NASA
Lyndon B. Johnson Space Center

Space News Roundup

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Crew begins training for STS-26 mission

STS-26 crew members posed in front of the motion-base Shuttle Mission Simulator last week prior to a training session. From left to right are Mission Specialists Pinky Nelson, Dave Hilmers and Mike Lounge, Pilot Dick Covey and Commander Rick Hauck.

Mission excitement and enthusiasm are beginning to build again at JSC now that training for the crew of STS-26 has begun.

Commander Rick Hauck, Pilot Dick Covey, and Mission Specialists David Hilmers, Mike Lounge and Pinky Nelson began their Shuttle Mission Simulator (SMS) and Single Systems Trainer (SST) work Feb. 11 in preparation for their scheduled launch a year from now.

"Being back to Houston with the crew and being able to focus on a mission and a date is most exhilirating," Hauck said. "It's a good feeling to be pointed in a concrete direction. We're starting to immerse ourselves."

Hauck said the crew recently visited Marshall Space Flight Center and would soon be going to Kennedy Space Center, but that he was especially glad to be back at JSC.

"It's good to get back to this area and back to doing the things I joined NASA to do," he said, "although I do feel good about the five months I spent at Headquarters."

Ron Epps, head of the Flight Training Branch's Control/Propulsion Section, said the crew's training team will consist of Rick Bush, team leader; Dudley Long, training manager; Steve Messersmith, DPS/navigation (NAV); Darrel McGregor, systems, and Bill O'Keefe, control/propulsion.

"The enthusiasm in the training division is really picking up now that we're getting closer to launch," Bush said. "Everyone here has been chomping at the bit to increase the tempo of operations from generic training to high-intensity flight-specific training. The time has arrived and we are ready."

Training of the STS-26 crew will begin a phased buildup to support the scheduled launch date and other manifested flights, Epps said. The training team and crew are coordinating a plan based on crew experience as applied to the established Training Catalog.

The current schedule calls for running simulators 60 hours a week, with the STS-26 crew receiving 4 hours a week at proficiency level.

In addition to spending time in the SMS, the crew also will be working on the SST to enhance

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Super computer system to go operational at Ames

NASA's numerical aerodynamic simulation (NAS) computer, considered the world's most powerful computing system, will be operational in early March.

To mark this event, dedication ceremonies will take place March 9 at the NAS site, NASA's Ames Research Center in Mountain View, Calif. Other events include a symposium on the future implications of super-computer systems for society, tours and illustrations of system capabilities. An air show also will take place.

NAS will be used for pioneering research in aeronautics. This includes work on the National Aero-Space Plane Program, a joint DOD/NASA program to validate a wide range of aerospace vehicle technologies and capabilities including horizontal takeoff and landing, single-stage operation to orbital speeds and sustained hypersonic cruise within the atmosphere using airbreathing propulsion.

A wide variety of future operational aerospace vehicles may be possible as a result of this technology development and validation program, ranging from space launch vehicles to long-range air-defense interceptors and hypersonic transports.

The NAS system will help ensure continued national preeminence in aeronautical research. It will allow major steps toward simulating actual aircraft flight in a computer, making possible important advances in aircraft design—reducing cost and increasing performance. NAS will serve as a pathfinder capability in supercomputing for government, universities and industry and will encourage development of improved supercomputers.

The operational system will be capable of a quarter of a billion computations per second. This speed will be increased to a billion calculations per second with acquisition of a second high-speed processor this year and to 10 billion calculations per second within a decade.

The NAS system is presently driven by the Cray 2 supercomputer, which has an enormous 256 million word internal memory, 16 times larger than those of previous supercomputers.

Planners for NAS expect to have the two fastest supercomputers available as central computing engines for the system. As a faster processor is developed by industry and becomes available, it will be acquired and the slower of the two current central supercomputers will be retired.

A national network will allow off-site scientists, at 27 locations, access to the system via satellite or high-speed terrestrial lines. More than 250 scientists and engineers will be using the system.

Consequences of collisions at hypervelocity dramatic

Editor's note: Since 1976, JSC scientists have been studying orbital debris to learn more about the nature of man-made objects and fragments circling the Earth, the means by which they proliferate and ways to control and protect against the problem. This is the second of two articles.

By Kelly Humphries

On the third day of STS-7, Commander Robert Crippen reported a pit on the outside of one of *Challenger's* windows. After the Orbiter landed, the pit was inspected and judged too big to risk the stress of another launch. The window was replaced.

The pitted piece of glass was removed, and sent to JSC for analysis, where Dave McKay and other JSC scientists scanned it using an electron microscope with X-ray defraction. Fused into the window they found titanium oxide, carbon, aluminum, potassium and zinc — all constituents of white paint. After looking at the pit diameter and depth, they were able to estimate that the particle was about 0.2 millimeters in diameter traveling at between 3 and 5 kilometers per second.

Conclusion: the Orbiter had collided with a paint flake.

"That was the first operational loss we had suffered because of breakup debris," said Don Kessler, project scientist for orbital debris studies at JSC.

How can a tiny paint flake create a crater large enough to require replacement of a window five-eighths of an inch thick built to withstand pressures of 8,600 pounds per square inch and temperatures of 482 degrees centigrade?

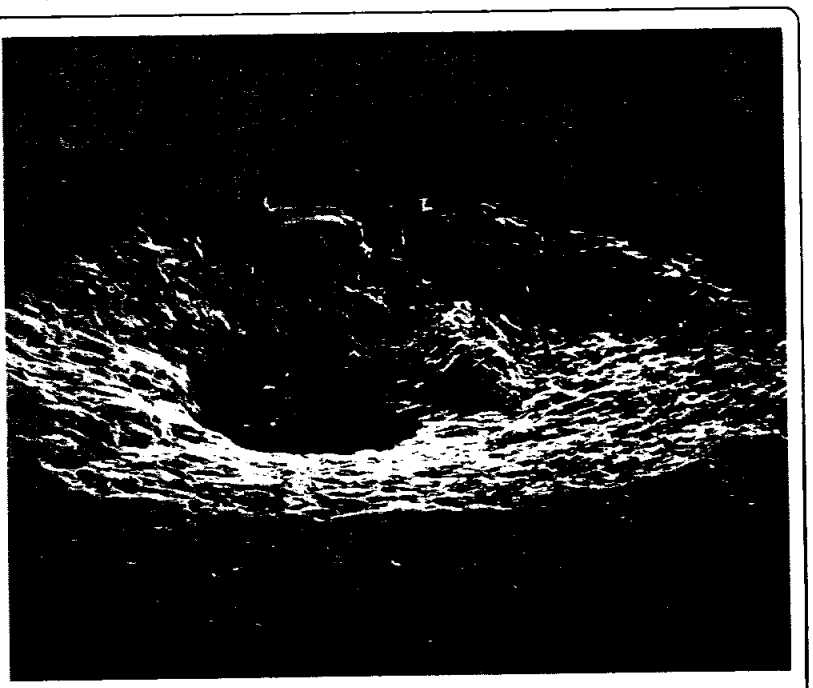
"Energy is proportional to the mass times the velocity squared," explained Joe Loftus, JSC's Assistant Director for Plans. "So, if you keep in mind that things in Earth orbit are traveling at seven kilometers a second, or 25,000 feet per second, and the energy is proportional to the square of that number, then you have an impressively large number. Even if the mass is small the consequences are dramatic."

The damage processes that can be caused by collisions with debris and meteoroid particles, or impact physics, is what interests Burt Cour-Palais, one of JSC's senior scientists working in the Space Sciences Branch. Some colleagues call him the "guru of impact shielding."

Strewn about Cour-Palais' office are numerous sheets of aluminum scarred by what appear to be shotgun blasts. The gaping holes, however, are the results of collisions with particles ranging from the almost infinitesimal to three-eighths of an inch in diameter fired from hypervelocity light-gas guns at JSC, Marshall Space Flight Center and Ames Research Center. As with the paint flake and the Space Shuttle window, it is the relative speeds and masses of the objects colliding that determine the amount of damage.

A typical spacecraft shielding scheme is to install a "bumper" or outer sheet separated from the structural wall by a calculated distance that depends on the expected size of impacting debris, Cour-Palais said. The bumper concept was first proposed by Fred Whipple, the noted astronomer and meteor physicist, in the early 1930s.

The impact region of the bumper, typically aluminum at this time, will melt as it meets a particle traveling at hypervelocity, Cour-Palais said, while the particle itself bursts into thousands of even smaller particles. Part of this "ejecta" will strike a largerarea on the next surface, usually the spacecraft wall, and the energy and momentum is absorbed. The bumper principle also works for spacesuits within the constraints of astronaut mobility, he said. A byproduct of the incoming particle's destruction, called "secondary ejecta," blows out and away from the surface adding to the number of debris particles in orbit, he said.



This is a scanning electron micrograph of the crater created when a paint flake hit Challenger's window on STS-7. The pit is about 640 micrometers in diameter, 630 micrometers in depth and is surrounded by a spall zone about 2.4 millimeters in diameter. The image was taken by Linda Schramm, Lockheed/EMSO scientist, using an ISI SR-50 scanning electron microscope at a tilt angle of 70 degrees.

The shock waves accompanying such events can, by themselves, cause serious damage. Hypervelocity tests have shown that even when a particle fails to penetrate a target of sheet aluminum the shockwave can travel through the aluminum and damage the other side of the sheet, ejecting fragments by "spallation."

Cour-Palais said particles 0.3 millimeters in diameter — slightly larger than a grain of salt — can puncture a large enough hole in a spacesuit to force an astronaut to return quickly to the spacecraft to avoid depressurization. The odds of such a collision are 1 in 110 for every 1,000 hours exposed

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Space News Briefs

Moore joins Ball Aerospace

Former JSC Director Jesse W. Moore, who has been serving as a special assistant to the Associate Administrator for Policy and Planning, resigned from NASA Feb. 8. Moore joined Ball Aerospace Systems, Boulder, Colorado, as Director of Program Development. In accepting Moore's resignation, Administrator Dr. James C. Fletcher said, "The agency and the nation have been served well and faithfully by Jess Moore. In the most difficult of times for NASA, he filled the demanding jobs of Associate Administrator for Space Flight and Director of the Johnson Space Center. We will miss him and wish him all the best in his new endeavors."

Houston Industries invests in SSI

A new subsidiary of Houston Industries, Development Ventures, Inc. (DVI), has invested in Space Services, Inc. of America. Houston Industries, a local holding company, is the parent firm of Houston Lighting & Power Co. and six other companies. According to Houston Industries, DVI "has purchased warrants which it may exercise to acquire a future equity position in Space Services, Inc." DVI also has invested in the Gemini Fund, Ltd., a Houston venture capital fund whose general partners include former astronaut Walter Cunningham.

ESA lets first Hermes contracts

The European Space Agency has selected Aerospatiale and Avions Marcel Dassault for the first two contracts in the Hermes spaceplane program under the aegis of ESA. The contracts are for the stuy of aerodynamic configurations and crew safety issues. ESA also plans to allocate contracts to the Swiss Federal Aircraft Factory in Emmen and West Germany's Stuttgart University for work on a plan to create or restore to service some 15 European wind tunnels and aerodynamic facilities for the Hermes program. ESA said a "large number" of other contract studies are in work, with 250 prospective industrial contractors.

GOES-H launch rescheduled for Feb. 24

The launch of the GOES-H weather satellite for the National Oceanic and Atmospheric Administration has been rescheduled from Feb. 19 to no earlier than Feb. 24. The 33-minute launch window for the 24th extends from 4:44 to 5:17 p.m. CST. The launch slip is the result of a decision to change a suspect switch which selects between a pair of transmitters on the satellite. The transmitters send GOES image data to the ground. Identical switches failed during assembly and testing, and a switch failure in orbit would leave GOES-H unable to switch to the backup transmitter. The satellite is to be launched aboard Delta-179.

Research balloon crashes; another sent aloft

A 600-foot-tall research balloon launched from Australia Jan. 25 crashed in Paraguay Feb. 1, ending a bid to make the first around the world balloon flight and gain valuable long duration data on solar flares in the process. A second balloon was launched Feb. 9. The flight was part of a program to study newly discovered solar phenomena—hard X-ray microflares and superhot flare plasmas. The experiment, prepared by the University of Washington and Louisiana State University, is managed by the Goddard-Wallops Flight Facility.

Bulletin Board

Truly to address AFCEA luncheon

Rear Admiral Richard H. Truly, Associate Administrator for Space Flight, will address the March 13 meeting of the Houston Space Chapter of the Armed Forces Communications and Electronics Association (AFCEA). The luncheon meeting will begin at 11:30 a.m. at the Holiday Inn on NASA Road One. The $8 admission price includes the 11:30 a.m. social and the noon luncheon. Reservations are due by Tuesday, March 10, and can be made by calling Peggy Towns, 280-7312, or Carole Shannon, 280-7307.

NETS Expo set for Feb. 25

Center Director Aaron Cohen will present awards to JSC's NASA Employee Teams as part of a joint award ceremony and exposition at 1:30 p.m. Feb. 25 in the Bldg. 2 Teague Auditorium. Both civil service and civil service/contractor teams will be recognized. Employees are invited to attend.

IEEE video conference is Feb. 26

Optical disc issues will be the topic of the next video conference Feb. 26 sponsored by the Clear Lake Council of Technical Socieities, the Institute of Electrical and Electronic Engineers and the Instrument Society of America. The one-day video conference will be held from 9:30 a.m. to 3:30 p.m. at the Gilruth Recreation Center. For more information, call Ray Baker, x30078, or Bill Densmore, x30069.

NASA mixed bowling tourney is in March

The 2nd annual NASA Mixed Team Bowling Tournament will be held March 7-8 and March 14-15 at the Alpha Bowl in Webster. The entry fee for a 5-person team is $50. To qualify, a team must have at least 2 members who are of the opposite gender of the other 3. Teams also must consist of at least 3 people who work for NASA or a contractor company. Entries must be filed at Alpha Bowl no later than midnight March 1. For more information, call Norma Kersman, x30235.

AIAA issues call for abstracts for May symposium

The Houston Section of the American Institute of Aeronautics and Astronautics has issued a call for abstracts for the 12th Annual Technical Symposium, to be held May 14. The theme for 1987 is "Space Frontiers—New Beginnings," and the deadline for submission of abstracts is Friday, April 3. The symposium is open to the JSC community. Abstracts should be 250 words or less, and the presentation should be 10 to 15 minutes using viewgraphs or 35mm slides. Formal publication is not required, but presenters are requested to make handouts available. Submissions should include a company affiliation and telephone number. Abtracts or inquires may be directed to: Walter Lueke, Code ES36, x35939.

BAPCO to meet March 17

The next meeting of BAPCO, the Bay Area PC Organization, will be held at 7:30 p.m. March 17 at the Holiday Inn on NASA Road One. For more information, call Earl Rubenstein, x33124, or Jack Calvin, 326-2983.

KSC homecoming planned; former employees sought

The Kennedy Space Center, celebrating its 25th anniversary this year, is working on a comprehensive list of present and former employees. The center also plans a homecoming in March. Names and addresses of former workers should be sent to Mail Code PA-VIC, Kennedy Space Center, FL 32899.

The Public Affairs Office was one of the several organizations around the site to say goodbye to the old black rotary telephones last week. Employees of GDSI have been disconnecting the old units in the wake of JSC's conversion to the digital Rolm system.

STS-26 crew training begins

(Continued from page 1)

technical skills and attending many briefings on Shuttle systems and flight techniques "to get a feeling for the changes that have occurred," Long said. They'll also be working with the payload, a Tracking Data Relay Satellite (TDRS), and its payload carrier.

At launch minus 30 weeks (L-30), or mid-July, the crew's SMS time will be increased to 8 hours a week using a computer software load similar to the mission profile, Epps said. Soon after that, they will begin to pick up extravehicular activity (EVA), crew systems, inertial upper stage (IUS) and orbit systems training at other JSC facilities.

At L-15, or early November, the crew will begin working with the "first drop," or the first flight specific training software load that matches the mission profile. At L-11, integrated training involving the Mission Control Center (MCC), SMS and Sunnyvale, Calif., will begin. At L-8, a second software drop will occur.

A long-duration integrated simulation is scheduled at L-3 weeks in January 1988. This simulation will be initiated at launch and will cover ascent, post-insertion and orbit procedures leading up to TDRS deployment.

During the stand-down period, training was cut from 148 hours a week to 60 hours a week. The cutback allowed time for sustaining engineering and maintenance on SMS equipment while providing crew proficiency training. The Space Transportation System Operations Contract (STSOC) has been using the time so that facility restoration, SMS computer rehost planning and System Review Design Items could be worked.

EAA, NASA scholarships available

Scholarships offered by the JSC Employee Activites Association and the NASA College Scholarship Fund will be available to the dependents of employees this year.

The scholarships are administered by two different organizations and have different backgrounds, according to EAA Scholarship Chairman Dick Thompson.

The EAA scholarships have been offered since 1967 and provide $4,000 (up to $1,000 per year) for study at any college or university. Forty-eight dependents of JSC employees have received scholarships through this program. This year, three scholarships will be awarded.

The NASA College Scholarship Fund, Inc., was set up in 1982 as the result of a gift by author James Michener. The corporation has offered scholarships since then to the qualified dependents of NASA and former NASA employees, Agency-wide. This year, two $1,500 scholarships will be awarded.

The application period for the EAA Scholarships runs through March 31. Application forms are available in Bldg. 45, Room 712. For information call Avis Nettles, x33164, for information.

Generally, the EAA Scholarships are open to students who will graduate from a public, private or parochial high school in 1987 or students currently enrolled in college with a good academic standing. High school applicants must have at least a 2.5 on a 4.0 scale or the equivalent. Applicants must be dependents of JSC employees who have worked at the center or at White Sands Test Facility or the Downey or KSC Resident Offices for at least two years as of Jan. 1, 1987. The scholarship winners may pursue any course of study leading to a recognized degree from an accredited college or university.

The scholarship will be awarded on the basis of scholastic achievement, extent of financial need and the breadth and substance of school and community activities.

Dependents of JSC empioyees who during the last year were medically retired or deceased and who otherwise would have met these qualifications are also eligible. For the purposes of the scholarship, "dependence" is defined as having been listed on an employee's federal income tax return as a dependent.

High school students are expected to provide a transcript and a record of their scores on the ACT or SAT tests. College students are also expected to provide a transcript of both high school and college grades, as well as their ACT or SAT scores.

The results of the scholarship selections will be announced by the end of April.

Application forms for the NASA College Scholarship are available in Bldg. 1, Room 541. Interested persons may call Cheryl Howard, x38969, for more information. The deadline for applications is March 27.

Generally, the NASA scholarship is $1,500 per student, per year, not to exceed $6,000 over six calendar years. Eligibility requirements are similar to those for the EAA scholarship. One major difference in the two is that the NASA Scholarship is limited to students studying in the engineering or science fields.

Applicants are ranked on the basis of academic preparation, school activities, community activities, performance on tests such as the SAT and ACT, written recommendations from instructors or other references, and a one page statement of academic purpose written by the student.

SIGAda plans two programs

SIGAda, a special interest group centered on the Ada computer language, will sponsor two programs in coming days.

On Feb. 26, Thomas Arkwright, Project Manager of the Ada Technology Support Laboratory for the Lockheed Missiles and Space Co., will discuss "Results of the Reusable Software Implementation Program."

On March 12, SIGAda will sponsor a talk by Ed Chevers, Assistant Chief of the Avionic Systems Division, who will discuss "Avionic Systems Testbeds for the Space Station."

Arkwright's Feb. 26 talk will be part of a dinner and social to be held at the Gilruth Recreation Center beginning at 5:30 p.m. in Room 216. Tickets are $8 for members and $9 for non-members. Dinner will include BBQ Beef, chicken and sausage, salad and dessert.

For information or reservations, call Dennis Pleticha, 280-1500, x3254; Al Menchaca, x39077; or Kathy Rogers, 282-5415.

The Chevers talk will begin at 5:30 p.m. at the University of Houston, Clear Lake Bayou Bldg., Room 2-532. A wine and cheese reception will precede the talk. No reservation is required. For more information, call Rogers.

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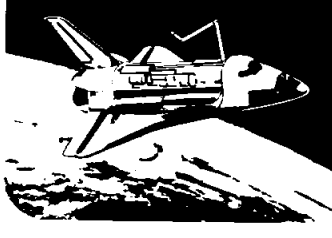

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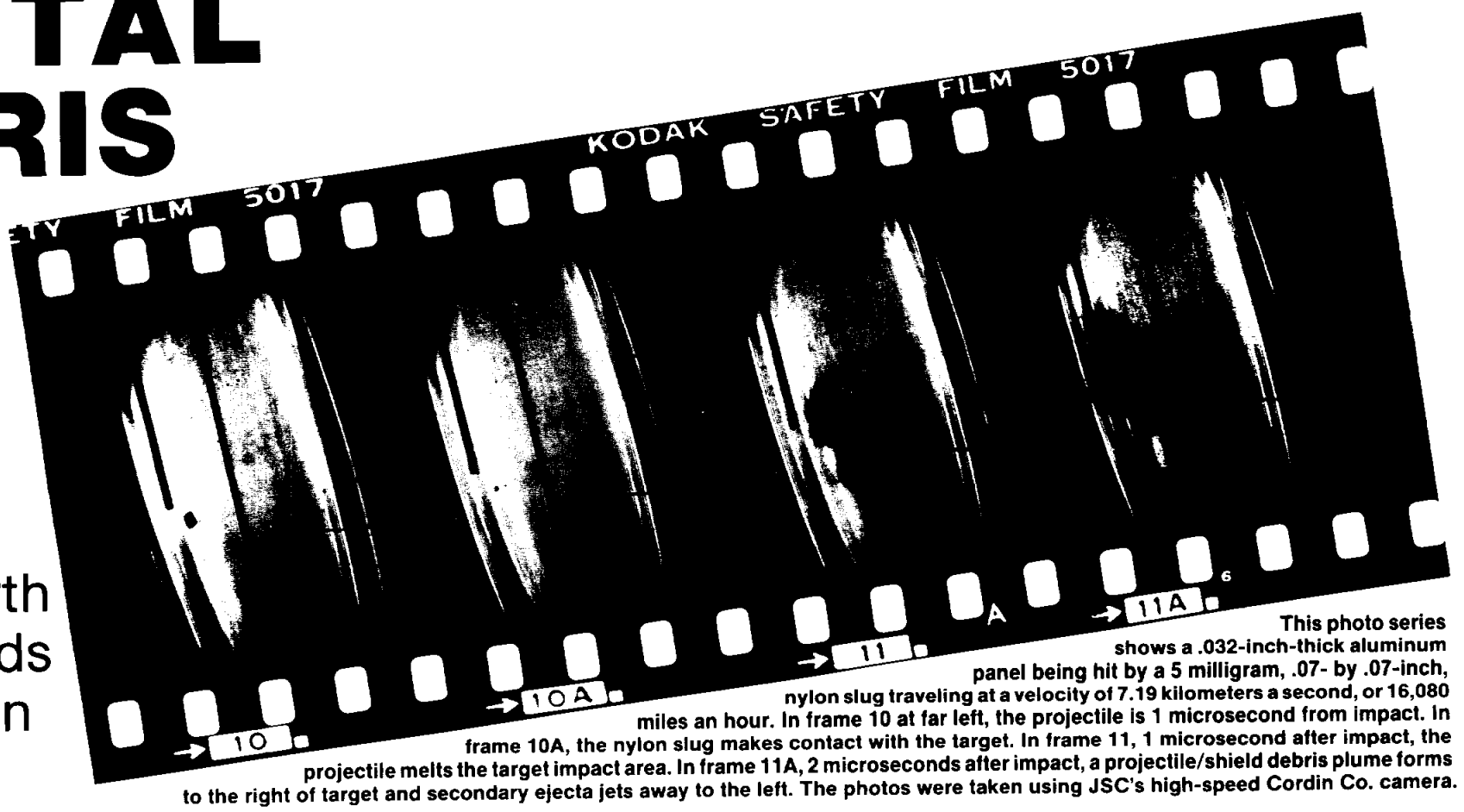
Editor . . . . . Brian Welch
Assistant Editor . . . . . Kelly Humphries

ORBITAL DEBRIS

Ounce of prevention may be worth many pounds of protection



This photo series shows a .032-inch-thick aluminum panel being hit by a 5 milligram, .07- by .07-inch, nylon slug traveling at a velocity of 7.19 kilometers a second, or 16,080 miles an hour. In frame 10 at far left, the projectile is 1 microsecond from impact. In frame 10A, the nylon slug makes contact with the target. In frame 11, 1 microsecond after impact, the projectile melts the target impact area. In frame 11A, 2 microseconds after impact, a projectile/shield debris plume forms to the right of target and secondary ejecta jets away to the left. The photos were taken using JSC's high-speed Cordin Co. camera.

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to the debris environment, he said.

The smallest particle that could cause a Space Station habitation module to depressurize faster than its systems could keep it pressurized hasn't yet been determined. The current design prevents penetration by 0.6 to 1 centimeter (pea- to marble-sized) particles, said Cour-Palais. The chances of such a collision with each habitation module are 1 in 222 for every 10 years in orbit.

The ability of spacecraft and astronauts to survive such collisions, and the relatively high odds that they may experience such an event, make up the survivability/vulnerability equation being studied here and at other NASA centers.

"If we're going to have a manned presence in space for long periods, we really do need to ensure that adequate protection against debris impacts is provided," said Cour-Palais.

"We will require the Station to have a design which provides a measure of passive protection," Loftus predicted. "That is, you just sit there and get hit by little things."

Loftus said active protection measures such as literally moving Space Station out of the path of large threats also may be necessary.

"We already have a form of active protective measures in the sense that any time we're going to launch, we use the tracking system to sort of say, 'Is anything going to be close at hand to the Orbiter?' We routinely advise the crew if there's any satellite potentially within sight. So all of those precautions have been going on for years."

At JSC, research is now centered around non-metallic and composite materials, said Jeanne Lee Crews, project engineer for the Orbital Debris Impact Laboratory in Bldg. 31.

While the initial Space Station configuration probably will feature aluminum bumpers, Cour-Palais said, there may come a time when the probability of a collision that could breach those bumpers becomes too high. By then, he said, the work being done at JSC may have led to development of materials that can be added to the outside of the habitation modules or sandwiched between the existing bumpers.

Cour-Palais also is studying the effects of hypervelocity impacts on the graphite epoxy composite trusses planned for the station. Collisions can delaminate the trusses so that protecting film is ripped away to expose the composite to free atomic oxygen, he said. Research indicates the atomic oxygen then may work its way into small holes and cracks produced by collisions and weaken the truss over a period of years.

Windows and instrument ports probably will be impacted by tiny primary and secondary ejecta particles so often in the course of the Space Station's lifetime that they may look as if someone had sand-blasted them. Therefore, such ports will need a shielding mechanism that can cover them when they are not in use, Cour-Palais said.

Thought has been given to ways of reversing the orbital debris process, but it won't be easy, Kessler said. In theory, some sort of collector could be used to clean up the man-made debris in much the same way as the Earth collects natural space debris, he suggested. One way might be to deploy a giant foam ball that would hit but not stop orbital debris. The soft object would slow debris so that it falls out of orbit and reenters.

Another possible solution is a laser beam that could vaporize debris particles or deflect their paths and cause them to reenter. Still another is an active spacecraft designed to get in the way of debris and survive the collision without generating more debris, he said.

Hardware changes may help in the near-term, but those studying orbital debris agree that the only economical way to stop the probability of collision from reaching unacceptable levels is to develop and enforce policies to minimize the creation of new debris.

"No preventive measure is free," said Loftus. "You're going to have to require people to give up performance or something if you're going to get rid of this debris. There *is* cost. So the question is, how do you decide whether it's worthwhile to bear that cost?

"I imagine that in the course of the next several years we will come up with a NASA policy which says that anything that is committed to after such and such a date simply shall be designed with those provisions built into it," Loftus continued. "We will have to to do that by general consensus with the DOD, and then we will have to reach some agreements with U.S. commercial enterprises. We will have to go forward into international forums and it'll take some years to bring all this about."

The U.S. Department of State has set up an interagency group to discuss the need for a government policy on debris. Agencies involved include NASA, the Federal Communications Commission, the Air Force, the Office of Science and Technology Policy, the National Security Council, the Departments of Transportation and Commerce, the Strategic Defense Initiative Office, and the Arms Control and Disarmament Agency.

Kessler presented the technical aspects of the existing problem to the orbital debris working group Jan. 26, and suggested three areas that need to be addressed.

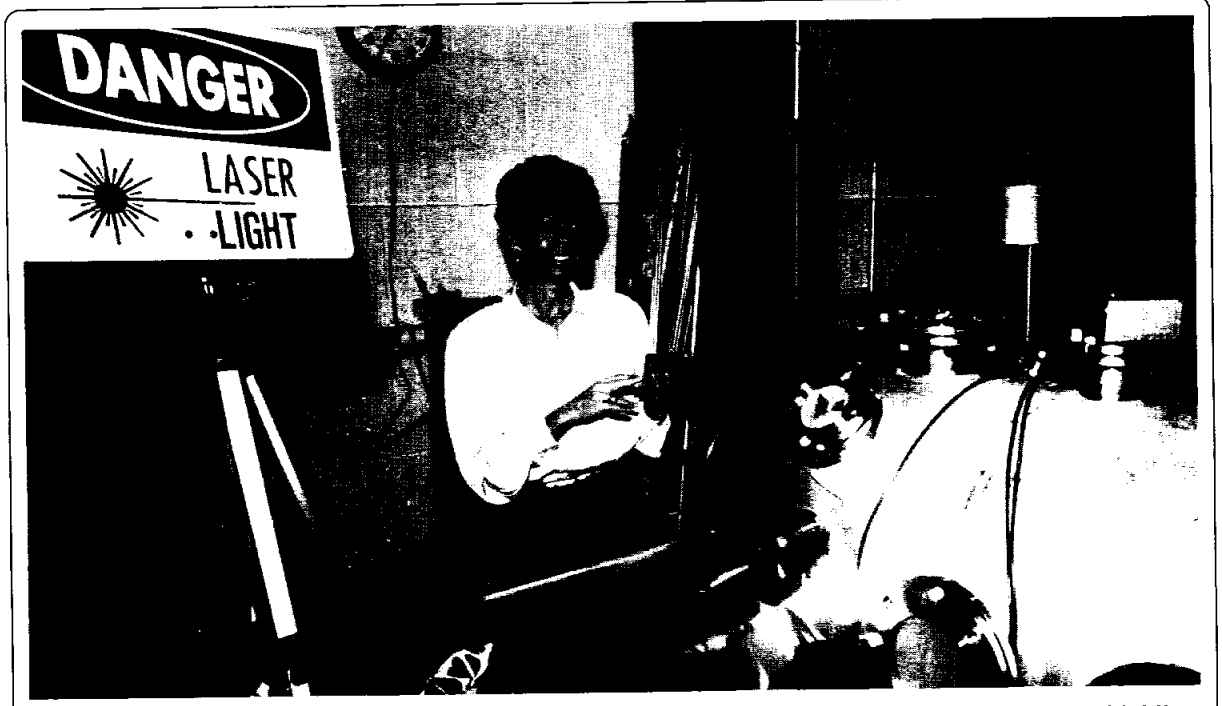
"To me, the biggest need in the policy area is for the spacecraft community to agree that spacecraft must stay intact until reentry," he said.

Another important need is a method to accurately monitor what is going on in the orbital environment. Designers won't know how to build or protect spacecraft without a clear understanding of the environment, he said. The monitoring system also should be used to enforce whatever policies are established, he added.

Policies on geosynchronous orbit should be studied separately, he suggested, because the debris problem there is 20 to 30 years behind the low Earth orbit problem.

"This is a common good kind of problem," Loftus said. "That is, it doesn't do any good for one nation to start being a good guy unless everybody starts being a good guy. That means you have to reach a consensus among the community that, yea verily, it is in everybody's best interest to do this."

In the final analysis, experts agree, the best interests of all spacefaring nations appear to dictate that steps be taken quickly before a vicious cycle of exponential growth renders Earth orbit unuseable.



Jeanne Lee Crews, project engineer for the Orbital Debris Impact Laboratory, stands behind the shielding that protects human eyes from the laser light used to illuminate light-gas gun hypervelocity tests.

Light-gas gun is research workhorse

The workhorse of hypervelocity impact physics is called a light-gas gun. The device, so named because it uses light gases such as helium or hydrogen, is really a two-stage launcher that theoretically can propel particles as fast as 12 kilometers per second.

In JSC's Orbital Debris Impact Laboratory is a light-gas gun that has achieved 9 kilometers per second — 20,450 miles an hour.

Jeanne Lee Crews, project engineer for the lab, is in charge of the small gun in Bldg. 31. She works closely with Burt Cour-Palais and other members of the Space Sciences Branch as they try to simulate the effects of hypervelocity collisions that are becoming more frequent in Earth orbit.

Those effects are spectacular because of the extremely high pressures generated when two pieces of matter meet at such speeds, she said. Shock waves create terrific compression in the target material and, depending on what it is made of, the area of the target that is hit fractures, melts, or vaporizes.

The light-gas gun at JSC is being used to research the ability of non-metallic materials to protect spacecraft from hypervelocity collisions. Larger guns at Marshall and Ames are evaluating hypervelocity impacts on metals.

The first stage of the JSC gun contains the firing mechanism, made from a modified .22-caliber rifle, Crews said. That mechanism fires into a pump tube filled with hydrogen gas. Also in the pump tube is a polyethylene piston. When the gunpowder is exploded, it propels the piston through the pump tube toward a high-pressure coupling toward a shear plate, compressing the gas.

A shear plate sits in front of high-pressure coupling that connects the pump tube to a launch tube within a vacuum chamber. When the hydrogen gas reaches sufficient pressure, the shear plate made out of thin metal bursts and the gas drives a projectile down the launch tube.

Projectiles range in size from 100 microns (the size of a small salt grain) to 1.7 millimeters (the size of buckshot), the full bore of the launch tube. Their masses can be up to 5 milligrams. When smaller projectiles are fired, several of the same size are imbedded in a nylon slug that is designed to separate as it nears the target. The projectiles then continue alone to hit the target. For very small projectiles, several are used to ensure that at least one hits the target.

The impact of projectile on target — which is what interests the researchers — is recorded using a state-of-the-art high-speed camera system made by Cordin Co., the only one in existence.

The camera can take 80 stop-action photos of the impact at up to 2 million frames per second. At JSC, the camera's speed is limited to 1 million frames per second because the infrared laser used to illuminate the subject is only able to pulse once every microsecond. The laser pulse length is 15 nanoseconds.

Crews said the light-gas gun fires about eight shots a week at samples of spacesuit materials and prospective non-metallic Space Station materials.

The gun was built in-house using modified plans provided by the Langley Research Center. The lab is developing a larger, 4.3-millimeter bore gun that can propel masses of 100 milligrams.

Roundup Swap Shop

All Swap Shop ads must be submitted on a JSC Form 1452. The forms may be obtained from the Forms Office. Deadline for submitting ads is 5 p.m. the first Wednesday after the date of publication. Send ads to Roundup, AP3, or deliver them to the Newsroom, Bldg. 2 Annex, Room 147. No phone in ads will be taken.

Property & Rentals

Lease: Condo on Clear Lake, 24 hr. security, pool, tennis, 2-1, $365/mo. plus utilities. 480-5583 or 482-7156.

Sale/lease: Nassau Bay 2,200 sq. ft. townhouse, new carpet, paint, large garage, deck, atrium, 20 ft. FPL, $890/mo. or $119,000. Jerry, x38922 or 474-4310.

Sale: Shoreacres 3-2-2 country home, 1/2 acre wooded lot, fenced, knotty pine kitchen and dining, beam ceiling master BR, walk to Bay, boat ramp, pier, HYC, $84,100. 470-9267.

Lease: Christie Lodge at Beaver Creek ski area, luxury resort, 1 BR condo avail. 3-14 to 3-21, $599/wk. D. Smith, x31167 or 280-0027.

Rent: 3-2 home near San Jac, Pasadena, formal dining, lg. den, covered patio, fenced, $550/mo. 476-4000.

Sale/lease: CLC 2BR Baywind condo, all appliances, W/D connections, fans, storage room, pool, etc., near NASA. 488-0719.

Sale/lease: University Trace 2-1-1 condo, W/D, security, upstairs, balcony, storage, appliances, $35,000 or $360/mo. + deposit. 488-1215.

Lease: CLC/Oakbrook West 4-2.5-1, fenced, FPL, GDO, professional landscape, custom drapes, large kitchen, formal dining, new paint, security alarm, $795/mo. 482-6609.

Lease: Dixie Hollow/Pearland 3-2-2, clean, new paint in and out, fan, good location, $495/mo. 482-6609.

Sale: Friendswood custom built 4-2-2, 1/3 acre fenced, ex. cond., microwave, fans, quality woodwork,, never flooded, 15 min. to NASA, CC Schools, near Baybrook Mall, high $50s. Susarla, 333-6556 or 482-9666.

Lease: Friendswood 4-2-2, FPL, extra clean, plush carpet, near Baybrook Mall, 10 min. to NASA, ready March 1, no smokers, outside pet only, $550/mo. + 1 mo. deposit. 996-8541.

Sale: Baywind II 1-1 condo, FPL, mirrored walls, mini-blinds, fans, W/D connections, assumable. 471-6814.

Sale/lease: El Dorado Trace condo, 2-2, FPL, appliances, pools, workout facilities, $33,500 or $420/mo. Dan, 757-2398 or 480-6913.

Sale/lease: Sycamore Valley 3-2-2, new carpet, parquet, custom drapes, FPL, large backyard with activity gym, $625/mo. or $61,000. 481-9095.

Sale: Heritage Park 3-2-2, assumption, clean, FPL, landscaped, fans and extras. 482-3761.

Lease: 2-1.5-1 home, fenced, W/D conn., all appliances, lawn maint. included, $450/mo. 486-4466.

Lease: Barringer Lane 2BR apartment, Webster area, W/D conn., $330/mo. + $50 deposit. 996-8113.

Lease: Baywind II condo, 1-1, FPL, all appliances, pool, game room and tennis. Jim Wiltz, x39009 or 944-0451.

Lease: Heritage Park 3-2-2, all electric, 1,450 sq.ft., fenced, fans, on cul-de-sac, near park & pool, $500/mo. Mike, 280-1714 or 480-4507.

Sale/lease: 1,800 sq. ft. metal bldg. on 3 lots; 250 sq.ft. portable bldg. in Channelview area, take up payments. Roeh, x33213 or 482-1348.

Lease: West Galveston Island beach house, 3-2, furnished, day/week/month. Ed Shumilak, x37686 or 482-7723.

Lease: Bayridge 3-2-2A, fenced, FPL, central H/AC, references, deposit, no pets. 488-1301.

Sale/lease: Austin/UT condo, 1-1, perfect for students, assume loan, no equity. B. Craig, x34158 or 420-2936.

Sale/lease: Pasadena/South Houston 3-1.5-2, brick, central H/AC, all appliances, carpet, drapes, fresh paint, no pets, $440/mo. or $46,500 w/8.5% VA assumable loan at $343/mo., owner equity $16,500. 941-5908.

Lease: Baywind I condo, 1-1, all appliances, pool, gameroom, etc, $350/mo. + 1 mo. deposit. Walt, x36353 or 532-4766.

Rent: Rooms in Friendswood home, wooded area, furnished or unfurnished, male/female, util., W/D, microwave, hot tub, cable, $225/mo. Rowena, x32349 or 996-9249.

Rent: Waterfront League City townhouse, on marina, 2-2, FPL, loft, W/D, tennis/pool, non-smokers, no pets, ready 4/1 or 5/1, $800/mo. + util., unfurnished, will consider furnishing. 554-6907.

Sale: League city 3-2-2 house, attached garage, large lot, near schools, mahogany den/kitchen/DR, large walk-ins, $65,000. Martin or Jeanne, 333-3133, x226, or 554-2976.

Cars & Trucks

'82 Saab 900S Turbo, AM/FM/cassette, sunroof, ex. cond., $6,500 OBO. McMillan, x32936 or 481-9095.

'78 Camero, AC, PS, PB, auto, tilt, chrome custom wheels, clean, $2,500 OBO. Bill Wood, x33838 or 554-2283.

'71 Corvette, auto, new engine, T-tops, Calif. front end, new tires, new bright yellow polyurethane enamel paint, AM/FM, good interior, $5,200. Chris, 482-1821.

'79 Nova, AC, good cond., $1,900; '78 Grand Prix, AC, good cond., $1,200. 280-2444 or 488-0275.

'75 Dodge pickup, good work truck, needs some body work, $500. Herman, x35095 or (409) 389-2461.

'86 Chevy Cavalier, loaded, AM/FM/cassette, power locks & windows, low miles, 5 yr. warranty, $10,000 or assume pymts. Monica, 282-3788 or 333-2519.

'84 Jeep Cherokee 4x4, loaded, tint, must sell, ex. cond., $8,500. 332-3301.

'83 Ford F-150 pickup, 6 cyl., std., AC, PS, PB, stereo, cruise, aux. tank, LWB, shell top, low miles, top shape, $4,800. 488-6358.

'78 Buick Estate wagon, engine needs work, good body, new Michelins, $875 OBO. 488-4412.

'85 Jeep Cherokee, V-6, 5-spd., PS, PB, AC, AM/FM, tilt, roof rack, cloth seats, 42K mi., ex. cond., $10,500. 480-6805.

'79 Cadillac Coupe DeVille d'Elegance, copper, plush, wire wheel covers, one owner, good condition, must sell, $2,800. 996-7933.

'83 Olds 98, 4 dr., loaded, blue, 1 owner, 78K miles, $4,200. Kandy, 482-2750.

'74 Fiat Spyder convertible, $800. Byrns, x30974.

'75 Ford Maverick, dependable, auto, 44K mi. (orig.), good cond., AC, AM/FM/cassette, $1,200. Kathy, 538-1633.

'71 VW Beetle, good work car, $800. L. Parker, x58622 or 481-4372.

'82 Honda Accord, 4 dr., fully equipped, owner retired, 58K mi., like new, $5,200. Kinzler, 326-2449.

'78 Camaro Type LT, 350 4bbl., 4-spd., dual exhaust, positrak, radial TAs, gas shocks, deluxe interior, factory guages, new clutch, Z-28 suspension, 85K mi., $3,200 OBO. Adams, x32567 or 488-3314.

'85 Buick Regal LTD, ex. cond., 2 dr., 28K mi., $7,700. Bill, x34516 or 484-7308.

'84 Nissan 200SX-XE pkge., digital, sunroof, 5-spd., ex. cond., 37.5K mi., $7,800. Susan, x38642 or 485-0204.

'84 Pontiac Fiero, red, 4-spd., 21K mi., extend. warranty, $6,200. Marie, x38875 or 480-4507.

'81 Honda Prelude, auto, AC, moonroof, AM/FM, looks and runs great, blue, $3,850. Pete, x36228 or 480-4525.

'85 Toyota truck, 4 spd., AC, 4 new tires, ex. cond., $5,500. Ed Rainey, x39650 or 358-6612.

'78 Chevy Malibu Classic station wagon, AC, PS, PB, good family car, $1,500 OBO. 480-9280.

'86 Toyota Camry, 4D sedan, white, 5-spd., AC, AM/FM, manuals, ex. cond., for blue book retail. Martin, 554-2976.

'84 Pontiac Fiero SE, white, very good cond., '50K mi., 2.5L 4 cyl., 4-spd., AC, AM/FM/cassette, brown int., $6,500. Rick, 282-2714 or 559-2735.

Boats & Planes

50HP Chrysler outboard, $435. B. Reina, x31588.

18 ft. Sol Cat catamaran, 2 mainsails, jib, life preservers, wetsuit, trailer, 2 trapezes & buckets, $900. Ron Dickey, x39275 or 332-6003.

Sunfish sailboat w/trailer, both in ex. cond., $1,100. Kevn, x30867 or 484-1158.

Dolphin Sr. sailboat, 14', galv. trailer, $450. Dave, 333-1425 days.

23' cabin cruiser, sleeps 4, head, gally w/stove & refrig., 228 HP Mercruiser I/O w/trimtabs, depthfinder. Frances, x39199 or 332-4081.

VW airboat kit for aluminum boat, cage, engine, electric start, 48" prop., guages & lights, needs work, $200 OBO. Quinn, x30765 or 482-2821.

'62 Piper Colt airplane, 300 SMOH, 2220TT, 2 place, hangared, $4,900. 538-2299.

Cycles

'82 Harley Davidson FL-H, 80 cu. in., w/saddle bags & windjammer, upper ½ of motor overhauled, garaged, $3,295. Gale, 338-1169 or 488-7522.

'80 Suzuki GS450, 53K mi., garaged, $450. Dave, 333-1425 days.

'78 Suzuki GS-1000, 21K mi., helmets, shop manual, new battery & regulator, custom paint, many, many extras, $750 OBO. Charlie, x37771.

'78 Honda 400 Hondamatic, 9K mi., new battery, two helmets & rainsuit, really nice, good cond:, $450. 946-7720.

Honda XL 125, runs great, ex. cond., $295. Dan, 943-5226 or 338-1322.

'83 Honda Nighthawk CB550, ex. cond., less than 2K mi., crash bar, 1 owner, shaft drive, $1,500 OBO. Dean, x31456 or 554-5933.

Girl's 24: 3-spd. bicycle, silver & chrome, ex. cond., $75. Roeh, x33213.

'83 Honda Nighthawk CB550, ex. cond., less than 2K mi., crash bar, one owner, shaft drive, $1,500 OBO. Dean, x31456 or 554-5933.

Audiovisual & Computers

Pioneer SX-850 stereo receiver, less than 5 yr. old, was Pioneer's top of line model, lovingly cared for, looks new, works perfectly, 85 watts/ch., was $600, now $250. Randy, 480-5194.

Portable Zenith stereo, 2 spkrs., new needle, nice, $10. 482-8729.

Intel 330 computer system, includes 32MB hard drive, 896K RAM, Hazeltine Espirit terminal, C.Itoh 467 terminal, etc. Phil Glynn, x38805 or 488-4453.

XT Compatible computer, includes 360K floppy and 12MB hard drive, 640K RAM w/6 pak clone card & software, printer coprocessor card, mono card, CRT, etc., $950. Phil Glynn, x38805 or 488-4453.

TEAC A-106 stereo dolby tape deck, ex. cond., $75. Gerry, x39805 or 486-0889.

JVC video camera w/character generator, case, uni-omni mic., wireless mic., filters, lens hood, color and stereo, was $1,200, now $950. Underhill, x32291 or 326-1303.

Texas Instruments TIPC professional computer, IBM compat., 256K, 2 drives, RGB color graphics & monitor, much software, was $3,000, now $1,200 OBO. Lewis, x38373 or 479-4002.

VHS VCR, front loading, remote, 9 mo. old, $225. Villars, x32988 or 930-1509.

Ohio Scientific PC, color, 1 floppy drive, 8 ch. analog input, 2 ch. analog output, assembler, $200 OBO. Dieterich, x31912 or 482-1859.

Household

Heavy duty washing machine, almond color, hardly used. 996-8541.

Supreme IV queen size waterbed mattress, $100; fiberglass shell for 8' pickup bed, $175; TI-99/A word processing pkge., never opened, 2 for sale, $20 ea. Herman, x35095 or (409) 389-2461.

Ward's frost-free 18 cu. ft. refrigerator, off white, good cond., works great, $200. Ron Dickey, x39275 or 332-6003.

Speed Queen heavy duty washer, large capacity, runs but needs some repair, $75 OBO. 554-2908.

Matching sofa, armchair and coffee table, $50. Paul, x39218 or 486-6813.

15 gal. hot water heater; 15' formica bar top; 24"x30"x2" maple cutting board; new birch chairs; 4-ton AC, used 1 season. 554-2908.

Small apartment dryer, good shape, needs belt, $40; washer, needs repair, make offer. 487-2383.

Maple bunk bed set with safety rail, ladder and mattresses; 40" whole house ventilator fan, stand and motor. Thibodeau, x38275 or 480-0919.

Green velour couch, $100; four leather game chairs, $100; exercycle, $75. 472-8466.

Two matching rattan loveseats in perfect cond., flower print, blond rattan frames, were $1,500, now $750. Gene, x39030 or Joyce, x39033.

Chest of drawers w/mirror, dark wood, $65; dark rattan fan chair w/cushion, $35; full-size bed, $85; all in great cond. Gene, x39030 or Joyce, x39033.

Small antique china cabinet, barley twist legs, dated 1870, ex. cond., $275; matching antique bugget w/barley twist legs, $275 or both for $525. 488-5564.

Small table and two chairs, $35; upholstered office chair, $25; IBM electric typewriter, ex. cond., $120. 488-5564.

Cream color carpet w/foam pad, 9'x12', $75; bike rack for 2 bikes, $10. Sharon, x30210 or 480-2646.

Sealy Posturepedic box spring, never used, still in plastic, full size, was $145, now $95. 482-8729.

Fireplace screen and accessories; dinette table w/chairs; lamp; washing machine; variety of household items. 482-1317 or 338-2074.

Kenmore washer and dryer, ex. working cond., almond, xtra lg. capacity washer, perm. press cycle, delicate, adj. water levels, xtra lg. dryer has perm. press, time & air-dry cycles, must sell. Trish, x31835 or 486-7736.

Wicker furniture: 2 chairs, table, setee in good. cond., sell sep. or all for $150; exercise bike, good cond., $75; inflatable 2-person raft, wooden floor, motor mount, paddles, used 3 times, $75. Lavon, x30351, 34432 or 486-5351.

Electric stove, 4 burners, like new, '85 model, $125. Ed Rainey, x39650 or 358-6612.

Commissioned Spainish style oil painting, 24"x36", framed, very striking, make offer. Thompson, x30017 or 332-2229.

Six-drawer dresser, matching 4-drawer desk; single box springs & mattress, single frame w/maple head & footboards; formal pecan dining table, 6 chairs, matching china cabinet & hutch. Theresa, x58301.

Photographic

35mm telephoto lens to fit any 35mm Minolta, 4 yrs. old, good cond., $75. Randy, 480-5194.

Canon 100-200 zoom f5.6 auto lens, $100; assorted 55mm filters, $1 ea. Nering, x31382 or 481-0608.

Kodak carousel 600 slide projector, screen, 4 trays, $100. Nering, x31382 or 481-0608.

Wanted

Want male or female roommate to share 3 BR League City home, w/household privileges. Frances, x39199 or 332-4081.

Want female red Doberman, from 6 mo. to 3 yr. old, for companion and guard dog, will pay good price for good dog. Merrell, x37570.

Want engineers for speech recognition experiments, send name and phone number to Mark, EE2. For info, call x30160.

Want behavioral sciences research assistants: doctoral students for analyzing and coding studies, experience w/statistics and word processing desirable, send resume to CASET, c/o NASA JSC, P.O. Box 580405, Houston, 77258-0405.

Want acoustic guitar, in good cond., perfer nylon strings. Schwartz, x34474.

Pets & Livestock

AKC Labrador puppies, parents present, hunting background, great with kids, males $124, females $175. 332-3301.

Thoroughbred poodle puppies, litter ready in early April, $50 per dog. Tammy, x38322 or 488-8481.

AKC male chow, 2 mo., $125; 3 yr. old Appalousa filley, $1,200; bee hives and equipment. Byrns, x30974 or 925-8257.

Male boxer, 1 yr. old, fawn/white, AKC, beautiful, excellent w/children, shots, FREE. Susan, x38642 or 485-0204.

Purebred Siamese kittens. Steve, x32530 or 326-2174.

Young gray striped kitten needs a home. Joyce, x36157.

Pit bull puppies, UKC, purebred, born 12-13-86, males & females, $150. 534-3487.

Two 10-gal. aquariums plus stands, light hoods, filters, ready for fish, plus 15 yrs. of experience to help get you started, $150. Lavon, x30351 or 486-5351.

Musical Instruments

Kawai walnut console piano, ex. cond., was $2,500, now $1,500. 337-6840

Olds trumpet, silver chrome finish, good cond., free case, $175. Rick, 282-2714 or 559-2735.

Miscellaneous

Mark IV Shopsmith, 1957 model, as is, $100. Byrns, x30974 or 925-8257.

Sears exercycle, speedometer/odometer, lever tension control, 19" covered flywheel, heavy duty steel frame, $90 OBO. Lynda, 488-3300 or 332-3290.

Ford manuals, 3 vol.+ set, for 1982 models, Escort thru Continental, $25. Faber, 482-7877.

Ladies blue fox fur coat, ex. cond., size 7/8, $200 OBO. Cheri, x34305.

Two science fair backdrop boards, made from 1/2" plywood, $15 ea. or 2 for $25. Boykin, 326-1267.

'75-'78 Fiat X1/9 parts, wheels, muffler, distributor, factory shop manual, all good cond., $2 ea. Leonard S., 280-1692.

Porsche 924 factory shop manual for '77 thru '82 models, was $200, never used, now $50. Leonard S., 280-1692.

Coachman over-the-cab camper, 8 ½ ft. w/refrig., stove, heater, sleeps 4, $450. 474-2906.

VHF car telephone, operator serviced, not working, cost $4,000, now $200. 474-2906.

Sears Lifestyler 1000 rowing machine, like new, was $149, now $75; Spaulding body pack stomach and back machine, like new, was $249, now $150. Margaret, x33664 or 487-1204.

Mark 10 capacitive discharge ignition unit, $20; ampmeter kit, $10; trailer elec. conn., $5; auto alarm kit, $25; For Fiarlane shop manual, $5; '75 Toyota Celica shop manuals, $5; Heathkit solid state ignition analyzer, $65; exhaust gas analyzer, $25. Thompson, x30017 or 332-2229.

Mazda GLC bucket seats; insulated & paneled cover for '81 Toyota longbed, $200; Baja kit parts, $35; VW extractor exhaust sys., $50. Underhill, x32291 or 326-1303.

Bed liner for std. wheel base Toyota, $100. Mark, x36051 or 554-2440.

Astro Craft aluminum camper top, red, 8'x6'x2', $150. 485-2282.

Lawn edger, new, in box, $100. 473-2505.

Firestone P195/75R14 mud tires on Chrysler rims, $60/pr. Rich, x35137 or 554-6780.

Gilruth Center News

Call x30304 for more information

SCUBA — Learn to scuba dive and receive an NAUI certification card. Class starts March 23 for 6 weeks and meets every Monday from 6:30 to 9 p.m. and every Wednesday from 7 to 9:30 p.m. The initial fee is $45. Additional fees will be collected at the first meeting.

St. Pat's Run — This 5-kilometer run will begin at 9 a.m. Saturday, March 14. Pre-registration by March 11 costs $6. Late registration is $8. T-shirts and awards are included in the fee.

Physical fitness — The next 12-week course of the JSC Physical Fitness Program will be held April 6 to June 26 from 11 a.m. to noon or from 4 to 5 p.m. All NASA and contractor employees and dependents are eligible upon completion of an acceptable physical exam and a maximal treadmill stress test. Call x30302 for more information.

Aerobics — Exercise to music and improve fitness in this course which meets for 9 weeks beginning March 3. The class meets every Tuesday and Thursday from 5:15 to 6:15 p.m. and costs $27 per person.

Karate — This course in the "natural way" includes Taekondo, kung fu, hapkido and shido ryu. The 4-week class begins Feb. 25 and meets every Monday and Wednesday from 7 to 8 p.m. The cost is $25 per person.

Exercise class — Improve your cardiovascular fitness, flexibility and overall body tone in this class, which meets from 5:15 to 6:15 p.m. every Monday and Wednesday for 9 weeks beginning March 2. The cost is $27 per person.

Weight safety — This is a required course for those employees wishing to use the Rec Center weight room. The class will be held Feb. 25 and March 11 from 8 to 9:30 p.m. The cost is $4.

Defensive driving — Learn to drive safely and qualify for a 10% reduction in auto insurance rates for the next 3 years. This all-day Saturday class meets from 8 a.m. to 5 p.m. March 21 and April 25.

Ballroom dance — Professional instruction in beginner, intermediate and advanced ballroom dancing begins March 5 and runs for 8 weeks. All class meet Thursdays. The cost is $60 per person.

Help us help you.

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