Physical Science

Lunar orbiter gives new meaning to "moon shot"

June 18, 2009

The Interdisciplinary A building on the Arizona State Univ. Tempe campus looks rather average from the outside. There isn't anything that hints at the excitement, talent and innovation hidden behind its nondescript doors, and there is certainly no indication that the first steps of a great journey are taking place inside.

For nearly two years, professor Mark Robinson and his team have called this building home, developing it into a state-of-the-art Science Operations Center (referred to as the SOC) to work in conjunction with their contribution to the Lunar Reconnaissance Orbiter (LRO). The instrument payload of LRO consists of seven scientific instruments from institutions around the nation and globe that will return lunar imagery, topography, temperatures, and more. Robinson is Principal Investigator of one of the instruments on board, the imaging system known as LROC (short for Lunar Reconnaissance Orbiter Camera).

Click image for full resolution version.

Scheduled to launch just a day after the Space Shuttle Atlantis scrubbed its June 17 liftoff, the Lunar Reconnaissance Orbiter, on launchpad, should take flight this afternoon. Image: NASA

"LRO is the ever important first step in America's human return to the moon. We have much to learn as we restart exploring our nearest neighbor," says Robinson. "We are returning to the moon as humankind's first step in leaving planet Earth to explore the Solar System. Learning to live and work on the moon will allow us to build the skills and technologies to take the next steps to Mars, the asteroids, and beyond."

LRO is the first mission in NASA's Space Exploration policy, a plan to return to the moon and then to travel to Mars and beyond. Just as a scout finds the safest way for expeditions on Earth, LRO will act as a robotic scout to gather crucial data on the lunar environment that will help astronauts prepare for future lunar expeditions. The LROC imaging system serves the mission's primary objective of scouting for safe and compelling lunar landing sites.

LROC will retrieve high-resolution black and white images of the lunar surface, capturing images of the lunar poles with resolutions down to 1m, and will image the lunar surface in color and ultraviolet. The imaging system consists of two Narrow Angle Cameras (NACs) to provide high-resolution images, a Wide Angle Camera (WAC) to provide images in seven color bands over a 60-km swath, and a Sequence and Compressor System (SCS) supporting data acquisition for both cameras.

To give you an idea of the scale of resolution, the NAC gives us a resolution of 0.5 meters/pixel so you could recognize features the size of a car on the surface, but you wouldn't be able to read its license plate. Whereas the WAC provides a resolution of 100 meters/pixel in the visible spectrum, which means you could see images the size of a football field.

"We're collecting the data that will be used to determine where the first lunar outposts, and eventually settlements, will be located," says LROC scientist Samuel Lawrence, a postdoctoral fellow in the School of Earth and Space Exploration in ASU's College of Liberal Arts and Sciences.

The LROC facility is normally lively, filled with Robinson's team of scientists, staff, student researchers and instrument developers. But today, the building is unusually still and quiet. With launch only hours away, Robinson and a majority of his team are already awaiting liftoff from the viewing areas at Kennedy Space Center. The hustle and bustle of notebook-carrying students and researchers is gone, and in place of animated hallway discussions on telemetry, trajectories and camera resolution there is only the soft hum of the lights and AC.

Click image for full resolution version.

Zack Bowles and Sean Merritt, research analysts on LROC's Science Operations Team, are two of the few members left at the SOC. He and Merritt will be responsible for monitoring the power and temperature status of LROC. The duo has spent many hours preparing for the launch, arriving at the SOC as early as 2 a.m. to run through simulated instrument turn-on procedures.

"We are now very confident in our reaction to different situations involved with monitoring the spacecraft and LROC specifically," states Bowles who recently graduated from ASU with an M.S. in Geology. "To be this involved with an active mission is not something I expected so soon after finishing my master's."


The Lunar Reconnaissance Orbiter, which contains a high-sensitivity camera, and the Lunar Crater Observation and Sensing Satellite are hoisted atop the Atlas V launch vehicle on June 17. Image: NASA

The general schedule of launch day activities begins roughly 12 hours before launch when the mission operations staff at NASA Goddard begins setup. About 10 hours before launch, Bowles and Merritt will establish communication and start running through the launch day configuration procedures. At 6 hours prior to launch, the orbiter, and specifically, the instruments, begin powering on during the "Aliveness Test".

"During this sequence, we deliver LROC's 'Go!/ No go' status to the payload manager at Goddard who will relay the official payload readiness to the LRO Mission Operations staff prior to launch," explains Bowles. "After the Aliveness Test is performed, the instruments are powered down in preparation for launch – and then it is liftoff!"

Lillian Rose Ostrach, one of Robinson's graduate students working at LROC, is also staying on site for launch. She and a handful of other team members unable to attend launch intend to camp out in front of the big screen TV in the conference room to watch the live countdown.

Since August, Ostrach has helped with whatever needed to be done at LROC, from transfering hand-written calibration notes into spreadsheets to viewing calibration ratio images for possible issues.

"I never imagined that I would be a member of the LROC team; in fact, I never imagined I'd become a lunar scientist," says Ostrach. "There are not many people who get the opportunity of being one of a handful of people viewing, processing, and analyzing new lunar images."

Ostrach's previous research focused on Mars, a planet she was content to stay on, but Robinson helped alter her trajectory. In addition to great training and preparation for future independent, high-caliber research, he offered her the chance to become one of the next generation's lunar scientists and the opportunity to be part of a team seeing the moon in a brand-new way.

"The students involved with LROC will engage in significant data analysis and other projects important to the mission. By graduation, they will be able to point to work accomplishments that are as real and significant as any in the full-time arena," says Tim Donnelly, a member of the LROC Mission Operation Team.

"What we learn here is so unique, but at the same time so universally applicable to space mission operations, that all of us should be able to find positions in future space exploration endeavors," he adds.

A Day in the SOC

The SOC isn't your typical office workplace—unless you're accustomed to working in a fish bowl permeated by Apollo-era enthusiasm. Visitors are offered an unimpeded view of LROC operations in action. Wall-size lunar images from the Apollo missions decorate the walls of the glass-enclosed work area containing four workstations facing a large 9-screen grid mounted on the back wall.

After LRO is on its way to the moon Robinson and the rest of the team return from Kennedy Space Center, the real work begins. During its year in low polar orbit around the moon, LROC will capture thousands of images of the lunar surface. The LROC SOC will become a hub for the collection and processing of NAC and WAC images and the accompanying information and meta data such as location, exposure, time, and camera temperature.

LROC Mission Operations team members will plan which lunar regions to image, target them, deliver commands to Goddard Space Flight Center to be relayed to the instrument, and then manage and process all the incoming data. The SOC team is also tasked with analyzing the telemetry of the instrument. Telemetry tells the story of the health of the LROC instrument suite and through simple measures of power and temperature.

Managing and processing the incoming data will also keep the team busy. LROC and Mini-RF, a synthetic aperture radar also onboard LRO, produce large volumes of data in a short amount of time. On a typical day LRO sends down about 440 Gbits (55 Gbytes) of LROC images.

In addition to the science mission of LROC, as part of a separate project Robinson and his team are working with the NASA Johnson Space Center to scan and archive the original flight films from the Apollo missions. The newly scanned images have great scientific (and historic) value and are are bing used by lunar scientists today. LROC will rephotograph the surface in areas where the highest resolution Apollo orbital images were taken to look for new craters that formed in the past 40 years.

LROC images will be posted frequently on the LROC webpage. All the LRO data will be deposited in NASA's Planetary Data System (PDS) for permanent archive and access. The PDS is a publicly accessible repository of planetary science information. LRO mission data will be deposited into PDS starting six months after the start of the primary mission.

If this article has piqued your interest or left you with questions, you are invited to visit lroc.sese.asu.edu/EPO/askquestion to submit your lunar questions. A team of LROC educators and advocates are collecting questions from students and the general public and interviewing lunar experts and mission affiliates. The responses to the questions will be videotaped and then uploaded to the LROC Web site and YouTube.

For the latest information about the LRO mission, including official launch date and time, go to the mission home page at: http://www.nasa.gov/LRO.

Live coverage begins at 2 p.m. on NASA TV at www.nasa.gov/ntv

VODCast about the LCROSS mission

Coverage at Scientific American

SOURCES: NASA; Arizona State Univ.

R&D Daily
Advantage Business Media

Rockaway, NJ, 07866

- Add a Comment
- E-mail for more information
- E-mail to a colleague
- Printer friendly format

Show Archived Articles

Talkback!
R & D Magazine is pleased to provide you an opportunity to share your opinions on any of the news stories or articles on our site. We reserve the right to edit/remove comments.

Viewing 0 User Comments Add a Comment

Add a Comment...

E-Mail:
The content of this field is kept private and will not be shown publicly.

Subject:

Comment:

Submit Comment