



Working ahead
A team of JSC Crew Systems workers is preparing a helmet-mounted display for space station space walkers. Story on Page 3.



Module move
The mockups for Space Station Freedom have been moved from Bldg. 15 to the recently completed Bldg. 9B. Photo on Page 4.

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Commander Rick Hauck presents an STS-26 flight jacket to President Ronald Reagan during his recent visit to JSC. Hauck told the president the crew would carry the president's name tag and a crew patch into orbit on *Discovery* and return them to him after the mission.

JSC Photo by Bob Waick

GO! *Discovery* Return to flight launch is perfect

Before the eyes of the world, Americans returned to space Thursday.

History broke through crystal-clear Florida skies as *Discovery* roared free of Earth in a perfect 10:37 a.m. CDT launch, a tribute to more than two and a half of the most crucial years of NASA workmanship in the agency's history.

After a faultless 43-hour terminal countdown,

Commander Rick Hauck, Pilot Dick Covey and mission specialists Mike Lounge, Dave Hilmers and Pinky Nelson flew *Discovery* into a 160-mile-high orbit.

The crew was all business during the launch, but a tinge of excitement sounded in Hauck's voice when he confirmed CAPCOM J.O. Creighton's "go for throttle-up" with a succinct, "Roger, go!"

"It's nice to be in orbit," Hauck said as *Discovery* left the Earth's atmosphere.

"Wow, that was really something," NASA Administrator James C. Fletcher told the team in Kennedy Space Center's Launch Control Room immediately following lift-off. "The nation owes you a lot and will continue to owe you a lot in the days and months to come. Congratulations on a job well done."

Launch Director Bob Sieck told the launch team members he understood why they had to cheer as *Discovery* cleared the tower after 6.8 seconds and the Solid Rocket Motors (SRMs) separated two minutes into the flight.

"After a few long years, you've just got to let it out," he said.

Sieck also explained the significance of a large American flag hanging in the Launch Control Room. He said the gesture is the start of a new tradition; the flag will be raised when the Rotating Service Structure (RSS) is rolled back and lowered at the successful completion of the mission.

Across JSC, employees glued to television monitors in their various buildings shouted encouraging cries of "Go, *Discovery*," in response to the successful launch.

With a direct ascent, *Discovery* achieved a 156 by 35-nautical mile ballistic trajectory at main engine cutoff, 8 minutes, 31 seconds into the flight, and moved into a 160-nautical mile circular orbit with a picture-perfect Orbital Maneuvering System burn about 40 minutes after liftoff.

Discovery's launch signals NASA's recovery from the *Challenger* accident on Jan. 28, 1986, and a renewed era of American manned spaceflight. No problems were apparent during ascent with any of the hundreds of modified Shuttle components.

The launch originally had been planned for 8:59 a.m. CDT, but was delayed as mission managers monitored upper-level winds and other weather factors that were desirable for *Discovery's* direct insertion, abort shaped trajectory. These conditions eventually reached satisfactory levels as the morning progressed.



Ellington ceremony

Houston plans big welcome

Discovery's crew will be welcomed back to Houston after the return to flight by NASA dignitaries, employees and the public in grand ceremonies planned at Ellington Field.

The crew is expected to arrive at Ellington about eight hours after *Discovery* lands at Edwards Air Force Base in California. The red carpet will be rolled out for the crew, and JSC Director Aaron Cohen and other NASA officials are expected to greet the astronauts and their families as they leave their plane.

Cohen and the crew will make a few remarks regarding the mission during

a 20-minute ceremony.

A band will provide entertainment, and a variety of other entertainment and special guests are being invited.

JSC employees who wish to attend should call the Employee Information Service, x36765, for the latest information on when ceremony is expected to start.

The rally is a joint effort of the Greater Houston Chamber of Commerce, the Houston Economic Development Council, Houston Proud, the Clear Lake Chamber of Commerce, the Clear Lake Economic Development Council, NASA-JSC and other business and

civic leaders.

The public is invited to attend, and the Clear Lake Area Chamber of Commerce has asked that Clear Lake-area residents wear something yellow so they may be identified in the crowd.

Free refreshments will be available, and a carnival will be open for those who want to pay for entertainment.

The welcome-home ceremony will be one of the last events of the four-day STS-26 mission.

The crew's final full day in orbit will begin with an hour and a half of work on the Phase Partitioning Experiment. Please see **HOUSTON**, Page 4

Discovery carries many payloads

Middeck experiments study diverse subjects

By James Hartsfield

In addition to its primary payload of Tracking and Data Relay Satellite-C, *Discovery* will carry 11 middeck experiments that will study a variety of areas, from research that could result in new drugs to treat cancer and AIDS to studies of lightning.

As part of the experiments, a wide range of special solutions is being carried aloft, from a derivative from the venom of cottonmouth snakes to blood samples from donors with diabetes and forms of cancer.

Other experiments will study lightning as seen from orbit and evaluate the use of infrared light as a method of transmitting voice communications within the Orbiter. Two experiments were developed by students as part of the Shuttle Student Involvement Project. A list and description of middeck payloads flying on STS-26 includes:

Organic films

As part of a long-term space research program that will extend

into the space station era, 3M Company scientists will fly an experiment called the Physical Vapor Transport of Organic Solids (PVTOS) on STS-26, the experiment's second trip to space.

PVTOS will produce thin organic films with ordered crystalline structures in order to study their optical, electrical and chemical properties. The primary aim of PVTOS is to build upon knowledge gained from an earlier flight of the apparatus aboard *Discovery* in 1985.

The PVTOS experiment, to be activated on the first flight day of STS-26, consists of nine independent cells 12 inches long and 3 inches in diameter. Each cell contains a test tube-like ampule containing organic material. During space flight, the organic material is vaporized. Migrating through a buffer gas, the vaporized material forms a highly ordered thin film on a flat surface. After the samples are returned to Earth, scientists will study the films produced in space. The results could eventually be applied to

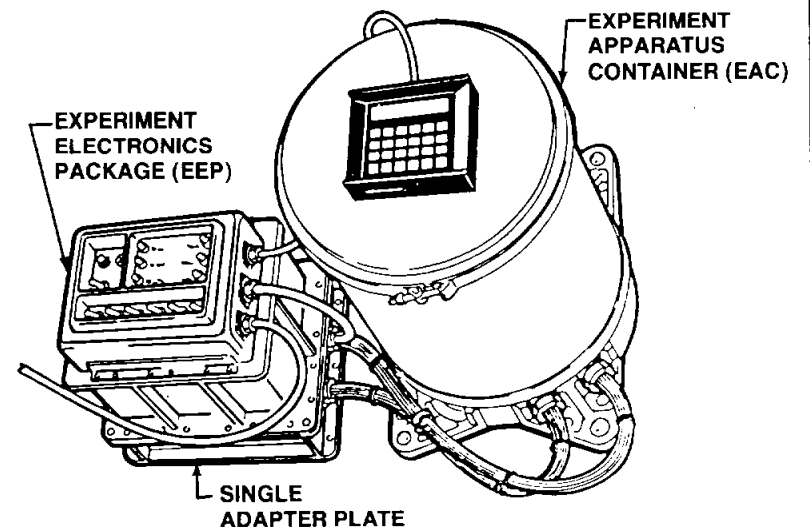
production of specialized thin films on Earth or in space.

Crystal growth

Protein Crystal Growth (PCG) experiments flying aboard *Discovery* may help scientists develop new drugs to help battle AIDS, emphysema and a form of cancer, among other possible benefits.

PCG experiments may advance a technology attracting intense interest from major pharmaceutical houses, the biotech industry and agricultural companies. More perfect protein crystals grown in microgravity may divulge the secrets of their complex, three-dimensional structures more easily than such crystals grown on Earth. Knowing the precise structure of these complex molecules can provide the key to understanding their biological functions, thus leading to methods of altering those functions in ways that may result in new drugs.

During the flight, 60 different crystal growth experiments, including as many as 10 distinct proteins, will be

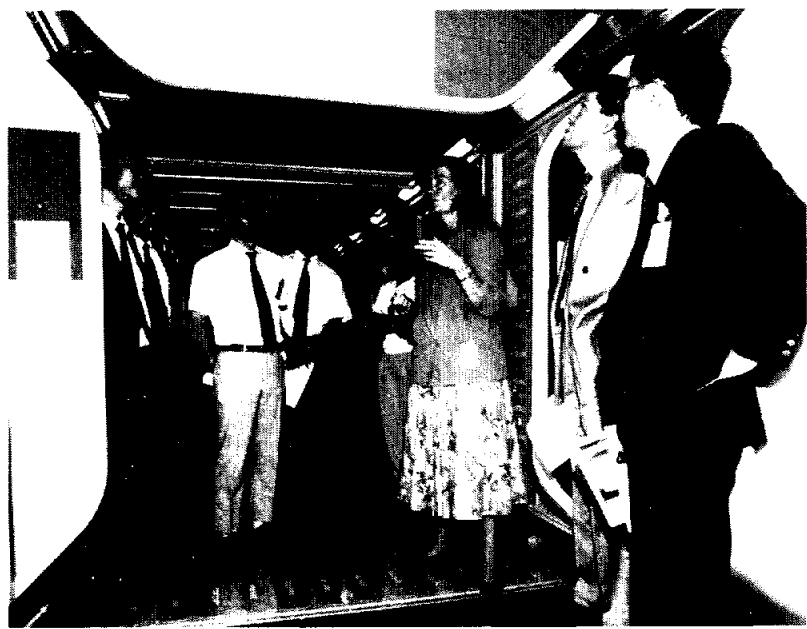


One of the experiments to be flown on *Discovery's* middeck will study the Physical Vapor Transport of Organic Solids (PVTOS). Sponsored by NASA's Office of Commercial Programs, PVTOS will produce and study thin organic films with crystalline structures.

attempted in an apparatus that fits into one Orbiter middeck locker. The crew will initiate the crystal growth process shortly after achieving orbit, and it will continue for several days. The experiment apparatus, being flown for the first time on STS-26,

differs from previous protein crystal payloads in that it provides temperature control and automation of certain processes.

Following post-flight analysis, crystals produced on the flight will Please see **MIDDECK**, Page 4



JSC Photo

EAST MEETS WEST—Frances Mount, space station crew quarters subsystem manager, gives representatives of the Japanese space program a tour of the space station mock-ups. The Japanese were at JSC recently for a Joint NASA-NASDA Man-Systems Subsystem and Architectural Control Document Review. During the review, the two groups went over plans for incorporating the Japanese module into the space station.

JSC

Space Shorts

NOAA satellite launch success

Early reports indicate NASA's Saturday launch of the NOAA-H weather satellite from Vandenberg Air Force Base was successful.

Launch, using an Atlas 63E expendable launch vehicle, took place at 5:02 a.m. CDT Saturday, and all Atlas staging operations occurred nominally on time. The apogee kick motor on the NOAA-H spacecraft fired on time and worked properly.

The satellite became NOAA-11 when it achieved orbit 470 nautical miles above the Earth at an inclination of 98.86 degrees.

The satellite will orbit the Earth for the National Oceanic and Atmospheric Administration (NOAA) once every 102 minutes, tracking hurricanes, photographing the Earth for weather forecasters, monitor

icebergs, measure temperature and humidity and relay data from 2,000 ground weather stations. It also will perform atmospheric studies as part of the global effort to provide more information on ozone depletion.

NOAA-11 joins the already orbiting NOAA-9 and NOAA-10 spacecraft.

Magellan roll out eyes Venus shot

The Magellan spacecraft that is scheduled to begin its journey to Venus in April was officially rolled out Tuesday at Martin Marietta Corp. facilities in Denver.

Magellan, the first U.S. planetary mission in more than 10 years, will map Venus in the greatest detail ever using radar.

Magellan is to be launched from the Space Shuttle *Atlantis*, which is to be launched April 28, 1989.

JSC

Ticket Window

The following discount tickets are available for purchase in the Bldg. 11 Exchange Gift Store from 10 a.m. to 2 p.m. weekdays:

General Cinema (valid for one year): \$3 each.

Loew Theatre (valid for one year): \$3 each.

Astroworld/Six Flags (available through today, valid until Oct. 31: season, \$32.95; children, \$12.95; adult, \$14.25

Sea Arama (valid until Dec. 21): children, \$13.56; adult, \$15.96

Sea World-San Antonio (year): children, \$13.56; adults, \$15.96.

Renaissance Festival (weekends in October through Nov. 15): children, \$4; adults, \$8.

Bus trips to Renaissance Festival (includes bus fare and ticket): children (1-4), \$6; children (5-12), \$7; adults, \$10.

JSC

Library's Latest

• *Astrodynamics 1985: Proceedings of the AAS/AIAA Astrodynamics*, by B. Kaufman

• *Automating Code and Documentation and Management (CDM)*, by M.E. Singleton

• *Avoiding Microcomputer Headaches: How to Control the Acquisition*, by R.B. Nadel

• *Computational Complexity of Sequential and Parallel Algorithms*, by L. Kronsjo

• *Conceptions of Space and Time—Sources, Evolution, Directions*, by M.D. Akhundov

• *Corrosion Data Survey: Metals Section - NACE Corrosion Inhibitors*, by C.C. Nathan

• *Design and Analysis of Plates and Shells*, by G.E.O. Widera

• *Developments in Boundary Element Methods*, by P.K. Banerjee

• *Encyclopedia of Fluid Mechanics, Vol 5: Slurry Flow Technology*, by N. Cheremisinoff (ref)

• *Encyclopedia of Fluid Mechan-*

ics, Vol. 6: Complex Flow Phenomena, by N. Cheremisinoff (ref)

• *Fatigue and Fracture Assessment by Analysis and Testing*, by S. K. Bhandari

• *Forms of Corrosion: Recognition and Prevention*, by C.P. Dillon

• *Fourth-Generation Languages*, by J. Martin

• *How to Deal with Difficult People (audiocassette)*, by R. Kirschner

• *How to Delegate Work and Ensure It's Done Right (audiocassette)*, by D. Lohr

• *Machine Interpretation of Line Drawings*, by K. Sugihara

• *Modern Batteries: An Introduction to Electrochemical Power Sources*, by C.A. Vincent

• *Modern Control Systems*, by R.C. Dorf

• *NASA Space Plans and Scenarios to 2000 and Beyond—NASA Networking and Data Communications*, by V. Marney-Petix

JSC

Dates & Data

Today

Flu vaccinations—The JSC Clinic will be giving influenza vaccine inoculations from 10-a.m.-noon and 2-4 p.m. Oct. 3 in the Bldg. 8 clinic. The shots are recommended for people with heart disease, chronic bronchopulmonary diseases, diabetes and other chronic disorders. Employees who provide essential services or who may be exposed through greater contact with possibly infected people also are urged to consider vaccination. Employees will have an opportunity to ask questions, and then be asked to sign a consent form before being vaccinated. For more information, contact the JSC Clinic at x34111.

EAA badges—Dependents/spouses may apply for a photo I.D. badge from 6:30-10 p.m., Monday through Friday at the Gilruth Recreation Center.

Aerobics and exercise—Both classes are on-going. Sign up at the Rec Center. For more information, call x30303.

Cafeteria menu—Entrees: seafood gumbo, broiled codfish, fried shrimp, baked ham, tuna and noodles casserole (special). Vegetables: corn, turnip greens, stewed tomatoes.

Monday

Cafeteria menu—Entrees: cream of broccoli soup, braised beef ribs, chicken a la king, enchiladas w/chili, Italian cutlet (special). Vegetables: beans, Brussels sprouts, whipped potatoes.

Tuesday

Engineering expo—The Engineering Directorate will host an exposition Oct. 4-6 in the Rec Center ballroom. The theme for this year's expo is "Engineering—Technical Excellence through Teamwork." Each of the seven Engineering divisions will demonstrate a variety of hardware and software technology including the EVA Retriever, the Aeroassist Flight Experiment; the Orbiter crew escape system; space station avionics, zero-gravity fluid transfer, and laser and infrared communications. All JSC and contrac-

tor employees are invited. The expo will be open 10 a.m.-4 p.m. Oct. 4; 10 a.m.-4 p.m. and 4:30-7:30 p.m. Oct. 5; and 10 a.m.-4 p.m. Oct. 6.

IEEE videoconference—The IEEE will host a videoconference on "The Interdisciplinary World of Computing" from 10 a.m.-3:30 p.m. Oct. 4 in the Rec Center. Cost is \$50 for IEEE, ISA, AIAA and ACM members, and \$60 for others. Call Nancy Marshall, x30174, for registration. For more information, call Eddie Robinson, 333-7029.

Cafeteria menu—Entrees: beef and barley soup; turkey and dressing, round steak w/hash browns, stuffed cabbage (special). Vegetables: corn cobette, okra and tomatoes. French beans.

Wednesday

Toastmasters meet—The next Toastmasters meeting will be at 7:15 a.m. in the Bldg. 3 cafeteria. This worldwide public speaking club promotes self-improvement through an individually paced program. For more information call Carl Martin, x31559.

Introduction to Bridge—A basic introduction to the game for those who have never played. Meets 5:15-7 p.m. every Wednesday at the Rec Center. Cost is \$10. For more information, call x30303.

Beginning Bridge—The fundamentals of bidding, declarer play and defense will be taught from 5:15-7:30 p.m. every Wednesday at the Rec Center beginning Oct. 19 for eight weeks. Cost is \$35. For more information, call x30303.

Cafeteria menu—Entrees: seafood gumbo, catfish with hush puppies, roast pork with dressing, pepper steak (special). Vegetables: broccoli, macaroni and cheese, stewed tomatoes.

Thursday

Weight safety—The next weight safety course required for employees wishing to use the Rec Center weight room will be from 8-9:30 p.m. Cost is \$4.00.

Cafeteria menu—Entrees: seafood gumbo, liver and onions, deviled crabs, roast beef with dressing, tuna and

noodle casserole (special). Vegetables: whipped potatoes, peas, cauliflower.

Oct. 12

IEEE videoconference—Registration deadline for the IEEE-sponsored "Applications of High Temperature Superconductivity" videoconference is Oct. 12. The videoconference will be from 10:30 a.m.-2 p.m. Oct. 20 in the Rec Center. Cost is \$60 for IEEE, ISA, AIAA and ACM members, and \$60 for others. Call Nancy Marshall, x30174 to register. For more information, call Eddie Robinson, 333-7029.

Oct. 13

Return to flight celebration—The eighth annual North Galveston County Chamber of Commerce's Bayou Festival will adopt "A Return to Space Flight Celebration" as its theme Oct. 15-16 at Walter Hall Park in League City. A return-to-flight banquet is slated for Oct. 13 at the South Shore Harbour Resort and Conference Center and tickets are available through the North Galveston County Chamber of Commerce Office in Dickinson and the Clear Lake Area Chamber of Commerce Office, 1201 Nasa Road 1.

Oct. 26

End user conference—The Data Processing Systems Division will host a DPSPD-Supported End User Conference products from 9:30-4 p.m. Oct. 26-27 in the Product Demonstration Facility (PDF), Bldg. 12, Rm. 112. End users will have an opportunity to explore software and hardware products already in use, and see selected DPSPD-supported products they may want to consider purchasing. Products to be demonstrated include: Professional Write, DisplayWrite 4, Harvard Graphics, TELL-A-GRAF, Video Show, Lotus 1-2-3, VP Planner, 132-Column display, dBASE-III Plus, RBase for DOS, extended memory, external storage, multiple host session, concurrent multiple hosts, UTS—40 connectivity to Unisys and category OB/OC workstation. For more information, call the PDF at x37572.

JSC

Swap Shop

Swap Shop ads are accepted from current and retired NASA civil service employees and on-site contractor employees. Each ad must be submitted on a separate full-sized, revised JSC Form 1452. Deadline is 5 p.m. every Friday, two weeks before the desired date of publication. Send ads to Roundup Swap Shop, Code AP3, or deliver them to the deposit box outside Rm. 147 in Bldg. 2.

Property

Sale: Patio home, just outside Credit Union gate, clean and bright, \$98,700. 488-0397.

Lease: 1 BR condo, super clean, W/D, ceiling fan, mini-blinds, 2 balconies, overlooks pool, covered parking, no pets, \$330 plus dep. Mark, x30131 or 332-2416.

Rent: Mobile home, 84', 3-2, mint cond., near NASA, incl. water/gas/sewer, \$395/mo. 337-3970.

Lease: Jamaica Beach beach house, off season, \$500, year round, \$650, plus util. and dep. 337-3970.

Sale: Brook Forest, CLC, 4-2.5-2, approx. 2,500 sq. ft., both formals, large MBR, double FPL, landscaped, near schools, 5 mi. to JSC, \$134,500. x37016 or 488-7224.

Lease: Baywind II condo, 2-2, upstairs, refrig., stove, dishwasher, FPL, W/D, \$350/mo., plus dep. Bill Gordon, x35023 or 487-6151.

Sale: '80 14x80 mobile home, 3-2-2, FPL, wet bar, balcony kitchen, W/D, all kitchen appl., must sell, being transferred, \$11,000 cash. 480-8142 or 484-0858.

Lease: Baywind I, 2-1, W/D, fans, upstairs, \$375/mo., \$150/dep. x37595 or 488-1359.

Sale: Middlebrook, 3-2-2, study, FPL, wet bar, covered patio, large lot, ex. cond., FHA assum. 10%. 480-9363.

Cars & Trucks

'83 Porsche 944, silver, 5-spd. trans., sun roof, alarm system, two new tires, ex. cond., 46K mi. Frank, 333-5251.

'80 Toyota Celica, depen. transportation, rebuilt eng., 46K mi., very good cond. 488-8556.

'79 Toyota Celica, AM/FM stereo cass., A/C, good cond., \$250, OBO. Jim, x30742.

'82 Ford EXP, 4-spd., Std., AM/FM/tape, A/C, ex. cond. Dick, 280-7411 or 332-3678.

'84 Sunbird 2000 LE, 4 dr., cinnamon/brown, EFI 4 cyl., 5-spd., A/C, AM/FM, cruise, \$3,995. John, x36243 or 488-8775.

'85 Ford XLT Club Wagon van, 302 V-8, AOD, dual A/C, cruise, tilt, P/D, P/W, P/S, P/B, AM/FM cass., 4 capt. chairs, seat bed, like new, \$11,500, OBO. 282-4677 or 481-1207.

'80 Saab 900 for parts, needs transaxle, \$750, OBO. Al, x32456 or 996-0501.

'67 Mustang, red, 3-spd., 289 V-8, A/C, lots of new parts, very good cond., \$2,995 Mike. x38169 or 482-8496.

'83 Ford Supercab pickup, shortbed, tan, camper shell, 351 V-8, A/C, power, tilt, dual tanks, 5 new tires, new brakes & battery, Holley Economiser carb., 64K mi., ex. cond., \$4,500 firm. Patrick, 477-8647.

'85 Camaro Berlinetta, V-8 w/"T" tops, 4bbl Quadra-jet, digital, AM/FM/cass., tinted glass, A/C, P/S, P/W, 2 new tires, black w-tan int., tow mi., \$9,500, OBO. Leslie, 482-6491.

'80 Mustang, 6 cyl., P/S, P/B, auto., A/C, hatchback, runs very well, good tires, clean. \$1,500. Tim, x38843 or 332-6153.

'80 Mustang, 6 cyl., P/S, P/B, auto., A/C, hatchback, runs very well, good tires, clean. \$1,500. Tim, x38843 or 332-6153.

Boats & Planes

'76 VIP 16' tri-hull boat, 115hp Evinrude with 2 S.S. props and 2 alum. props, McClain gal. tilt drive on trailer, new tires and spare. Bimini top, AM/FM cass. stereo, Lowrance depth finder, good cond., \$2,995, OBO. 280-8855.

Apple II+, 64K, disk drive, monitor, Videx 80 col. card, joystick, Okidata 92 printer, graphics printer interface, software, manuals, \$550, OBO. Kevin, x30867 or 484-1158.

IBM PC-AT (Western digital), hard disk controller, new, never used, \$100. Frank, 333-5251.

TRS 80 Model I computer, 48K RAM, 2 floppy drives, printer w/stand, mono monitor. Nights, x36953 or days, 482-4343.

VIC-20 computer, data cass., joystick, software games, like new, manuals, \$150, OBO. x30577.

Fortran 77 for Atari ST, \$60; MacIntosh software, Modula-2, \$60; Turbo Pascal pkg. (Turbo 1.1, Tutor, Numer. Methods Tlbx, data base Tlbx.), \$100. Peter, x31624 or 944-0918.

Commodore 64C system I disk drive, Seikosha SP1000UC printer, joystick, Commodore color monitor, software. Nights, x36953 or days, 996-5244.

Chromecraft Modern Executive walnut dinette set, 4 black naugahyde diamond tufted swivel chairs. Cost \$6009, sell \$275, OBO. Boyd, 488-8806 or 482-5274.

Antiques — "Primitives," cherry corner cupboard, 200 yrs. old, \$550; work table w/2 side drawers, \$175; oak, s-curve, roll top desk, \$950. Emily, 481-8847.

Bunk beds w/2 mattresses and chest, \$200; twin bed w/box spring, mattress, and night stand, \$100; twin bed w/box spring, \$50; queen size sleep sofa, \$200; Magnavox Odyssey II video game, \$25. Al, x32456 or 996-0501.

Two coffee tables, good cond. \$15 ea.; contemporary sofa, ex. cond. \$85; single bed w mattress \$60. Kam or Mary, 486-5247.

Light oak country dining room set, oval table, drop leaf, china cabinet, buffet, six chairs, \$900. 474-2292 or 282-2223.

90" couch and matching chair, \$300; inlay marble coffee end and round tables, \$100 ea. stereo-radio record cabinet, \$75. 488-3588.

Wanted

Want to buy elec. trans. Don, x37832 or 996-1425.

Want reliable used refrig., prefer manual defrost Mark, x30131 or 332-2416.

Progressive creative mature, three-piece four piece rock band "Powered Flight" needs a keyboardist to complete its high-tech sound. Rene, 488-7909 or Tom, 532-2209.

Want to trade Ninetendo set w 6 games or Atari set with over 30 games for Sega set w games. Joseph, 326-2187.

Want 0.15 model A craft engine and 3 or 4 channel R/C eqpt. Also want tools for Briggs & Stratton engines. Bill, 326-2187.

Want '79-'83 Ford or Chev. pickup, 4x4, auto., P/S, P/B x31604 or 333-3103.

Pets & Livestock

Cocker Spaniel, female, 2 1/2 yrs. old., beige, very friendly, free, comes w bowl and doghouse. Kevin, x30867 or 484-1158.

AKC Rottweiler pups. 3 males, shots, wormed, \$400. x34231 or 473-1287.

Musical Instruments

Lester Baby Grand piano, ex. cond. \$2,495, OBO. (713) 282-1727 or (409) 273-4098.

Miscellaneous

Nagei's Patrick, commemorative prints, #7, #11, #12, #13, #14, #15, \$150 to \$500. Mike, x32439 or 326-3947.

Florsheim black "lightweights" man's dress shoes, 10-E, composition sole, soft inside, worn twice, \$30. x31604 or 333-3103.

White Kenmore washer, \$100; D-8 battery, \$100; 3 Toyota Celica alum. rims, \$100; bench and bar bell weight set, \$50. 480-5426.

Ski parka, never worn, very nice, silver w black/white trim, sleeveless, \$20. Bob, 488-0397.

Fuel storage/transfer system, 3-15 gal. stainless steel tanks, 10 GPM barrel pump, 6' hose, \$75, OBO. Boyd, 488-8806 or 482-5274.

Pierre Cardin 5-piece nylon luggage set, \$50. Carla, 643-7734.

Bell V1 pro bicycle helmet, black w safety reflector strips, size SM/MD, \$20. Samouce, x35094 or 482-0702.

HEADS UP

Helmet-mounted display may give space walkers both data and an unobstructed view

By James Hartsfield

During future spacewalks, astronauts may have more than just the universe before their eyes—they may have just about anything they desire from a transparent, television-quality computer monitor on their visors.

That's the goal of a team in the JSC Crew Systems Branch working on a helmet-mounted display for spacesuits. And the difference that a helmet-mounted view screen can make could be essential to the demanding orbital work that will be required for space station.

During an extravehicular activity (EVA) now, astronauts have one 12-character liquid crystal display at the top of a large, cumbersome chest-mounted control module. The 12-character strip displays vital suit information, such as suit pressure, available oxygen, available water and available power, in an abbreviated form. And the tiny readout is inconveniently located.

But outside the vehicle at work in space, convenience and quick access to information can be the difference between a task completed and a task made impossible. The helmet-mounted display under devel-

opment has resolution comparable to a television, said Jose Marmolejo, project engineer. Among the items it can display are a quick, easily read, graphic of the spacesuit's status; all of the pages of the bulky wrist checklist now worn during EVAs; and just about any data item, including video, Marmolejo said.

"During space station operations, astronauts could be outside nearly every other day, three times a week, for 90 days. That's about 36 EVAs," he said. "I believe a helmet-mounted display is the only way to go."

The helmet would be linked to the spacesuit's computer, providing a capability to display information on the vital functions of the suit or transmitted data from other computers, originating from the space station or from the ground. Checklists, schematics, even video could be shown on the monitor, and a possible voice-controlled system could let the astronaut choose displays and use video-displayed controls hands-free. However, manual switches would still be used to control critical suit functions, Marmolejo said.

Progress toward an operational helmet-mounted display is well under way since the work began in 1984.

Two demonstration units have been studied at JSC. The first, delivered in March 1987, was built in conjunction with Wright-Patterson Air Force Base and featured 1-inch cathode ray tubes that projected a monochromatic binocular image onto a semi-transparent, curved plate. The second, delivered in June, is more advanced.

Built by Hamilton-Standard, the demonstrator projects a liquid crystal display image through five lenses onto a plate that serves as a screen, folding the image back to the viewer, Marmolejo said. The screen is partially transparent, and it can be seen through easily when the liquid crystal projector is off. The display serves as a black-and-white, binocular monitor that has a resolution high enough to show low-quality video, Marmolejo said. "Most people have been very pleased with this. It's very easy to view, and there's virtually no eye strain."

The next version of the display, to be built by April 1989, will employ holographic elements and be constructed in a helmet that may be close to the project's final form. Special, holographic materials will be deposited directly on the pressure helmet,

the innermost visor, and the protective visor, the second visor of a helmet. A third, moveable, gold-plated sun visor completes the makeup of the helmet, he explained.

The image will be projected by being bounced between the holographic deposits on the two surfaces. Such a system could reduce the packaging size of a helmet display, Marmolejo said. The team is aiming at developing a display in a helmet that would be only one and a half inches taller than the pressure helmets. The display would not be a holographic, three-dimensional display, but holography is used in creating the special reflective deposits needed.

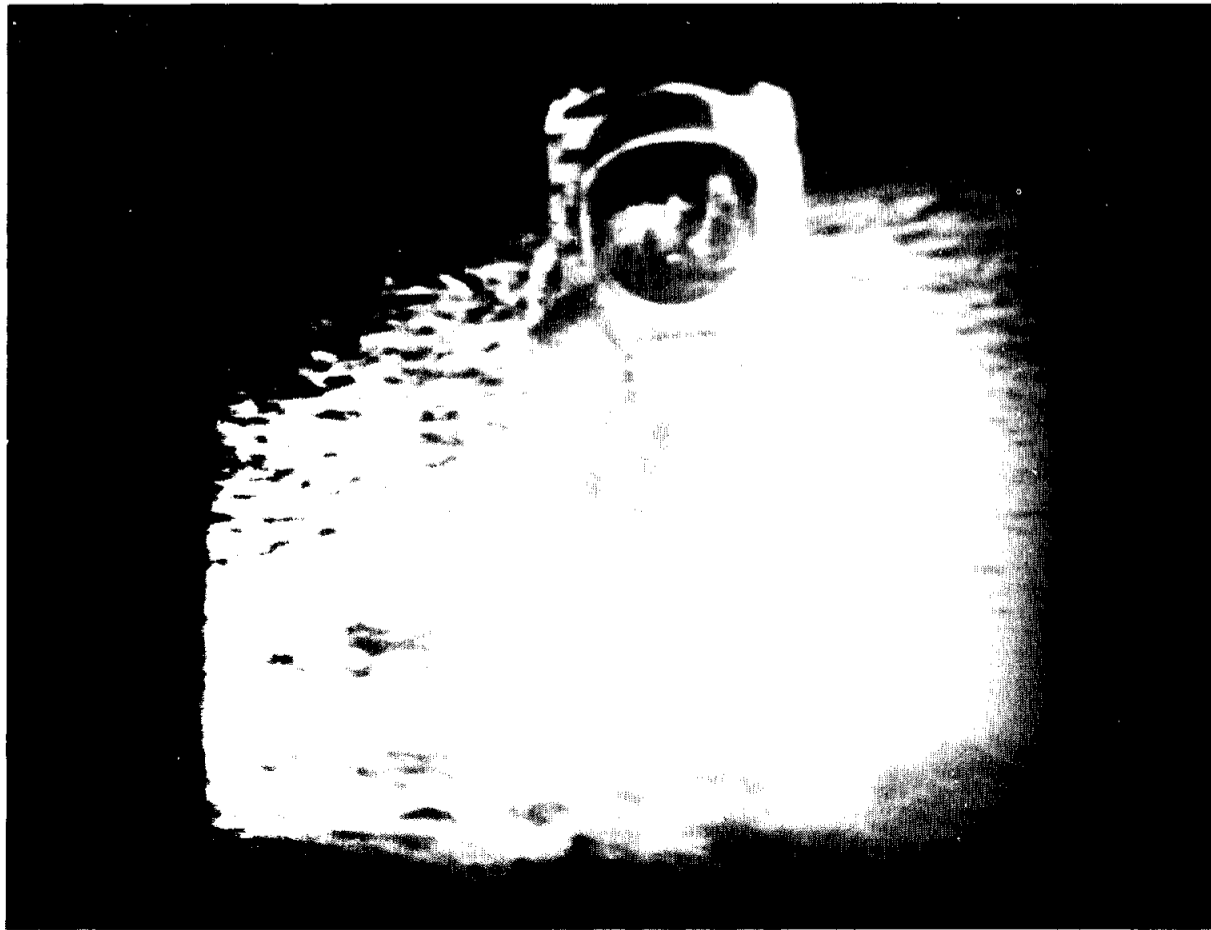
"First, we wanted to look at the mechanics of a display. Next, we'll concentrate on packaging," he said. One of the biggest attributes of the holographic deposits is that such a view screen could reflect 90 percent of the projected light back to the viewer and, at the same time, be 90 percent transparent when the projector is off, he added. The screen should present close to a 30-degree diagonal field-of-view image and be located just above the normal line of sight.

"The helmet-mounted display is not a weight-critical item," Marmolejo added. "Its size and the power it uses are the main concerns."

Training astronauts for the large demands of space station EVAs will be extensive. But a helmet-mounted display could minimize that training by having virtually unlimited checklists at the beck and call of the astronaut during EVAs. "I've seen the amount of training that the astronauts go through for just one pair of Shuttle EVAs. And there's no way you can do all that training here on the ground to get a guy totally ready for 90 days worth of work," Marmolejo said.

The helmet-mounted display also could be used as a television monitor to show astronauts using a television camera the video they're sending back to Earth.

Marmolejo and his team also are working with other software that could be used in the display, including a graphic informational aid for astronauts flying the manned maneuvering unit. "If we can prove that the holographic display is feasible, there's really not a whole lot left to work on except reducing the volume and increasing the resolution," Marmolejo said.



JSC Photos by Bob Walck

Top: Jose Marmolejo, JSC project engineer for the helmet-mounted display, checks out a demonstrator in the Crew Systems Branch. Also working on the project are Connie Tritsch, left, a Lockheed optical engineer, and Chip Shepherd, a Lockheed human factors engineer. Above: An actual display from the prototype shows that television-quality pictures will be easily visible for astronauts on EVA. Right: Co-op Gretchen Smith models the helmet-mounted display system.

NASA signs contracts for Space Station Freedom

NASA concluded contract negotiations Wednesday for full-scale development of the permanently manned Space Station Freedom, scheduled to be deployed in orbit in the mid 1990s.

The 10-year cost-plus-award fee contracts with the four aerospace firms have a total value of approximately \$6.7 billion, which is within NASA's estimates for the combined value of the four work package contracts to design, develop, test, evaluate, and deliver the components and systems comprising Space Station Freedom.

And on Thursday, NASA was to have signed agreements with its international partners—Canada, Japan and nine European nations—to cooperate on construction and operation of the space station. The

agreements were signed in a ceremony at the Department of State.

Wednesday's action marks the successful settlement of contract negotiations that began in December 1987 with Boeing Aerospace Co., Huntsville, Ala.; McDonnell Douglas Astronautics Co., Huntington Beach, Calif.; GE Astro-Space Division, Valley Forge, Penn., and East Windsor, N.J.; and Rocketdyne Division of Rockwell International, Canoga Park, Calif.

Clarke Covington, manager of JSC's Space Station Projects Office, said signing of contracts is an important milestone, but that it won't affect operations because the center already had been operating on a letter contract with McDonnell Douglas.

"I really view this as a continuation

of our work as usual," Covington said. "We feel we have a good contract from both our perspective and MACDAC's. This is just the next major step of beginning the DDT&E (design, development, testing and evaluation) of space station."

JSC's Work Package 2 contract with McDonnell Douglas is valued at approximately \$2.6 billion, not including priced options for additional work or Phase 2 elements. Under its contract with JSC, McDonnell Douglas will outfit the resource nodes and develop the integrated truss structure, mobile servicing system transporter, airlocks, and hardware and software for the data management; communications and tracking; guidance, navigation and control; extravehicular

activity; propulsion, and thermal control systems.

Marshall Space Flight Center's Work Package 1 contract with Boeing is valued at approximately \$1.6 billion, not including priced options for additional work or elements that would be provided for the Phase 2, or enhanced, space station configuration. Under its contract with Marshall, Boeing will develop the U.S. laboratory and habitation module, logistics elements, structures for the resource nodes, the environmental control and life support system, internal thermal, and internal audio and video systems, and associated software.

Goddard Space Flight Center's Work Package 3 contract with GE Astro-Space Division is valued at

approximately \$895 million, not including priced options for additional work or Phase 2 elements. The contract calls for GE to provide a free-flying, unmanned polar-orbiting platform, and various attach-point hardware, including a pointing system for accommodating external scientific instruments on the manned base.

Lewis Research Center's Work Package 4 contract with Rocketdyne is valued at approximately \$1.6 billion, not including priced options for additional work or Phase 2 elements. Rocketdyne will provide the 75 kilowatt electrical power and distribution system for Freedom's manned base and the electrical power system for the U.S. polar platform.

Houston plans gala welcome

(Continued from Page 1)

followed by a flight control systems check, an adjustment of Discovery's orbit and a 30-minute crew press conference from space. After lunch, the crew will begin stowing away articles in the cabin in preparation for the return to Earth. After an evening navigation check, the crew will go to sleep at three days, eight hours mission elapsed time.

The crew will be awakened eight hours later to begin preparations for deorbit and landing. At four days mission elapsed time, the OMS engines will be fired again to slow the Orbiter for reentry. Landing at Edwards Air Force Base is scheduled 56 minutes later.



BIG MOVE—Technicians check out the Space Station Freedom mockups in their new home in Bldg. 9B. The large mockups of the habitation and laboratory modules, as well as the resource nodes and cupolas, were moved from Bldg. 15 this past weekend.

JSC Photo By Benny Benevides

JSC receives award

The Houston Federal Executive Board and Federal Business Association presented JSC with the 1988 Productivity Award in a ceremony Sept. 8, along with several honors presented to individual JSC employees.

Employees honored in the FEB's Agency and Career Service Awards Program this year included Lupita M. Armendariz, honored as outstanding Hispanic employment program manager; Claudette A. Gage, professional employee of the year; and Willie L. Richardson Jr., craft employee of the year.

Armendariz is an Hispanic employment program manager at JSC while Gage is a flight medicine nurse and Richardson is a mechanical engineering technician. The FEB awards are presented each year to recognize excellence in government agencies and employees who have performed their duties in an exemplary manner.

Middeck experiments study diverse subjects

(Continued from Page 1)

be used by the participating industrial scientists for applied research. Industrial participants and their experiments include:

- Burroughs Wellcome Co. is experimenting with an enzyme known as reverse transcriptase. The enzyme is a chemical key to the replication of the AIDS virus.

- Du Pont Co. is conducting two experiments aimed at growing crystals of proteins important to life science research. One is isocytate lyase, a target enzyme for fungicides. Better understanding of this enzyme could lead to more potent fungicides to treat serious crop diseases.

The other protein, alpha 1-B, is the first totally synthetic peptide to mimic ion channels in cell membranes. Research on alpha 1-B could lead to an understanding of how cells regulate the flow of ions such as potassium, sodium, and calcium, which has important potential in therapeutics and diagnostics.

- Merck Co. will fly a sample of elastase, an enzyme associated with the degradation of lung tissue in people suffering from emphysema.

- Schering-Plough Co. hopes to grow crystals of alpha interferon. Interferon, a protein, stimulates the body's immune system.

- Upjohn Co. is flying two protein samples: genetically engineered human renin and phospholipase A2, found in cottonmouth snake venom. Human renin is produced by the kidneys and plays a major role in the chemical reaction that controls blood pressure. Phospholipase performs functions associated with cell membranes, and a better understanding of it could lead to improved medications for pain and inflammation.

Infrared communications

Using the same kind of invisible light used in remote controls for home television sets and videocassette recorders, mission specialist Pinky Nelson will conduct experimental voice communications with his crewmates via infrared light, rather than standard radio frequency waves.

On a non-interfering basis and during non-critical normal crew activities requiring voice operations, Nelson will use the Infrared Communications Flight Experiment (IRCFE),

developed by Joseph Prather, project engineer at JSC, to communicate with the rest of the crew.

One major objective of the experiment is to demonstrate the feasibility of the secure transmission of information via infrared light. Unlike radio frequency (RF) signals, infrared waves will not pass through the orbiter's windows; thus, a secure voice environment could be created. Infrared waves can carry data as well as voice.

If proven effective, the technique of using infrared light as a voice and information carrier could have widespread applications including incorporation in the Shuttle, Spacelab and the space station as well as potential non-NASA uses in military aircraft, naval ships and Army combat vehicles.

Magnetic composites

The Automated Directional Solidification Furnace (ADSF) is a special space furnace developed by Marshall Space Flight Center to demonstrate the possibility of producing lighter, stronger and better-performing magnetic composite materials in microgravity.

Four furnace modules are included in the ADSF, each processing a single sample. The samples to be used are manganese and bismuth composites, which will be processed at a constant melting and resolidification speed of about a third of an inch an hour.

Material processed during the mission will be compared with samples of the same metallic alloys processed in laboratories on Earth, as well as from previous Shuttle and sounding rocket flights.

The furnace is specially designed to melt materials along a plane in a long, slim, magnetic composite sample and then cool the molten metal. The furnace module traverses the sample in a single direction, melting and then resolidifying the material as it goes.

The total flight package weighs about 250 pounds and occupies the space of five crew lockers in the orbiter middeck.

Red blood cells

Blood samples from donors with such medical conditions as heart disease, hypertension, diabetes and cancer will fly in an experiment called Aggregation of Red Blood Cells (ARC)

developed by Australia and managed by Marshall.

The experiment is designed to provide information on the formation rate, structure and organization of red cell clumps, as well as on the thickness of whole blood cell aggregates at high and low flow rates. It will help determine if microgravity can play a beneficial role in new and existing clinical research and medical diagnostic tests.

The first ARC experiment flew aboard STS 51-C in January 1985. The STS-26 experiment differs from its predecessor only in the samples tested.

Electrophoresis

Isoelectric Focusing (IEF) is a type of electrophoresis experiment which separates proteins in an electrical field according to their surface electrical charge.

The isoelectric focusing technique applies an electric field to a column of conducting liquid containing certain molecules which create a pH gradient in the column, putting alkalinity at one end and acidity at the other end. This pH gradient causes the biological sample to move to a location in the column where it has a zero charge - its isoelectric point.

A crewmember will activate the equipment 23 hours into the flight. The experiment will operate for 90 minutes with pictures of the separations being taken every two to three minutes. The crewmember will return to the experiment hardware at the end of the running time to verify that it has successfully turned itself off.

The film from the experiment camera will be removed for processing upon landing, but the samples themselves are not required for post-mission analysis.

Lightning research

The Mesoscale Lightning Experiment (MLE) is designed to obtain nighttime images of lightning in an attempt to better understand the effects of lightning discharges on each other, nearby storm systems, storm microbursts and wind patterns to determine relationships over an extremely large geographical area.

Payload bay cameras will observe lightning discharges at night from active storms. The experiment uses

color video cameras and a 35mm hand-held film camera, providing coverage of an area roughly 200 by 150 miles directly below the Orbiter.

Crewmembers also will document storm systems that are oblique to the Shuttle but near NASA ground-based lightning detection systems at Marshall, Kennedy, Stennis Space Center and the National Oceanic and Atmospheric Administration's Severe Storms Laboratory in Norman, Okla.

The payload bay camera system provides camera orientation data so that the locations and dimensions of the lightning discharges recorded can be easily determined from the video and film images. The imagery will be analyzed for the frequency of flashes, the size of the lightning and its brightness.

Cell separation

One of the most important aspects of biotechnical and biomedical technology involves separation processes. Cell types producing important compounds must be separated from other cell types. Cells with important biomedical characteristics must be isolated to study those characteristics. The Phase Partitioning Experiment (PPE) involves a separation method termed two-phase partitioning.

PPE is designed to fine-tune understanding of the role gravity and other physical forces play in separating, or partitioning, biological substances between two unmixable liquid phases.

Most people are familiar with a two-phase system formed by mixing oil and water. In PPE, the systems are simple saline solutions containing two different polymers. When the polymers are dissolved in a solution, they separate. On Earth this results in the lighter phase floating on top of the heavier one. But in space the demixed phases exhibit more complex behavior, looking somewhat like an egg which has a yolk floating inside of the egg white.

Phase partitioning has been shown on Earth to yield more effective, large-scale cell separations than any other method, differentiating cells on the basis of their surface properties. Space experiments should improve efficiency of Earth-bound partitioning and may allow scientists to carry out cell separations unobtainable on Earth.

Horizon sensing

The Earth Limb Radiance Experiment (ELRAD) was developed by the Barnes Engineering Co., designed to photograph the Earth's "horizon twilight glow" near sunrise and sunset.

The experiment is expected to provide photographs of the Earth's horizon that will allow scientists to measure the radiance of the twilight sky as a function of the Sun's position below the horizon. This information should allow designers to develop better, more accurate horizon sensors for geosynchronous communications satellites.

Communications satellites routinely use the Earth's horizon or "limb" as a reference for attitude control. Barnes Engineering is developing an advanced horizon sensor that uses visible light to sense the Earth's limb. Near the spring and fall equinoxes, however, the Earth eclipses the Sun once a day, as seen from the satellites' orbit, often for as long as 70 minutes.

During these eclipses, the Earth's horizon is invisible to a visible light horizon sensor. However, the Earth's upper atmosphere scatters sunlight to produce a thin ring of blue and ultraviolet light that would still be visible during an eclipse. This ring of light is what ELRAD will photograph.

JSC manages the mission integration of ELRAD, and the payload integration manager is Ed Jung while the mission manager is Willie Beckham.

Student experiments

Two experiments developed by students will be flown. One evaluates using a semi-permeable membrane to direct crystal growth. Richard S. Cavoli's results may be useful in imaging systems for detecting gamma and X-rays and could be used in spacecraft sensors for astrophysical research purposes. Cavoli is enrolled at the Buffalo (N.Y.) School of Medicine. The other will look at the effects of weightlessness on grain formation and strength in metals. The experiment, is proposed by Lloyd C. Bruce, a senior at the University of Missouri. The research might lead to a new, lightweight and stronger titanium-aluminum alloy or a new type of industrial process.