April 10, 2016 A letter for the SPACE PORTION of the LIMARC TECH NET web site: www.limarctechnet.com
Space net report on the web. # 2 from Paul (WS2N).

The LIMARC Long Island Mobile Amateur Radio Club TECH NET is on every Sunday between 8 pm and 12am on the 146.850 mhz. 136.5 pl repeater and also other frequencies. (See the LIMARC website for details, http://www.limarc.org/
Net control is Dick K2RIW.
The email questions are brought to the net by John KC2WGB. To ask a question on the tech net, email John at: jb5oo@aol.com
The SPACE NET REPORT is the third part of the net, and that segment is handled by me, Paul, WS2N. My email is ws2n@arrl.net

Many space and science topics are covered on the net. The following article is a recent example of one of our informational topics. This article is just one of them.

This story that was covered on the net is about the CRS 8 (Commercial Resupply Services program) mission. The Spacex (**Space Exploration Technologies Corporation)** has been launching the Falcon 9 for many years, in quite a few different iterations, for NASA and other customers that need to send spacecraft and satellites into orbit. They launched this one on Friday April 8th, 2016 around 5 pm.
The two-stage Falcon 9 rocket blasted off at 4:43 p.m. EDT (2043 GMT) from Florida's Cape Canaveral Air Force Station Launch Complex LC 40.

This time the mission of CRS 8 was to bring supplies and the new BEAM (Bigelow Expandable Activity Module) to the ISS (International Space Station). NASA wanted to berth the BEAM to the aft CBM (Common Berthing Mechanism) of the Tranquility node module. As I said on the net, after the launch everything went according to plan. The launch went off without any delays. They had only a one second window to match the ISS inclination, which they did.

Spacex had another goal beside what NASA was contracted to do. They wanted to bring the first stage booster which is over 150 feet tall with a diameter of 12 feet onto a floating ship that is about the size of a football field located 210 miles off the coast in the Atlantic. They came close to doing this four other times but this time they had a better chance due to the fact that they had more fuel on this flight to accomplish the vertical landing. The ISS is only about 250 miles up compared to the geostationary orbits that are 23,000 miles up which Spacex has done for other satellite providers. Elon Musk, who is the owner of Spacex has successfully landed the first stage booster only once back in December of 2015 last year. But that was different. That time they did a boost back to Cape Canaveral to a new landing complex. Spacex has taken over and rebuilt many launch complexes in recent years such as LC 4 in Vandenberg California to launch polar orbital satellites. And LC 39A in Florida of Saturn V and Shuttle fame where Spacex will launch the Falcon 9 heavy (3 Falcon nines that are bolted together side by side) and future crewed Dragon missions. They launched this flight, CRS 8 from LC(Launch Complex) LC40. The new landing complex is called Landing Zone 1, which is another Launch Complex

that Spacex took over that was renamed from LC 13. Well anyway, here are the results of the CRS 8 mission.

SUCCESS! Falcon 9 booster lands vertically on the ASDS (Autonomous Spaceport Drone Ship (ASDS). The name of the ship is "of course I still love you."

THIS IS A GREAT VIDEO OF THE FIRST LANDING ON THE ASDS.

http://spacenews.com/spacex-falcon-9-launches-dragon-lands-first-stage/

Here is how this landing was accomplished. I saw this event live on the Spacex web site. Immediately after separation, the first stage began a busy sequence of events to return the first stage to the ground, beginning with a maneuver to flip the booster around using cold nitrogen thrusters to point its engines to the direction of travel for a 38-second boost back maneuver with three of the 9 merlin D rocket's engines. Each Merlin D produces about 150,000 pounds of thrust. All engines are able to be throttled and gimbaled. The booster at separation is going about 4,000 mph(6,437 km h).

Next was a short coast towards the atmosphere to set up for a re-entry burn of 24 seconds to slow the booster down and shield its engine section against the aerodynamic forces at the entry interface. Back in the atmosphere, the vehicle used its four actuated grid fins to guide itself to the Autonomous Spaceport Drone Ship (ASDS) battling strong winds in the upper atmosphere to reach the precise coordinates of the ship, located (210 mph) 338 Kilometers from the launch site.

Impressive airborne video of the landing showed the booster arcing towards the ship with its Center Engine (only one engine is used for the final landing) going through some heavy throttling and gimbaling action to transition the booster to a vertical descent with only meters to spare. The four landing legs sprung into place seconds before the vehicle made a successful touchdown only a few meters off center.

In the seconds after landing, all eyes were on the top of the booster to sense whether it was tipping over or remaining upright while the engine went through a shutdown sequence. I was looking for the nitrogen thrusters at the top of the booster to fire to start to compensate for any deviation from vertical. But apparently that wasn't necessary because I didn't see that happen. Loud cheers and celebration emerged at the Control Center in Hawthorne, California where hundreds of SpaceX employees had gathered on the factory floor to witness their company make another leap towards an operational reusability of the rocket stage.

With the first stage resting on its four legs, the SpaceX Launch Team could not break out in celebration as one part of the team was still overseeing the successful orbital delivery of the Dragon with BEAM on board to the ISS, while the other part of the Spacex team headed into post landing safing of the booster.

Steps completed immediately after landing were to make safe the propellant system and vent the pressurized propellant tanks to safe pressures. There are no people on the ASDS when a landing is in progress. The ASDS comes with a support ship that is a couple of miles away for their safety during landings. Crews were expected to approach the Drone Ship some time after landing, starting with a careful inspection of the booster before getting close to it to weld the landing legs to the steel deck of the ASDS using steel shoes. The booster is secured to the pad to prevent it from tipping over in the event of rough seas and strong winds which were expected for its return to shore. In an interview with Elon Musk, I heard him say the vertical position could be sustained even with a tilt of 6 degrees or so.

The Autonomous Spaceport Drone Ship arrived at Port Canaveral a couple of days later safe and sound.

At the post-flight press conference, Musk said this recovered booster would be the first to fly again. The first booster that returned to Landing Zone 1 in December has finished its active duty after a post landing Static Fire Test and will be put on display in front of the company's headquarters in California. But this newly recovered booster will be the first to refly for Spacex.

Before they re-fly the rocket, SpaceX will complete a rigorous testing campaign comprised of an initial inspection of the booster and putting it through ten consecutive Static Fire Tests. These tests are hoped to be completed at Cape Canaveral, either using SpaceX's new facility at Pad 39A at the Kennedy Space Center or further south at SLC-40. They will most likely use Pad 39A because they have a lot of launches on their manifest, and most of the flights are launched from LC 40.
Musk expects the booster to be re-flown on an operational mission with a paying customer as early as June.
SpaceX will not get much of a rest after the CRS 8 successful mission as the company ramps up its launch pace to tackle a busy manifest for the remainder of 2016. The next two Falcon 9 missions will lift satellites to Geostationary Transfer Orbit and rely on the (ASDS) Drone Ship for the return of the first stage due to the fact that the booster stage will be going about 8000 mph.

The next opportunity to land a Falcon 9 at Landing Zone 1 will come on the third flight from now, likely the Dragon CRS 9 mission, which will be carrying the new IDA or

International Docking Adapter. Currently they are looking at a launch target in late June. SpaceX's future plans to further expand reusability of launch vehicle components will focus on Falcon's 13 meter long payload fairing which costs several million Dollars to produce. Experimentation was already conducted on an earlier flight with stabilization systems on the fairing and early SpaceX concepts called for the fairing halves to be recovered by using helicopters.

President Obama congratulated SpaceX on the landing in a tweet: "Congrats SpaceX on landing a rocket at sea. It's because of innovators like you & NASA that America continues to lead in space exploration."

I consider the second part of the CRS 8 mission to be just as interesting. The berthing of Dragon and the installation of BEAM to the Tranquility module could

lead to big advancements in future crewed missions not only to the ISS but also to Cis Lunar and Mars habitat modules.

BEAM AND DRAGON were attached to the Earth facing side of the Harmony node (module) one and a half days later on Sunday morning. BEAM was set to be installed to the International Space Station Saturday, April 16.

The Bigelow Expandable Activity Module (BEAM) was attached to the station's Tranquility module over a period of about four hours. Controllers in mission control at NASA's Johnson Space Center in Houston removed BEAM from the unpressurized trunk of SpaceX's Dragon spacecraft, using the robotic Canadarm2, and moved it into position next to Tranquility's aft assembly port. NASA astronauts aboard the station will secure BEAM using common berthing mechanism controls.

BEAM and DRAGON LAUNCHED APRIL 8 2016.

BEAM

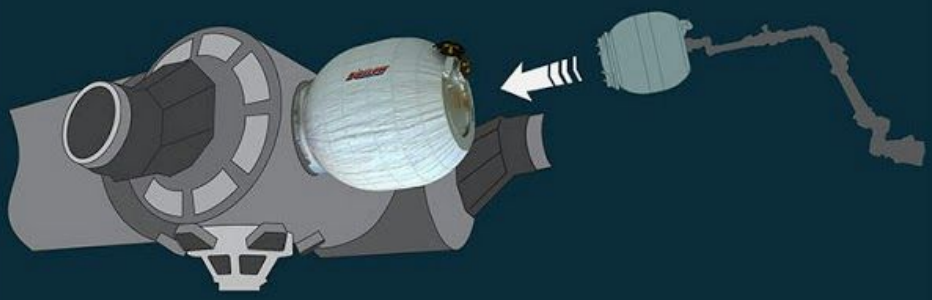
Bigelow Expandable Activity Module

Facts and Figures

WHAT

Bigelow Aerospace built a human-rated expandable habitat demonstration to be launched to the International Space Station for a two-year test.

WHERE



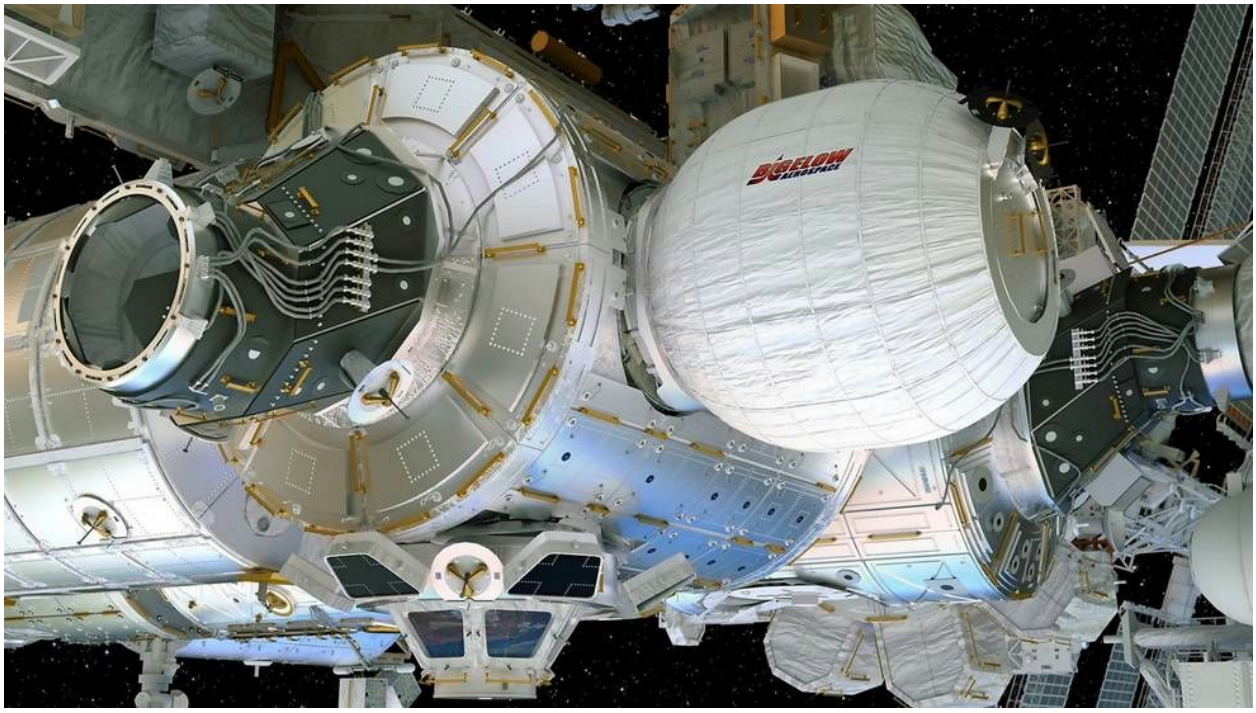
BEAM will be attached to the Tranquility Module by the robotic Canadarm2.

HOW

Once attached, BEAM will be filled with air to expand to four and a half times its original volume. Astronauts will enter the habitat four times per year to monitor performance.

WHY

While BEAM manufacturing techniques have been upgraded and are regarded as a trade secret, the original TransHab module designed by NASA in the 1990s used a dozen layers to build up a one-foot-thick wall capable of absorbing micrometeorite impacts.
The picture below is an artist view of what BEAM should look like after Canadarm 2 installed the BEAM.



The walls consist of alternating layers of foam and a material called Nextel. These layers provide impact resistance and thermal protection as the outside temperature can vary from –200 °F (–128.9 °C) in the shade to over 250 °F (121.1 °C) in sunlight. The inner structures form an airtight bladder that contains the pressurized atmosphere. **Bigelow replaced the Nextel cloth with Vectran and Kevlar during the reengineering process.**

TransHab was designed to provide living quarters, but BEAM is a small test article with a modest amount of space gain. BEAM expands to roughly 13 feet (3.96 m) long and 10.5 feet (3.2 m) in diameter, whereas the TransHab module was planned to be 36 feet (10.97 m) long and nearly 25 feet (7.62 m) in diameter.
After launch, BEAM was planned to spend at least five days getting acclimated to the vacuum of space. NASA flight controllers at the Johnson Space Center in Houston, Mission control unpacked the module with the station's robotic arm in mid-April, and attached it to Tranquility. BEAM will be inflated around the end of the month or beginning of May.
Originally the module was supposed to inflate using an onboard air tank, with the station's supply serving as a backup. NASA opted to reverse the process, and will now use an equalization valve to slowly bleed station air into the module at a slower, more controlled rate. The final pressurization will still be achieved using BEAM's onboard air tank. The entire process

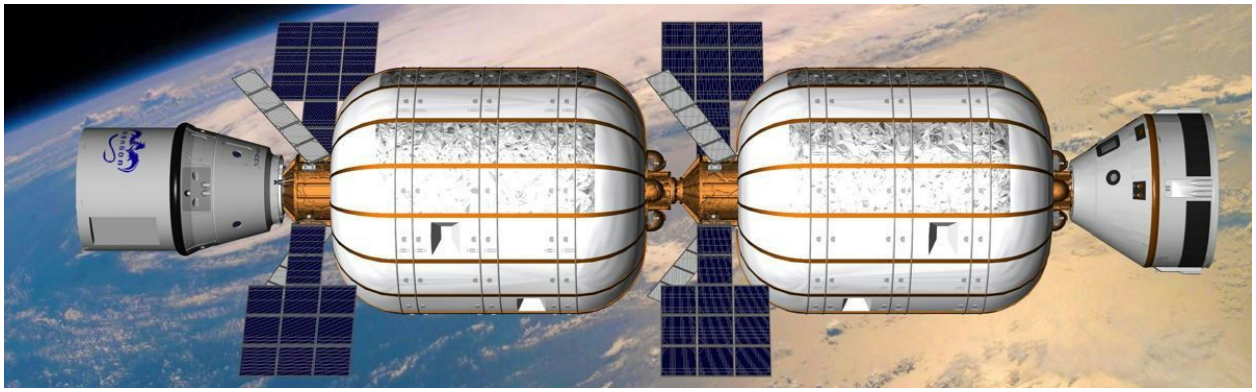
should take about 45 minutes—the daylight portion of a single orbit. The expansion is manually controlled; NASA astronaut **Tim Kopra** will likely oversee the process.
Some BEAM specifics are proprietary. During a conference call, **Lisa Kauke from Bigelow** said she couldn't reveal the composition of the wall material, or even how thick the module was. When asked what would happen if the module was punctured, NASA's answer was clear: that won't happen.
"Basically, nothing is going to happen," **Rajib Dasgupta** said. "BEAM has a very robust debris protection layer within its shell. Debris will not penetrate the structural layer of BEAM. We have tested it extensively. BEAM actually can resist space debris and micrometeorite orbital debris to the same extent that any other ISS module can."

The spaceship's cargo manifest includes:
BEAM — 3,115 pounds (1,413 kilograms)
Science Investigations — 1,410 pounds (640 kilograms)
Crew Supplies — 1,205 pounds (547 kilograms)
Vehicle Hardware — 674 pounds (306 kilograms)
Spacewalk Equipment — 26 pounds (12 kilograms)
Computer Resources — 238 pounds (108 kilograms)
Russian Hardware — 72 pounds (33 kilograms)
After loading Dragon with scientific supplies and hardware
Dragon will parachute to a splashdown in the Pacific Ocean on May 11, 2016

The future for an expandable module is the BA 330.

There are possible plans for NASA to attach a BA 330 to the ISS. The working name for this module is XBASE or Expandable Bigelow Advanced Station Enhancement. The BA 330 is 330 cubic meters of space. Equal to one third the volume of the ISS.
Possible configuration of the BA 330 attached to the ISS would be to use the forward CBM port on the Harmony node as shown below.

If Bigelow and the ULA don't get a contract to do that, one or two BA 330 modules could be put in orbit independently or docked together to act as a commercial space station such as pictured below.



This gives you a good idea of what's going on with today's space programs. These topics regarding our space program and other countries' space programs are covered on the Spacenet Report which is part of the LIMARC Tech net. Someday in the not too distant future, similar to today's ARISS (Amateur Radio on the International Space Station) program, I can see amateur radio operators worldwide getting QSL cards for working phone or one of the digital modes, and maybe even CW from one of these inflatable ham shacks in space.

73 and good DX from Paul WS2N.