



# MARSHALL STAR

Serving the Marshall Space Flight Center Community

Aug. 17, 2006

*An interview with Robert Lightfoot, manager of the Space Shuttle Propulsion Office*

## Until the wheels stop on the last mission!

### What is the Marshall Center's role in the Space Shuttle Program?

The Marshall Center's Shuttle Propulsion Office has responsibility for the manufacture, assembly, operation and integration of the elements that propel the space shuttle into orbit: main engines, external tanks and solid rocket boosters with their reusable solid rocket motors.

Our mission is to ensure our hardware is ready to fly, to support it while we're flying and to review its performance when it comes home, resolving any outstanding issues.

The Johnson Space Center in Houston has overall program management responsibility for the integration of the complete space shuttle vehicle and we report to them. As manager of the Shuttle Propulsion Office, I also serve as deputy program manager to Shuttle Program Manager Wayne Hale. I have recently assumed the duty of transition manager as we move toward retiring the shuttle in 2010 and transferring our assets.

### How is the Shuttle Propulsion Office organized and operated?

Each of the propulsion elements is managed by a project manager who reports to me, but each project also is linked to Wayne Hale



Doug Stoffer/MSFC

**Robert Lightfoot, manager of the Space Shuttle Propulsion Office, says their mission is to ensure that NASA's hardware is ready to fly, to support it while it's flying and to review its performance when it comes home.**

and the Johnson Space Center. We serve in the role that pulls it all together from a propulsion element perspective. Each project office has certain roles and responsibilities of flight readiness and countdown. Our teams are responsible for all aspects of their program, including flight hardware, anomaly resolution and support of the flight readiness process, including certification.

Our project offices and managers include the Shuttle Main Engine Project Office, managed by Gene Goldman; the External Tank Project Office, led by John Chapman;

the Solid Rocket Booster Project Office, managed by David Martin and the Reusable Solid Rocket Motor Project Office, led by Jody Singer. The Propulsion Systems Engineering & Integration Office, managed by Helen McConnaughey, is responsible for integration of all elements. The Program Planning and Control Office, led by Keith Brock, performs integrated administrative and business management functions by tracking the \$1.2 billion shuttle propulsion budget at Marshall.

**See Lightfoot on page 4**

# Chandra independently determines Hubble constant

From the Smithsonian Astrophysical Observatory

A critically important number that specifies the expansion rate of the universe, the so-called Hubble constant, has been independently determined using NASA's Chandra X-ray Observatory, managed by the Marshall Center. This new value matches recent measurements using other methods and extends their validity to greater distances, thus allowing astronomers to probe earlier epochs in the evolution of the universe.

"The reason this result is so significant is that we need the Hubble constant to tell us the size of the universe, its age and how much matter it contains," said Max Bonamente from the University of Alabama in Huntsville, lead author on the paper describing the results. "Astronomers absolutely need to trust this number because we use it for countless calculations."

The Hubble constant is calculated by measuring the speed at which objects are moving away from us and dividing by their distance. Most of the previous attempts to determine the Hubble constant have involved using a multi-step, or distance ladder, approach in which the distance to nearby galaxies is used as the basis for determining greater distances.

The most common approach has been to use a well-studied type of pulsating star known as a Cepheid variable, in conjunction with more distant supernovae to trace distances across the universe. Scientists using this method and observations from the Hubble Space Telescope were able to measure the Hubble constant to within 10 percent. However, only independent checks would give them the confidence they desired, considering that much of our

*"The reason this result is so significant is that we need the Hubble constant to tell us the size of the universe, its age and how much matter it contains."*

*— Max Bonamente, lead author on the paper describing the results*

understanding of the universe hangs in the balance.

By combining X-ray data from Chandra with radio observations of galaxy clusters, the team determined the distances to 38 galaxy clusters ranging from 1.4 billion to 9.3 billion light years from Earth. These results do not rely on the traditional distance ladder. Bonamente and his colleagues find the Hubble constant to be 77 kilometers per second per megaparsec (a megaparsec is equal to 3.26 million light years), with an uncertainty of about 15 percent.

This result agrees with the values determined using other techniques.

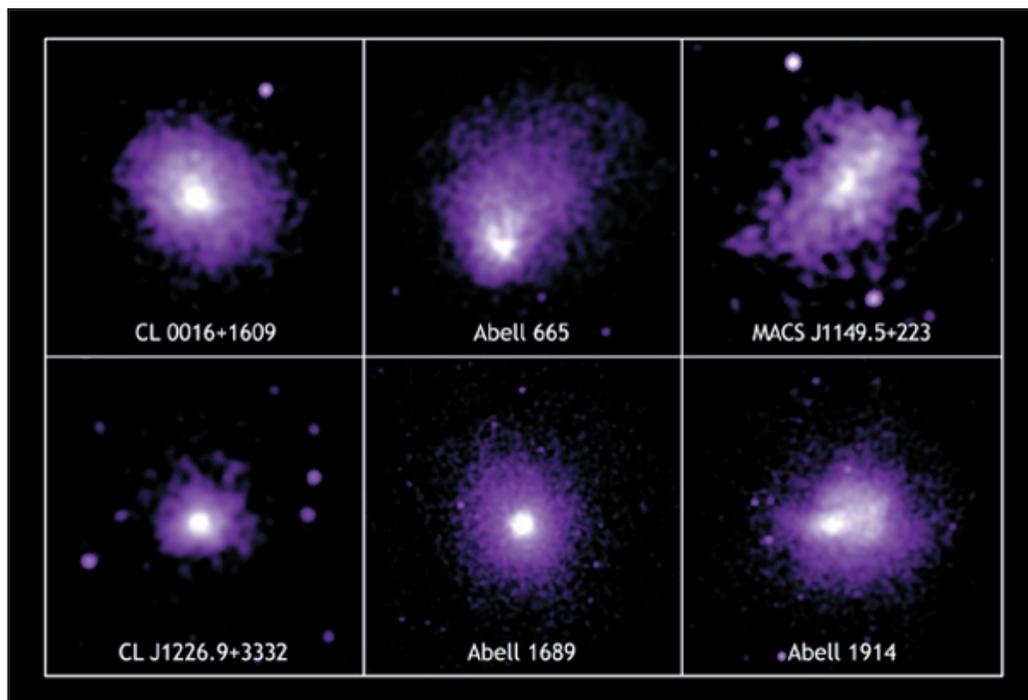
The Hubble constant had previously been found to be 72, give or take 8 kilometers per second per kiloparsec based on Hubble Space Telescope observations. The new Chandra result is important because it offers the independent confirmation that scientists have been seeking and fixes the age of the universe between 12 and 14 billion years.

"These new results are entirely independent of all previous methods of measuring the Hubble constant," said team member Marshall Joy of the Marshall Center.

The astronomers used a phenomenon known as the Sunyaev-Zeldovich effect, where photons in the cosmic microwave background interact with electrons in the hot gas that pervades the enormous galaxy clusters. The photons acquire energy from this interaction, which distorts the signal from the microwave background in the direction of the clusters. The magnitude of this distortion depends on the density and temperature of the hot electrons and the physical size of the cluster.

Using radio telescopes to measure the distortion of the

*See Chandra on page 7*



These six galaxy clusters are among 38 that scientists observed with Chandra to help determine the Hubble constant. The clusters' distances range from 1.4 to 9.3 billion light years from Earth.

NASA/CXC/MSFC/M. Bonamente et al.

# Marshall's Shuttle Propulsion Office celebrates STS-121 success with employee awards

By *Sanda Martel*

More than 200 employees attended the Space Shuttle Propulsion Office's STS-121 Awards Appreciation ceremony and lunch Friday, Aug. 4, at the Huntsville Depot Roundhouse. The event honored shuttle team members for their contributions to the success of the STS-121 mission in July.

"It was an incredibly great mission, and a lot of people contributed to its success," said Robert Lightfoot, manager of the Shuttle Propulsion Office, in welcoming remarks to employees.

"Because of your diligence, we now are ready to go again," said Lightfoot. The launch window opens Aug. 27 for the shuttle's next mission, STS-115.

Lightfoot and his deputy manager, Steve Cash, presented appreciation awards to the Program Planning and Control Office, accepted by manager Keith Brock; the Marshall Resident Office at the Kennedy Space Center, Fla., accepted by John Key; Space Shuttle Main Engine Project, accepted by project manager Gene Goldman; Reusable Solid Rocket Motor

Project, accepted by project manager Jody Singer; External Tank Project, accepted by project manager John Chapman; Solid Rocket Booster Project, accepted by deputy project manager Pat Lampton; and Propulsion Systems Engineering & Integration Office, accepted by manager Helen McConnaughey.

Awards also were presented to shuttle partners who provide background support, which is "just as important in getting the job done," Lightfoot said.

Chris Singer, deputy director of the Engineering Directorate, accepted the award for his directorate; Rosalyn Patrick accepted an award for the Safety and Mission Assurance Office; and Harry Craig received an award for the Procurement Directorate's Space Shuttle Support Office.

"We appreciate all you have done," said Cash. "You've gone above and beyond, and because of you we're flying again."



Emmett Given/MSFC

From left, Sharon White, Yolanda Harris and Stephanie Lacy-Conerly at the Shuttle Awards Appreciation ceremony and lunch held at the Huntsville Depot Roundhouse Aug. 4.

To view additional images of the STS-121 awards ceremony, go to the "Shuttle Awards Appreciation Ceremony and Lunch" on Inside Marshall at [http://inside.msfc.nasa.gov/center\\_orgs/am\\_photos/sts121/index.html](http://inside.msfc.nasa.gov/center_orgs/am_photos/sts121/index.html).

The writer, an ASRI employee, supports the Office of Strategic Analysis and Communications.

## Go 'tech shopping' at Marshall's Research and Technology Expo Aug. 24

By *Shelley Miller*

Marshall team members can go "technology shopping" among the more than 100 technologies exhibited at the Marshall Center's Research and Technology Expo, Thursday, Aug. 24, from 9 a.m. to 4 p.m.

The Vision for Space Exploration — of returning to the moon, reaching Mars and going to destinations beyond — provides the basis for the event. The expo, in Marshall's Activities Building 4316, will showcase in-house technology development capabilities and a host of technologies created for programs supporting NASA's exploration and science missions. Marshall representatives will be conducting demonstrations, discussing poster displays and answering questions from attendees.

Exhibits will be set up in two functional areas showing a variety of technology and

development in disciplines such as space infrastructure, advanced propulsion, advanced composite structures and more. "Focus" areas will show how to use technology for near-term opportunities to obtain new programs and projects. "Topic" areas will show technology that can be used for future development and also will provide workforce skill enhancements through hands-on technology development.

The event will provide something for everyone. Program managers, chief engineers and others can see if exhibited technologies fit their needs for generating more development funding or new applications. Partners from other federal laboratories will have the opportunity to identify technologies that can be used by their programs or merged with existing technologies to enable new products or business ventures.

"The expo offers multiple opportunities for

the Marshall team and our partner community to come together as we move forward with the Vision," said James Bilbro, assistant director for technology in Marshall's Office of the Director. "Two important aspects of this event are the interaction between Marshall technologists to discuss and demonstrate technology available today for their programs and projects, and the interaction with the community to foster an environment of technology sharing for future business development."

For more information about the expo, contact Fred Schramm, program administrator, Independent Research and Development, at 544-0823 or Kasandra Turner, event coordinator, at 544-9101.

The writer, an ASRI employee, supports the Office of Strategic Analysis and Communications.



Doug Steffer/NSFC

**Lightfoot believes the challenge will be to continue delivering high-quality hardware needed to complete the remaining shuttle missions. It's important because a limited number of missions are left.**

We're a highly matrixed organization, meaning we depend on other Marshall organizations to support us. We have about 500 full-time equivalents, or FTEs — civil servants who devote at least a portion of their work hours to supporting the shuttle program — and 70 percent of that comes from the Engineering Directorate, our largest partner. We also have a lot of support from the Safety & Mission Assurance Directorate and many other Marshall organizations.

And, of course, our office manages the contractors who manufacture and support our hardware.

### **What is your management style?**

Our goals are simple: deliver hardware to enable us to safely complete our mission of assembling the International Space Station. And my management style is simple. Trust the team and genuinely show that you care about them. I also try to have a little fun with it. I tell my team to take the job seriously, but don't take themselves so seriously. By that, I mean step back occasionally and think how cool our jobs are. I believe it is a privilege to work on this program. It's an amazing program. I cannot imagine being anywhere else.

### **What activities are underway to transition shuttle assets to new programs when the program ends in 2010?**

We're beginning to focus on transition activities, which is a new activity for us. Each of our project offices has a person assigned to a team reviewing how we're going to take our capabilities — be it workforce, facilities or hardware — and decide what to do with them. Are we going to transfer those assets to the next program? Or retire them (in the case of hardware)? The transition function is just now being developed and will grow over the next three or four years as we get closer to 2010. We're approaching it on a case-by-case basis. External tank, for instance, has stopped buying materials to build tanks because we have enough materials to build the tanks needed for the remaining missions.

### **What are the greatest strengths of the Shuttle Propulsion Office?**

I believe our greatest strength is pretty clear: our people. Nothing else even comes close. Our workforce will not only complete the shuttle mission, but provide the experienced workforce required for future projects. Our people have experience with flight hardware, have gone through several years of flying hardware and have the experience to go forward to support the exploration mission.

Every day I see the dedication of our people and it truly amazes me. They are tireless in what they do to make sure we have a safe vehicle to fly. They're so focused on the mission, and I don't have the words to express how proud I am of this team.

### **Some speak of the Shuttle Propulsion Office being like a "family." Can you speak about why that is?**

Coming into this position about a year ago, I inherited a culture created by Alex McCool and Mike Rudolphi, former Shuttle Propulsion Office managers. It is somewhat of a family. You could say partners, or team, but family means something different — a tighter-knit group. People here tend to look out for each other. Some of these folks have been together for a long time. But I think it goes back to the sense of mission we have. Fortunately, we know what we have to do — we've got to fly safely and finish the station, and that's a pretty clear mission. It keeps people focused. It's nice to see a group that cares so much about each other. This has been hard — a tough two years. Folks just care about their jobs. You can't measure that. It's an intangible and part of the strength we have.

### **What do you see as the challenges facing the Space Shuttle Propulsion Office in the next four or five years?**

The challenge is to continue delivering high-quality hardware needed to complete the remaining shuttle missions. That's so important because we have a very limited number of missions left and each is important in getting another stage of assembly completed on the International Space Station.

*See Lightfoot on page 5*

*Continued from page 4*

We're about to really start assembly on the station. We have done some of that, but we're about to really get going. The astronauts have enough challenges getting the assembly completed. We want to make sure we're providing them with a good vehicle.

Our secondary challenge is maintaining the workforce, showing them there's follow-on work. We have to keep critical skills in place to support work on the next program, work similar to what they're doing now. But we've got to finish this first. We have to assure them and ask them to hang with us and let us finish this mission. Our folks are wondering, as we get closer to retiring the shuttle and gearing up for future programs, and asking "what can I do to help?" What I would say is, finish the shuttle and then you guys can go help. For the most part, that isn't a problem because people care so much about this program.

The Constellation Program is exciting, real cool, and it will present some pretty big challenges. Our success will enable their future and we know we need to be successful.

## **From all reports, the STS-121 mission in July was a good mission. What are your thoughts about that?**

All of us are so grateful the STS-121 was as quiet a mission as it was. The timing couldn't have been better. We needed a good, quiet mission with good hardware. This mission showed us a couple of things — that we did the right work and the right risk and trades. We did have a clean mission.

I think this speaks to the dedication of our people. We all understood this was an important mission — to get off safely and have an efficient run at it. Now we're almost ready to fly again and we're thinking, "Wow, is it okay for us to get ready to fly again?" People are saying we're better than we were, and that was part of the goal, but we've still got work to do. For instance, we're looking at a redesign for the ice/frost ramp on the external tank. And we've still got to maintain focus on all the elements. We've been talking about external tank for three years now. And yet, the engine and solid rocket booster and motor folks have still had to keep focused.

It pays off that you've been down for a year and can still have a successful mission, because I get just as worried when we're not flying as when we are, because of the danger of atrophy of skills of knowing how to fly.

The question is, can we get back to flying routinely? We've just got to go do it now. That's the big key.

If you come back to me after STS-115 and if it was as good as STS-121, I'll say we're ready to start putting this thing back together up there — ready to assemble the station. STS-121 was a big mission. Putting the P3/P4 truss up, that's scheduled for delivery during STS-115, is a big thing. It starts expanding the station. The next four missions are big for us and exciting. Now

we can begin to talk about next missions, not mission. People are starting to feel okay and to feel we can do this again because we've done it before. But we have to be very cautious and not get too excited about one mission and, as they say in sports, take it one mission at a time.

## **What do you think the legacy of the shuttle will be?**

The most visible legacy will be the International Space Station. When it's completed, we'll see it as a star in the sky, even during the day. It will be huge, the size of two football fields. That, plus the hardware we've developed through the program. And that continues with the Constellation Program.

A less visible legacy is the workforce we leave this agency to go on into the future. It's the workforce that, through positive and negative experiences, has learned a lot and is prepared to take the next step.

And then there are the great observatories we've been able to develop — Hubble, Chandra — because of this remarkable vehicle. We're still learning things about the shuttle, but we owe a debt of gratitude to those who designed it back in the 1970s. It's truly an amazing machine.

The shuttle itself is an enabler. It enabled us to build the station. We get 13-14 days in space with shuttle and we're just one day away from home. When we complete the station, we'll have people on orbit six months and still just one day away from home. Farther away, the longer it will take to get home. But the research in low-Earth orbit prepares for how to live on the moon and Mars in the future. How we do maintenance on station is directly applicable to how we do maintenance on the moon. The shuttle is an enabler of all that. Once it's retired, it will be known as the only vehicle capable of that. And all that will have happened in only 30 years! It's pretty amazing, especially when you think it was just over 100 years ago that we took to flight for the first time.

One of Wayne Hale's favorite sayings is, "We put the agency at risk every time we fly." But our success is a predecessor to every success coming. That's not pressure, but a responsibility. It's what we're supposed to do and folks accept it with open arms.

When we finally finish in 2010, I think it will be incredibly sweet, but maybe more bittersweet. We have forged a great many friendships and established personal relationships we'd never otherwise be able to.

We know at the end things won't be the same again. But for now we don't want to focus on our legacy too much. We're so busy trying to finish what we're doing and we've got lots to do between now and then. And we're not going to stop until the wheels stop on the last mission.

*Sanda Martel, an ASRI employee who supports the Office of Strategic Analysis and Communications, contributed to this article.*

## NASA 'light healing' technology to be used in medical trials at UAB Hospital

A NASA technology developed by Wisconsin-based Quantum Devices Inc., originally used to grow plants on the space shuttle, is about to embark on its third round of medical clinical trials.

Special Light-Emitting Diodes with a

unique High-Emissivity Aluminiferous Light-Emitting Substrate, or HEALS, soon will be used at UAB Hospital in Birmingham to treat mucositis, or severe oral and throat sores often produced as a result of high-dose radiation and chemotherapy.

The UAB trials will focus on both pediatric and adult bone marrow transplant recipients. Biologists have found the light arrays to increase energy inside cells to speed the healing process. Each patient will receive the therapy starting the day of bone marrow transplant and daily thereafter for a two-week period.

The technology has been used in the

medical field by Quantum in Barneveld, Wis., and the Medical College of Wisconsin in Milwaukee to activate light-sensitive, tumor-treating drugs as part of a cancer therapy and also to speed the healing process for hard-to-heal wounds.

This research is funded by a NASA Small Business Innovation Research contract through the Marshall Center's Technology Transfer Program.

*Lori Meggs, an ASRI employee who supports the Office of Strategic Analysis and Communications, contributed to this article.*

## West section of Martin Road to close for several months Road to close just inside Gate 7

By Andy Roake

For the Redstone Rocket

A section of Martin Road on the west side of Redstone Arsenal will close for several months while a new bridge over Indian Creek and two culvert bridges are constructed.

"Starting Sept. 5, a contractor will begin replacing the existing bridges, which are aging and have deteriorated," said Keith Cook, program manager for the engineering division in the Redstone Arsenal Garrison Directorate of Public Works. "Part of Martin Road, from Gate 7 to Tiros Street, will be closed for approximately five months due to the construction."

Gate 7 will be open only to limited traffic.

"Only employees of Test Area 3, Test Area 6 and the UAH Aerophysics Research Center will be allowed to use Gate 7," said police captain Roger Triplett, assistant operations officer for the Garrison Directorate of Emergency Services.

Detour signs will be posted before construction starts to warn motorists of the upcoming road closure, according to the Directorate of Public Works.

Once construction begins, the limited drivers entering Gate 7 and traveling east on Martin Road will find the road closed at the entrance to Test Area 6.

Martin Road will be closed westbound at Tiros Street. Barricades and detour signs will be placed at the intersection of Martin Road and Rideout Road to notify drivers that Martin Road is closed ahead. Only local traffic can proceed beyond the barricades.

"Ultimately it's a safety issue," said Cook. "The bridges are old and need to be replaced. The substructure of the Indian Creek bridge and the two smaller culvert bridges were built between 1930 and 1940 under the Work Progress Administration.

"We currently don't allow large trucks through Gate 7 due to the load [weight] limitations of the bridges. The load rating is unknown

on the two culvert bridges, and the load rating was downgraded on the Indian Creek bridge due to age and deterioration. Once the new bridges are complete, we'll have a baseline load rating for the road that will allow heavy vehicle traffic."

People who regularly use Gate 7 should plan to enter Redstone Arsenal through another gate until the repairs are complete.

School buses that pick up children on base for schools outside Gate 7 are already using other routes and will not be affected by the road closure, said Triplett.

According to Cook, construction of the new bridges will cost approximately \$1.2 million.



Photo by Andy Roake

**ROAD CLOSED AHEAD** — Starting Sept. 5, only motorists requiring access to Test Area 3, Test Area 6, and the UAH Aerophysics Research Center will be able to enter Gate 7, which is the only active gate on the west side of Redstone Arsenal. All other motorists must enter Redstone through another gate.

# Classified Ads

To submit a classified ad to the Marshall Star, go to Inside Marshall, to "Employee Resources," and click on "Employee Ads — Submit Ad." Ads are limited to 15 words, including contact numbers. No sales pitches. Deadline for the next issue is 4:30 p.m. Thursday.

## Miscellaneous

Queen-size iron bed w/brass finials by Elliot's Design, \$150. 256-468-4107

SOLARFLEX exercise machine, legs and butterfly attachments included, \$145. 714-3742

Men's left-handed golf clubs, woods 1/3/5, irons 3-9, PW, SW, putter, no bag. 882-3983

Toshiba tube television, 27", \$150. 776-0811

Radio Flyer red wagon, all-terrain, large tires, wooden side rails, \$85. 353-0370

Gateway to the Great Books, 10 volume (shorter items) w/topical guide, \$45. 883-7752

eMachines 17" SVGA CRT monitor (eView 17f3 Model 786N), \$55. 256-722-0997

Diamond solitaire ring, .51 carat, appraised with papers at \$2,700, asking \$2,000. 256-468-4107

Everlast boxing bag, \$10. 830-0854

Dogloo dog house, large size, \$30; "Hit-A-Way" in box, tennis practice pole, \$200. 337-2534

Rugged Power Wheels dune buggy, yellow, purple and red, needs 6V battery and charger, \$65. 679-1681

Intel 875PBZ motherboard in original box, \$50. 256-850-4185

Large leather sectional w/sofa bed recliner & matching recliner, large overstuffed arms, cream color, \$1,100. 256-498-0506

Used PSP with charger, memory stick, case, and game (Untold Legends). 509-0256/Chuck

New Rigid tools: various saws, nailers, sanders, planers, impact drivers, \$2,100. 851-9287

Solid Oak baby crib w/mattress, \$100. 256-759-2521  
Queen-size Pier Group style solid Oak bed, lots of storage, \$400. 461-7786

Gemeinhardt flute with original case, used few months for symphony band, \$600. 256-880-7106 from 5-10 p.m.

Custom entertainment center, black and cherry wood, glass doors, \$1,600. 539-4898/evenings

2 Bush and 2 Nextel cup tickets to Bristol, Aug. 25 and 26, 2006. \$500. 366-7169

Austin furniture solid Oak table and 4 chairs, 3 yrs old, \$350, OBO. 464-9055

Antique solid wood upright piano. \$75, OBO. 828-9651  
Puppies, lab/boxer mix, dewormed, and parvo shots, \$25. 773-1433 (home)

Jenn-Air dishwasher, white, 3 yrs old, needs pump, \$50. 776-1652

IBM Laptop, 1.13GHz P3, 256 MB, 30 GB Modem. 810-9510

Oak entertainment center, holds up to 36" TV w/component pier, both \$600. 829-0285

Youth Cherry bedroom set: full/queen bed, chest-of-drawers, dresser w/hutch, \$600. 772-3303

Pool table, 8' w/1" slate, Kasson-Auburn, fruitwood, Queen Anne feet, all accessories, \$2,500. 880-6563

Chrome Pacer rims, 15", fits Rangers, newer Jeeps and Mazdas. 828-0631

Pair of Bose 301 bookshelf speakers, \$50. 679-1232

Antique drop-leaf, gate-leg table, \$375; Thomasville American Oak beveled glass butler table, \$150. 256-772-1989

Pottery Barn changing table, white w/two shelves, \$350. 256-783-4936

Boxes, moving/storage, dozens, undamaged, never wet, clean, all sizes, 50 percent off U-Haul cost. 881-9636

## Vehicles

1994 Camry LE, 118K miles, \$3,500. 497-3260

2004 Honda Civic EX, \$15,500. 256-233-6197

Prowler 5th wheel, 30' w/slide, bath, kitchen, sleeps 8, 18K miles. 721-1260

1990 Acclaim LX, 4-door, 6-cylinder, 78K miles, \$400. 881-1709

1999 Stratos 295, 200 Johnson, GPS, 12/24tm, tandem trailer, garage kept. 431-2499

2004 Chevrolet Tahoe Z71, black w/gray leather, 37K miles, loaded, \$27,600. 256-755-6017

1990 Honda CR-250 motorcycle, \$850. 256-837-8389

2003 Jeep Wrangler SE, white, 4-cyl, 38.5K miles, Mx6 adjustable shocks, 31x10.5 MTRs, \$13,900. 883-1874

1998 GMC Yukon, maroon w/tan leather, heated seats, auto, 4WD, \$9,400. 682-6326

2005 GMC Yukon, fully loaded, entertainment package, OnStar and satellite radio, \$34,000. 256-828-2643

2002 Chevrolet Trailblazer, green/tan, 91K miles, sunroof, OnStar, CD, 80% tread on tires, \$13,000. 205-454-6390

2003 Acura 3.2TL, one-owner, 22K miles, fully loaded, leather, sunroof, garage kept, \$21,000 firm. 883-5543

2001 Harley Davidson Ultra Classic, 24K miles, \$16,500. 256-434-0499

1993 Honda Accord, black, manual, wheels/tires, A/C, gas efficient, hwy miles, \$2600, OBO. 256-417-5464.

Jayco 18' Camper, full kitchen, bathroom, sleeps 6, new tires. 891-1550 or 640-6427.

Honda XR200 dirt bike, well maintained, easy to start, \$850 firm. 379-2512

2001 PT Cruiser Limited, all power, loaded, 75K miles, black w/gray interior, \$8,900. 468-1381

1995 Cadillac Deville, black, loaded, leather, \$2,150;  
1996 Cadillac Deville, loaded, leather, green, \$3,300. 256-520-2802

1995 Jeep Grand Cherokee, runs good, needs power brake booster, \$2,500. 797-7245

2001 Ford Windstar SE, leather, left sliding-door, rear a/c, rear bucket seats, PW/PDL, am/fm/cass/cd, \$8,950. 256-497-3951

2000 Nissan Frontier crewcab, silver, automatic o/d, CD/cassette, liner, 103K miles, \$9,600. 880-9025

## Wanted

30-foot ladder and a chipper/mulcher. 603-0667

40-foot extension ladder. 683-9364

Clean, nice, used twin bed, mattress/box springs. 256-233-0705/Athens

Double French horn. 837-1792

# Chandra

## Continued from page 2

microwave background and Chandra to measure the properties of the hot gas, the physical size of the cluster can be determined. From this physical size and a simple measurement of the angle subtended by the cluster, the rules of geometry can be used to derive its distance. The Hubble constant is determined by dividing previously measured cluster speeds by these newly derived distances.

This project was championed by Chandra's telescope mirror designer, Leon Van Speybroeck, who passed away in 2002. The foundation was laid when team members John Carlstrom of the University of Chicago and Joy obtained careful radio measurements of the distortions in the cosmic microwave background radiation using radio telescopes at the Berkeley-Illinois-Maryland Array and

the Caltech Owens Valley Radio Observatory. In order to measure the precise X-ray properties of the gas in these distant clusters, a space-based X-ray telescope with the resolution and sensitivity of Chandra was required.

"It was one of Leon's goals to see this project happen, and it makes me very proud to see this come to fruition," said Chandra Project scientist Martin Weisskopf of the Marshall Center.

The results are described in a paper appearing in the August 10 issue of "The Astrophysical Journal." Marshall manages the Chandra program for NASA's Science Mission Directorate. The Smithsonian Astrophysical Observatory controls science and flight operations from the Chandra X-ray Center, Cambridge, Mass.

*Sherrie Super, an ASRI employee who supports the Office of Strategic Analysis and Communications, contributed to this article.*

# Marshall's Ares I model draws crowd at Oshkosh, goes on display at Marshall

Visitors to the 2006 AirVenture air show in Oshkosh, Wis., July 24-30 got a glimpse of NASA's future Ares I crew launch vehicle and the agency's exploration goals — to return to the moon and travel to Mars and destinations beyond. Now, employees at the Marshall Center have the opportunity to view the model.

At the air show, the One NASA exhibit hangar featured a scale model of the vehicle, which will transport the Crew Exploration Vehicle — the capsule that will carry four to six astronauts — to space. The Ares I exhibit stands about 26 feet tall.

Inside the hangar, table-top versions of Ares I and its sister vehicle, the heavy-lift Ares V, also were displayed, along with a moon mission animation and Ares I launch simulation. The smaller table-top models stood approximately 3.3 feet tall for Ares I and approximately 3.7 feet tall for Ares V. Design and development of the Ares launch vehicles is managed by NASA's Exploration Launch Projects Office at the Marshall Center.

The One NASA hangar also featured an 18-foot model of the crew capsule,



Craig Crusem

At the recent 2006 AirVenture air show held in Oshkosh, Wis., visitors got a glimpse of NASA's future Ares I crew launch vehicle, left, and the crew capsule, inside the hangar to right, at the One NASA exhibit.

being developed by Johnson Space Center in Houston, and a host of kiosks that provided information highlighting work across NASA's field centers in support of the Vision for Space Exploration.

The AirVenture air show, held annually by the Experimental Aircraft Association, drew more than 700,000 visitors from across the

United States and abroad.

The 26-foot Ares I model is on display at the Marshall Center Aug. 14-25. Employees can view the model in the quad area between buildings 4200 and 4203 through Friday, Aug. 18. It will then be displayed outside Building 4600, Aug. 21-25.

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Vol. 46/No. 47

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The Marshall Star is published every Thursday by the Public and Employee Communications Office at the George C. Marshall Space Flight Center, National Aeronautics and Space Administration. Classified ads must be submitted by 4:30 p.m. Thursday, and other submissions no later than 5 p.m. Friday to the Marshall Public and Employee Communications Office (CS20), Bldg. 4200, Room 103. Submissions should be written legibly and include the originator's name. Send e-mail submissions to: [intercom@msfc.nasa.gov](mailto:intercom@msfc.nasa.gov). The Star does not publish commercial advertising of any kind.

Manager of Public and Employee Communications — Dom Amatore  
Editor — Jessica Wallace

GPO U.S. Government Printing Office 2006-523-050-20062

PSRST STD  
US POSTAGE PAID  
HUNTSVILLE, AL  
PERMIT NO. 298