Southeastern Space Supporter

Newsletter of HAL5 - the Huntsville Alabama L5 Society chapter of the National Space Society

Volume 4, Number 6 — November–December 1995

FIRST WORD

We Have Our Space Engine!

(by Gregory Allison, HAL5 President)

On the 12th of November HAL5 successfully fired a 340-pound thrust nitrous oxide and asphalt rocket motor! With this motor our performance and mass fraction of the resultant rocket should take the HALO Program into space on a ballistic trajectory to an altitude of over 50 nautical miles. If we can get our mass fraction down with a fiber wound casing we may be able to attain a 68 mile altitude!

This motor probably represents the top end of our asphalt fuel rockets. Asphalt forms a fairly rigid fuel grain. Under high chamber pressure it tends to want to crack. With our current motor we believe that we can control this by making the casing insert tight. However we deem that we will likely need to switch to a new fuel for larger motors. There is a fuel known as "P-Band" which we believe is a good candidate to replace asphalt. P-Band is flexible, easy to work with and inexpensive. We have already fired P-Band solid motors at our test stand. These were provided by James Mitchell of Memphis.

Asphalt has been great for us. It is paving our road to space. Now I expect with our next generation of motors that we will move on to new fuels and eventually to liquid oxygen as the oxidizer.

Personal Reflections of 1995

1995 has been a good year for HAL5. We have flown two balloons into the stratosphere with rocket motor test components and conducted almost 40 motor firings. We have learned much this year.

This year, we continued to hold public lectures and supported the City School System's Teaching Observation of Planet Earth (TOPE, now HOPE) program by donating a 7-foot reusable balloon and sending personnel to assist in tethered balloon launches. We have recruited UAH Students for the Exploration of Space (SEDS) members to assist with rocket motor research and production.

Our education committee is finally near completion on the HALO Achievement project to educate kids in the class room on space science topics modeled after the Junior Achievement approach.

We have begun planning for a regional Space Development Conference for the autumn of 1996 and also a 1996 "Race for Space." This year, as a chapter of the National Space Society we were a co-sponsor to the Von Braun (Space) Exploration Forum, which is hosted annually by the National Space Club of Huntsville.

Finally we are working on planning to conduct a Foundry at the 1996 ISDC in New York. HAL5 is poised to become the lead center for the Foundry.

All these things have been possible due to the fantastic crew of active members we have in HAL5. I ask you, what other space club comes close? HAL5 leads with conviction and action. It is our deep-seated belief in space development and resultant action that separates us from the rest of the crowd. I feel blessed to belong to a club such as ours. I count the best of my friends among our members.

Time to Get Active!

If you have not been active in this club you have missed a lot. At each motor firing we have a cook-out, burn rocket motors, talk and socialize. You should try to launch a weather balloon in high winds if you want a little excitement. How about chasing the payload all over hillbilly country in Paint Rock Valley?

You should have been there when we flew Gene Hornbuckle's first hybrid rocket in Manchester Tennessee. It was the first ever free flight of an asphalt motor. Ever fueled liquid oxidizer into a rocket in the middle of a cow Pasteur? Well why not? It's pretty fun to come up with a powder charge that will separate the avionics package without burning up the parachute. We had a lot fun when we walked into the last Constellation science fiction convention carrying in hand full-scale flight rockets and motors.

So what does this have to do with space? Show me some-one else who is talking about flying payloads into space for a few thousand dollars and we can talk. Yes, we are currently examining pathways that could us into orbit as an evolution to HALO technology sometime in the future!

To each of you I wish Happy HAL5 HALO Holidays! Ad Astra per Ardua!

Huntsville Alabama L5 Society

President — Gregory Allison
Day: 971-1041, Eve: 859-5538
Vice-President — Ethan Scarl
Day: 461-2747, Eve: 534-3993
Treasurer — Ronnie Lajoie
Day: 461-3064, Eve: 721-1083
Secretary — Larry Scarborough
Day: 881-1944, Eve: 881-4363
Membership — Philomena Grodzka
Day: 837-4287, Eve: 536-8638
Communications — Ron Creel
Day: 881-8016, Eve: 881-8016
Special Projects — Alfred Wright
Day: 876-8037, Eve: 420-6273

Southeastern Space Supporter
Volume 4, Number 6
November / December 1995

The Southeastern Space Supporter is a bi-monthly publication of the Huntsville Alabama L5 Society (HAL5), a not-for-profit 501(c)(3) organization devoted to the goal of seeing everyday people living in thriving communities beyond the Earth.

Any opinions expressed in this newsletter are those of the authors or of the Editor, and, unless expressly so stated, are not necessarily those of HAL5 or the NSS.

Visit the HAL5 Web Page on Internet via: http://www.cici.com/~hal5/index.html
Courtesy of Community Internet Connect. Contact Bob Ehresman for info: 722-0199

HAL5 encourages its members to speak out on space-related issues, and welcome submissions of both fact and opinion articles of interest to HAL5 members.

Submit letters or articles to: Ronnie Lajoie
162 Kirby Lane, Madison, AL 35758
Day phone/message: 205-461-3064
Night/Weekend phone: 205-721-1083
Electronic mail address: hal5@cici.com

Deadline for submittal is the last day of the following months: February, April, June, August, October, and December.

Preferred format for text is ASCII on a diskette or sent by E-Mail. Preferred format for text with graphics is Word on a diskette. Also acceptable are letters and articles sent by mail or faxed; however, the more retyping required, the less likely the acceptance. HAL5 is not responsible for receipt of mailed submissions; none will be returned unless sent with a SASE. Hand-delivered diskettes will be hand-returned. No compensation is paid for submissions.

PROJECT HALO NEWS

340-Pound Hybrid Motor Fires

(by Tim Pickens, and Ronnie Lajoie)

I have very good news to report. In just two months time, thanks to the hard work of many HAL5 and SEDS members, we have successfully scaled up our entire asphalt and nitrous-oxide (N_2O) hybrid rocket motor design — from yielding 200 pounds of thrust to yielding 340 — and, better still, successfully fire several motors. As Greg reports in his “First Word”, we now have our “space engine”!

Scaling Up the Rocket Motor

As reported in our last (Sep-Oct) newsletter: “Based on the results of several rocket design reviews, we will be scaling up our propulsion system in order to improve the vehicle propellant mass fraction. The new design should yield a thrust of 340 pounds and a 10 second burn time, for a total impulse of 3400 lb-sec.”

The work began in earnest late August and continued the entire month of September. Not only did the motor itself have to be resized, but also much of the test equipment, especially the oxidizer flow system.

The original flow system would never flow enough N_2O to satisfy our 1.4 lb/sec requirement, so we needed to replace all plumbing to carry us through this HALO phase, and the next.

While I concentrated on the latest ignitor design and the new plumbing for the flow system (both for the motor and the test stand, plus a miniature version to test on a balloon 100,000 feet up), Gene Hornbuckle prepared the new enlarged fuel grains, and Steve Mustaikis prepared the new enlarged nozzle (with a more optimized expansion ratio) and enlarged oxidizer injector heads.

The literally hundreds of other minor, but still essential, tasks were handled by HAL5 members Alfred Wright, Ron Lajoie, Ron Creel, and Mary Bare; and many SEDS members, including Douglas Childs, David Hewitt, Matt Beland, Jenn Kendall, Jennifer Lewter, Kristie Oldaker, Daniel Goldsmith, and Carrie Alderfer. (I apologize if I missed some names — there were so many of you. Thank you all!)

These tasks included improving our electronics wiring board (in the barn), preparing and testing our new larger oxidizer tank, labeling all our wires (to make setup easier), helping to prepare and test our latest ignitor design (including the one for the balloon), checking our new flow system for leaks, helping to prepare our new larger motor casings (both aluminum and steel), wrapping and heat-shielding our new motor grains, and many others.

Believe me, if you think there is no work you can do as a HAL5 member on Project HALO, you are wrong! Every little bit helps; just ask Greg. He has another long list of major and minor tasks which need to get done, and soon! HAL5 with Project HALO is very much in an amateur “Space Race” with other groups, and we want to get there first!

High-Altitude Balloon Flight #3

On Saturday, September 30, HAL5 sent its third balloon up to an altitude of 100 thousand feet. We had hoped to use one of our newly purchased 19,000 cubic-foot balloons (with a lift capacity of about 20 pounds), and start to gain the logistical experience of handling large balloons. Unfortunately, the weather was forecasted to be windy. Friday night, our resident balloon expert Bill Brown, convinced us to prepare a lighter payload which could be carried by one of his latex balloons.

Many HAL5 members showed up for the event, including Greg, Bill, Ronnie, Mary, Ron, Larry Scarborough, and Larry Larsen, plus friends and family.

The forecast held true; it was a very breezy day. Despite some awkward moments, when the entire HAL5 contingency struggled against the wind to keep the inflating balloon steady (which the Channel 19 newsperson thankfully chose not to film), we successfully sent a latex balloon up to 100 thousand feet.

As before, the "gondola" carried a video camera and a radio transmitter. This time, it also carried its first supply of N_2O, held in a small composite tank (bought surplus), plus the plumbing to connect the tank to two test ignitors. The camera was pointed at the test equipment, and a timer was set to start the test prior to the balloon bursting.

Up near 90 thousand feet, with the curvature of the Earth and the darkness of space in the background, the video of the test setup looked remarkably like the Space Shuttle robot arm dangling out the bay. Larry Scarborough later made several copies of the video for other members and for several interested teachers. If you also would like a copy, phone him at 881-4363.

The test itself went off on schedule — we just did not know it; for the test ignitor did not fire. Later, we determined the most probable cause (which may explain the failure of other rockoon attempts), and have already devised a potential solution.

Since the oxidizer tank did not release its supply of N_2O, and since the tank was fitted with a thermostat, we received a set of excellent data on both the atmospheric and N_2O temperature as a function of time and altitude, both on the way up and down. This data will be used to validate the oxidizer tank thermodynamics program that Ron Lajoie is working on (to help estimate insulation and heating requirements). The bottom line is that it is COLD up there! We must use both insulation and heating to keep the N_2O temperature (and thereby pressure) high enough to flow properly at rockoon launch.

The balloon burst on schedule and the gondola landed amazingly on the other side of the mountain of our test facility in Gurley! A chase crew tracked it down very quickly and recovered the payload intact.

Rocket Motor Test Day #8

The eighth Project HALO rocket motor test day was held three weeks later, on a chilly Saturday, October 21. After a month of arduous preparation, we were ready to test four new enlarged hybrid rocket motors.

As expected, it took all morning to set up and check out all of the new test equipment. It was noon by the time we finished, so we decided to take a lunch break, courtesy of Herman Pickens.

The only real problem we encountered was that we ran short on nitrous oxide. This new motor really does consume a lot of laughing gas. This, of course, was no laughing matter at the time since no one sells N_2O on a Saturday!

We did however get some relevant data from the single test we performed. We successfully test fired our first new enlarged motor (all-asphalt, a $1^1/_2$-inch core diameter, and a 15-inch length), observed the burn characteristics, achieved the desired chamber pressure of 550 psi, observed the new N_2O mass flow rate (flux), and evaluated the overall new motor design. Since the N_2O pressure was low, we did not see (nor expected to see) the desired 340 pounds of thrust. That would have to wait for another day.

Because of the cold tank temperatures and the resulting low N_2O static pressure, we decided to place band heaters (glorified heating pads) on our supply tanks. This really worked well for us. With all the new changes that had taken place since the smaller motor (200-pound thrust), we felt that it was a pretty good test day.

First HALO Test of HAN as Oxidizer

One other test we were able to perform involved a trail usage of hydroxylamine-nitrate (HAN) as an oxidizer for McDonnell Douglas' HTPB-based hybrid rocket motor fuel. HAN is mostly water (up to 95% by weight) and yields a lower specific impulse; but since it is as dense as water, yields a higher "density specific-impulse" than either N_2O or even LOX. Another benefit is that it is the most environmentally friendly oxidizer around.

Dr. David Dean and I worked out a way to use our nitrogen supply tank to pressurized some HAN in a small container. The first test was mostly a learning experience, since much of the HAN dripped out of the nozzle instead of burning. (Have you ever tried setting fire to water??!) We did see a small purplish flame for a second though, and agreed to try again later.

Rocket Motor Test Day #9

The ninth Project HALO rocket motor test day was held three weeks later, on Sunday, November 12. Armed with two full bottles of N_2O, we *really* were ready this time to test our three remaining new enlarged hybrid rocket motors.

November 12 turned out to be a *very* cold day. We came prepared with some large kerosene heaters. It was so cold that our N_2O tank pressure was only 450 psi, not good for a test motor that requires 550 psi to be optimized. We would quickly rectify this problem with the band heaters I mentioned earlier.

We even had problems with our 386-PC not wanting to boot up because of the extreme cold temperature. This was "nipped in the bud" by a heating pad that Chris Pickens (our great host) so graciously loaned us to place under the computer. Our PC must have had a "head cold"! Get it? Anyway, this too was overcome. We took a lunch break while the equipment warmed up.

340-Pound Thrust Motor Fires!

Once the test stand and data acquisition equipment was set up and successfully checked out, we prepared a motor (all-asphalt, a $1^1/_2$-inch core diameter, and a 16-inch length), started the video cameras rolling, cleared the test area, remotely loaded the oxidizer tank, performed one final range-safety check, then sounded the final 5-second warning alarm.

The count down went 5-4-3-2-1-IGNITION! First, we heard the pop of our igniter, then the “genie” hiss of the fuel slug, followed by the main N_2O dump valve opening, and the roar of the motor coming to life. It was very intense and exciting watching our hybrid rocket motor burn with a thrust of over 300 pounds for a full six seconds!

The second test started off with a bad ignition. To ensure a good ignition on the next attempt, we doubled the amount of solid fuel. BOY, DID WE GET A GOOD IGNITION! The cloud of black smoke which resulted obscured the test, but we could tell from the loud noise that the motor was thrusting at full force. After about 3 seconds, flame began to pour out from the side of the motor casing, near the top (much to our surprise). It turns out that the extra solid fuel served to superheat and weaken the aluminum motor casing. We won’t make that mistake again! At a minimum, we will insulate the casing with an additional thermal barrier to protect it from the heat.

Using the backup steel motor casing, the third motor test (all-asphalt, a $1^1/_2$-inch core diameter, and a 17-inch length) went flawlessly. The thrust was so powerful that it punched a hole right through our half-inch-thick steel flame deflector plate and left melted steel in a small crater in the concrete pad! Wow!

The acquisition data from all tests revealed that we had a peak thrust of about 350 pounds and an average thrust of 302 pounds. This is about what was predicted by Steve Mustaikis. The average chamber pressure was about. 514 psi. Our C* (characteristic exhaust velocity) was about 4,561 ft/sec. All other data was very satisfactory and pleasing.

The data also showed that we were somewhat fuel rich, which manifested itself in the form of black smoke and motor performance inefficiencies. This problem will be corrected for the next, and hopefully the final, test firing for this phase of project HALO.

Second HALO Test of HAN Oxidizer

One final test we were able to perform involved another trail usage of HAN with McDonnell Douglas’ hybrid fuel. Dr. Dean brought a better container. This second test went better than the first, including another small purplish flame; but still the fuel did not ignite. Speculation is that the HAN requires much higher pressure and/or a much finer injector nozzle.

Successful test of 340-lb thrust motor.

Most Exciting Motor Tests to Come

The tenth test day, in January, will no doubt be the most exciting for some time to come. There will be two motor firings that will represent the final motor-to-tank flight configuration. These tests will validate the system total impulse, N_2O filling procedures, ignition, main N_2O dump valve, total burn time (about 12 seconds), motor to tank axial loading, chamber pressure, motor alignment hardware integrity, peak thrust (loading), thermal characteristics of expansion nozzle, and many other related components. These tests will be the most significant since Project HALO began! I encourage all to come to the work parties and participate in the future of HAL5. Ad Astra! ✫

HAL5 Membership Update

(by Ronnie Lajoie, Treasurer)

The following is a list of final additions to the 1995 paid membership of HAL5. Membership now stands at **42**, which includes 23 renewals and 19 new members. We have set a new record for membership renewals, and have now tied last year’s record total membership of 42. (I am still hoping to beat it!)

Gene	Hornbuckle (N)
Gary	Marsh (N)
Will	Bet-Sayad (N)
Peder	Kilness (N)

(N) – New Member

Gene Hornbuckle has been helping Project HALO all year long, providing many valuable services including setting up the electronics for the rocket motor test facility, and preparing many asphalt motor fuel grains. Gene has combined his rocketry and HALO experiences and built his own small hybrid rocket, which successfully flew in the autumn (see last issue of SSS).

Gary Marsh and Will Bet-Sayad are both high school seniors who attended their first Project HALO meeting on December 13 — and joined HAL5 the same day!

Peder Kilness is a very hard working Boeing engineer (actually he’s a physicist), whom I had the pleasure of serving with on the International Space Station Program. Peder and I have had many conversations on space. He is definitely a space enthusiast, but work and family do not allow him to be a space activist. (Many HAL5 and NSS members share his problem.) Pete has offered his knowledge of physics and engineering as a consultant for Project HALO. We appreciate all assistance!

Welcome to all our new members! ✫

Editor’s Note: I apologize for the delay in getting out this issue. Be assured that you have missed no major HAL5 or HALO events. You will always receive adequate notice of key events.

HAL5 CALENDAR OF EVENTS (Post Me!)

December 1995

Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
3	4	5 Galileo Probe nears Jupiter	6 **HALO Gondola Design Review** 7pm at Tim's	7 **HAL5 Executive Comm. Meeting** Noon at Ponds	8 Galileo Orbiter arrives at Jupiter	9
10	11	12	13 **HALO Rocket Design Review** 7pm at Tim's	14 **HAL5 Executive Comm. Meeting** Noon at Ponds	15	16
17	18 **Happy Hanukkah!**	19	20	21 **HAL5 Executive Comm. Meeting** Noon at Ponds	22	23
24	25 **Merry Christmas!**	26	27 No HAL5 Program	28 No HAL5 Meeting	29	30
31	Merry Christmas and Happy New Year!					

January 1996

Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
	1 **Happy New Year!**	2	3 **HALO Program Doc. Review** 7pm at Tim's	4 **HAL5 Executive Comm. Meeting** Noon at Ponds	5	6
7	8	9	10 **HALO Gondola Design Review** 7pm at Tim's	11 **HAL5 Executive Comm. Meeting** Noon at Ponds	12	13
14	15	16	17 **HALO Gondola Design Review** 7pm at Tim's	18 **HAL5 Executive Comm. Meeting** Noon at Ponds	19	20 **HALO Rocket Motor Testing** 12pm, Gurley
21	22	23	24 **HAL5 Program Night** 7pm at Library	25 **HAL5 Executive Comm. Meeting** Noon at Ponds	26	27
28	29	30	31			

February 1996

Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
				1 **HAL5 Executive Comm. Meeting** Noon at Ponds	2	3 **HALO Rocket Ground Launch** Manchester, TN

SPACE SCIENCE NEWS

Lunar Ice Evidence Found

(The Huntsville Times, November 6)

Scientists studying images from the Clementine lunar probe believe they have found evidence of ice at the south pole region.

The 500-pound probe built for the Ballistic Missile Defense Organization conducted a survey of the surface in 1994. It observed the moon in 11 wavelengths. Radar pulses bounced back from the south pole basin, containing deep craters permanently shadowed, are indicative of water ice, scientists said.

If verified, the find could affect future lunar exploration plans if it could be extracted for use by a crewed lunar base for both drinking and rocket fuel. ☆

****

Galileo Arrives at Jupiter

(compiled from NASA Spacelink reports)

The Galileo spacecraft arrived at Jupiter on December 7, 1995, and fired its main engine for 49 minutes for a successful orbit capture around Jupiter. On the same day, Galileo's atmospheric probe plunged into Jupiter's atmosphere, and relayed information on the structure and composition of the solar system's largest planet. The spacecraft's orbiter will spend the next two years orbiting the giant planet, studying Jupiter and its moons, and returning a steady stream of images and scientific data.

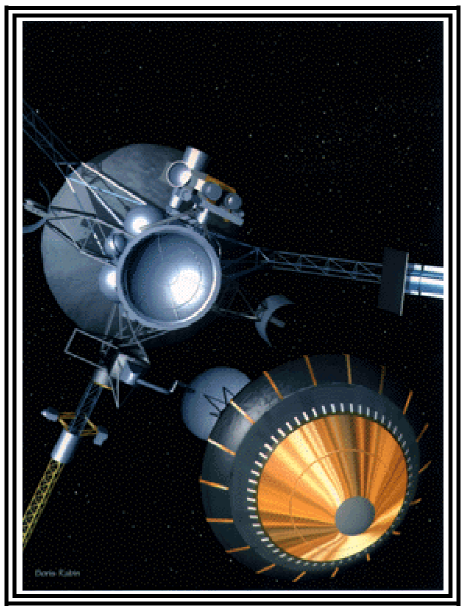
The following are excerpts from a series of status reports published on NASA Spacelink.

Galileo Nears Jupiter

Tuesday, December 5, 1995 — Galileo engineers today continue to prepare the spacecraft for its long-awaited arrival at Jupiter Thursday, when the spacecraft will fly through the harshest environment it will ever encounter.

As planned, selected portions of spacecraft's fault detection and correction software have been reconfigured via radio to ensure that Galileo will respond appropriately to the extreme phenomena it will experience Thursday while flying between Jupiter and its moon Io.

Jupiter's intense radiation and belts of trapped electrons and heavy ions in this area conceivably could disrupt or disable some portion of the spacecraft's electronics. On the inbound leg into the jovian system, Galileo is expected to



absorb a radiation dose of 35,000 to 40,000 rads. (1,000 rads will kill a human.) Some of the fault-protection changes sent to the spacecraft today are designed to heighten Galileo's tolerance of disruptions that could occur in this region. "When we were building Galileo, we put in a lot of shielding to offset the expected effects of Jupiter's environment," said Matt Landano, deputy mission director, "but we won't know how well a job we did until we fly through it."

Galileo is about 3.6 million kilometers (2.2 million miles) from Jupiter. Its velocity relative to the Sun is about 6,500 mph and slowing, while its velocity relative to Jupiter is more than 22,500 mph and increasing. The spacecraft is 932 million kilometers (579 million miles) from Earth, so that its radio signals take almost 52 minutes to reach the Earth.

Galileo Motion Becomes Retrograde

Wednesday, December 6 — At about 5:00 a.m. PST, Galileo's forward progress around the Sun was arrested, and the spacecraft began to move backwards (retrograde) around the Sun. Galileo is out in front of and below Jupiter, and had been orbiting more slowly with Jupiter catching up. Now Galileo (and the Probe) are rushing backwards towards the point where they will meet with the Giant planet in about 30 hours, 6 a.m. PST. Clean telemetry continues to come down, for the moment undisturbed by the Sun (which is coming between the Earth and Jupiter). All that changes today.

"It is Galileo's Big Day!"

Thursday, December 7 — Galileo's two critical activities have been completed successfully.

Galileo Probe Enters Atmosphere

Special data readouts shortly after 3pm PST showed that the Relay Radio Receivers were both locked onto the Probe's transmitted signals and that they contained good data. The Probe's atmospheric data is now stored on the tape recorder and in the main computer's memory. Memory readouts of the stored data will begin Sunday for a quick look at the Probe data, with complete readouts to commence after January 1 when the Solar conjunction period ends.

Playback of the recorded data will have to wait until February, when the necessary protection software and strategies have been implemented The ailing recorder was deemed safe to record the Probe data, which involved moving the tape continuously in one direction at low speed, but for playback the tape must be moved in both directions, and in short bursts. This will require software and operational changes to protect against failures like the one in October.

Galileo Orbiter Inserts into Orbit

Doppler data during the Jupiter Orbit Insertion 400N engine burn showed that the engine fired right on time, with the expected thrust, and to within 0.1% of the expected delta-V. Further analysis of trajectory data will determine if Orbital Trim Maneuvers #1 (Saturday) and #2 (early next week) are required, and if so how large they must be, but there is no question that the spacecraft is in a good orbit for an encounter with Ganymede next Summer and the subsequent Orbital Tour. Galileo's Big Day is over, but its mission has just begun.

Galileo Orbit is "Right On"

Saturday, December 9 — Orbital Trim Maneuver (OTM) #1 is canceled. The orbit after JOI is right on for an encounter with Ganymede in 207 days, one week earlier than originally planned. OTM-2 looks unlikely as well, but the final decision will be next week after accumulating more tracking data. OTMs approaching Ganymede can easily modify Galileo's trajectory to put it right back on the original tour, and at a far less propellant cost than doing it now. The only impact is that the Orbital Tour flight software load will have to be completed a week earlier, with the schedule already tight

Because Saturday was allocated for OTM-1, the Project decided to use the window to perform the first readouts of the Probe data stored in the CDS memory. The first readouts were to have come from sequenced commands on Sunday. Since Galileo is approaching Solar conjunction, the link performance degrades each day. Two readouts of this preliminary data gives a better opportunity to "fill in the blanks" resulting in a more complete dataset for preliminary analysis. These will continue into Sunday, when the next set will begin. ☆

Hubble Discovers Brown Dwarf

(The Huntsville Times, November 30)

A celestial object discovered 19 light years from Earth has been identified as the most convincing image yet of a brown dwarf, a stellar "wannabe" that is less than a star but much more than a planet.

Astronomers at California Institute of Technology and John Hopkins University reported Wednesday that light from the object bears the clear signature of methane, a chemical that is not found in stars, and a sure sign that the object is too cool to be a star.

That finding, said Shrivivas Kulkarni of Caltech, leaves no doubt that the object had to be one of the long-sought and elusive brown dwarfs. "We found methane," Kulkarni said in an interview. "No stars have methane. It is evidence of the object being cold. It is undeniably a brown dwarf."

First proposed in theory, firm proof of the existence of brown dwarfs have been sought by astronomers for decades. Some candidate objects have been identified, but the new discovery provides the most convincing evidence yet for the class of celestial objects.

Brown dwarfs are thought to be objects that started formation in the same way as stars — condensing from clouds of hydrogen. If enough matter is amassed in this way, gravitational compression will ignite the nuclear fires of a star. This takes at least 80 times the mass of Jupiter, the gaseous planet that is the largest in the solar system. But with less mass, the object merely heats for a while and then cools, becoming a dim and faintly glowing brown dwarf. ☆

****

Astronomers Seek Consensus

(excerpt from Huntsville Times, Nov. 27)

Having bagged two astronomical prey with week of each other, astronomers now face the daunting talk of reaching consensus on what they've got.

At a meeting in Italy last month, researchers announced the discovery of two long-sought objects — a planet circling a nearby sunlike star, and a brown dwarf, predicted by astronomers years ago but not known to exist until this year.

Now that they have firm evidence that brown dwarfs exist, astronomers would like to know how the mysterious objects form, how common they are, and how they differ from planets. "It's not an area we've had to worry about until now — what's a massive planet and what's a failed star," said Roger Angel of the University of Arizona.

The first planets orbiting other stars were found circling a pulsar 1,500 light-years from Earth. But the latest planet is a breakthrough for astronomers because it orbits 51 Pegasi, a star almost identical to the sun. "In fact, it's almost a dead twin of the sun," said William Cochran of the University of Texas. This month, he is attempting to confirm the planet sighting by observing 51 Pegasi from McDonald Observatory near Fort Davis, Texas.

One aspect of the apparent planet discovery that continues to vex astronomers is the distance at which the planet orbits the star. Although it is the size of Jupiter, the planet lies only five million miles from 51 Pegasi. That is about one-20th of the distance separating the Earth from the sun. "It's the sort of configuration of a planet that we didn't expect to find," Cochran said.

The detection of the brown dwarf is more convincing, astronomers said. "A lot of the previous brown dwarfs were stars that were hidden by dust," said Boss, an astronomer at the Carnegie Institution in Washington, D.C. "This is an object I think for the first time where the object spectrally doesn't look like a star."

Another brown dwarf discovery also may pass the test. Spectra of that object, known as PPL 15, reveal the presence of lithium, an element that couldn't exist in a star. Taken together, the two recent announcements are leading astronomers to conclude that brown dwarfs are not just theoretical but really to exist. ☆

****

Soho Off to Study the Sun

(excerpt from Huntsville Times, Dec. 8)

A solar observatory hurtled toward the sun Saturday after rocketing into space on a $1 billion mission. An unmanned Atlas rocket carried the Solar and Heliospheric Observatory, called Soho, blasted off at 3:08 a.m. from Cape Canaveral Air Station. Within a few hours, the spacecraft was boosted out of Earth orbit and heading toward the sun, with its power-generating solar panels and antennas fully extended.

Soho to Study Sun Inside and Out

Soho should reach its final destination in four months — a [Langrange] point nearly 1 million miles from Earth and 92 million miles from the sun. The gravitational pulls of Earth and the sun cancel each other at this point. Soho will remain between the sun and Earth, going round and round an imaginary point in a so-called halo orbit.

There, Soho will peer continuously at the sun and send back data for two years, if not longer. It is considered the most complex observatory ever built to study the sun's deep interior as well as the corona, its outer atmosphere, and the ever-expanding solar wind. The 4100-pound observatory has 12 telescopes and other science instruments — three from the United States and nine from Europe.
Scientists plan to probe the sun's mysterious interior by sound waves, exhibited on the solar surface by oscillations and variations in brightness. This new method, called helioseismology, is analogous to using earthquakes to study the Earth's interior.

"These experiments provide a new and really exciting, we believe, chance to journey from the center of the sun all the way out to the surface," said Philip Scherrer, a Stanford University physicist in charge of one of the Soho instruments. "Soho will see the conditions out to the farthest limits of the heliosphere."

Other scientists will use Soho to study charged particles streaming into space from the sun's outer atmosphere. This solar wind, if strong enough, can disrupt radio communications and cause blackouts on Earth. Soho will observe these particles at their source as they accelerate away from the sun.

"Soho is poised to make major inroads into the understanding of our star," said Fabrizio Felici, mission director for the European Space Agency.

About 200 scientists from 36 institutes in 15 countries are participating in the Soho project. NASA and the European Space Agency are splitting the $1 billion cost of the Soho mission. ☆

****

Voyageur Spacecraft Status

(excerpt from NASA Spacelink, Nov. 1)

Voyager 1 is currently 9.2 billion kilometers (5.69 billion miles) from Earth, having traveled 10.9 billion kilometers (6.75 billion miles) since its launch in September 1977. The Voyager 1 spacecraft is departing the solar system at a speed of 17.46 km/sec (39,055 mph).

Voyager 2 is currently 7 billion kilometers (4.35 billion miles) from Earth, having traveled 10.28 billion kilometers (6.38 billion miles) since its launch in August 1977. The Voyager 2 spacecraft is departing the solar system at a speed of 16.08 km/sec (35,970 mph).

Both Voyager spacecraft are healthy and continue their departure from the solar system. As they travel farther and farther from the Sun, the two spacecraft are returning data to characterize the outer solar system environment and search for the heliopause boundary, the outer limit of the Sun's magnetic field and outward flow of the solar wind.

Flight controllers believe both spacecraft will continue to operate and send back valuable data until at least the year 2015. It is the loss of electrical power from their radioisotope thermoelectric generators (RTGs) that will eventually cause them to stop functioning.

At launch, the three RTGs on each spacecraft had a power output of 475 watts. Today, that output is 341 watts for Voyager 1 and 345 watts for Voyager 2. Approximately 215 watts are necessary to operate the spacecraft and limited science instruments.

It is estimated that Voyager 1 will pass the Pioneer 10 spacecraft in January 1998 to become the most distant human-made object in space. ☆

Special Announcement

Please have a

Merry Christmas

and a

Happy New Year!

Huntsville Alabama L5 Society
1019-A Old Monrovia Rd, Suite 168
Huntsville, AL 35806

Place
First Class
Stamp
Here