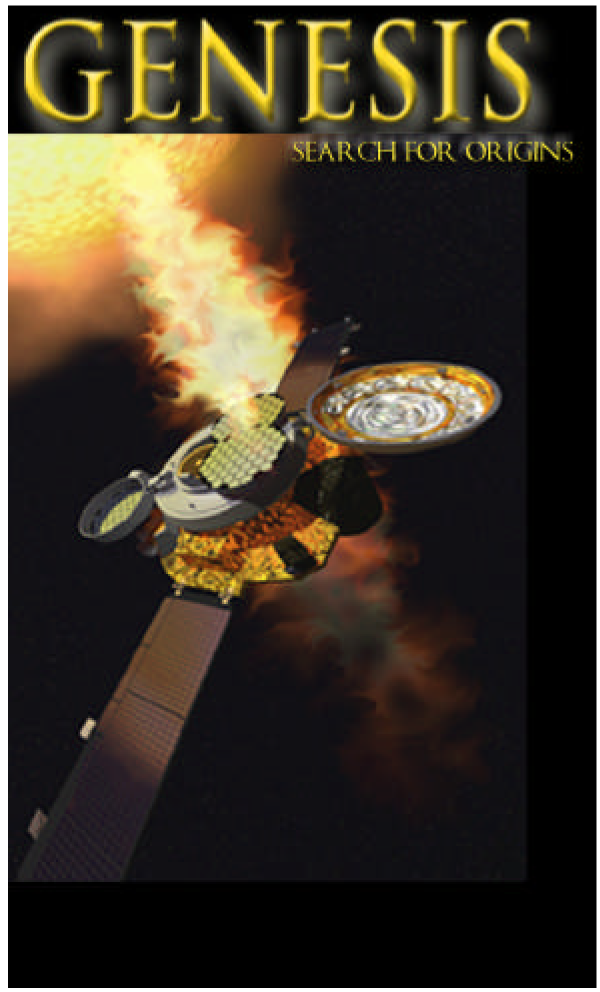
Dimensions: Main structure 2.3 meters (7.5 feet) long and 2 meters (6.6 feet) wide; wingspan of solar array 6.8 meters (22.3 feet) tip to tip; sample return capsule 1.5 meters (4.9 feet) diameter, 1.31 meters (52 inches) tall
Weight: 636 kilograms (1,402 pounds) total, composed of 494-kilogram (1,089-pound) dry spacecraft and 142 kilograms (313 pounds) of fuel
Science instruments: Solar wind collector arrays, ion concentrator, ion and electron monitors
Power: Solar array providing up to 254 watts just after launch; storage via a nickel-hydrogen battery

Launch Vehicle

Type: Delta II 7326
Weight: 151,036 kilograms (332,878 pounds)

Mission

Launch period: July 30 to August 14, 2001
Total distance traveled relative to Earth from launch to to L-1: 1.5 million kilometers (930,000 miles)
Total distance traveled relative to Earth from launch through end of mission: 32 million kilometers (20 million miles)
Solar wind collection: October 2001 - April 2004
Arrival at L-1 point: November 2001
Orbit around L-1 point: November 2001 – April 2004
Number of orbits around L-1 point: Five
Sample return capsule recovery: September 2004



Discovery Dispatch

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