Crash & Splash: NASA Probes to Dash Toward Moon

SCIENCE TUESDAY

By Charles Q. Choi
Special to SPACE.com
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08:50 am ET

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The last thing one usually wants on a spaceflight is a crash, but that's exactly what NASA is hoping for when it launches two new probes at the moon's south pole this week on the first U.S. lunar mission in more than decade.

The two probes will tag along with powerful new lunar orbiter that will map the moon's surface to help figure out where astronauts might set up moon bases in the future.

"We've never had a mission where two spacecraft go to the moon at the same time before - it's very exciting, the first time we've tried anything like this since the Apollo missions," said Anthony Colaprete, principal investigator on NASA's Lunar Crater Observation and Sensing Satellite (LCROSS) mission.

NASA plans to launch LCROSS and its partner orbiter atop an unmanned Atlas 5 rocket as early as Thursday afternoon at 5:12 p.m. EDT (2112 GMT), one day later than planned, from the Cape Canaveral Air Force Station in Florida. The $580 million joint moon mission, NASA's first since 1998, was delayed to allow a Wednesday launch for the space shuttle Endeavour after a gas leak thwarted an earlier attempt.

A tale of two probes

The Lunar Reconnaissance Orbiter (LRO), LCROSS' moon-bound partner craft, will map the moon's surface from orbit with unprecedented detail, capable even of imaging the tracks that lunar rovers left behind. Its high-resolution camera can image the moon to about 12 inch detail (30 cm), "which no one has ever had," Colaprete said. The best resolution until now from lunar orbit was roughly 20 meters.

The kind of images LRO will gather are needed for safe, highly precise moon landings at more hazardous places than astronauts ever went to with the Apollo missions. The data it collects on radiation and lunar chemistry could also influence the design of potential settlements. The probe will circle the moon in an orbit over both poles for a year, and its mission could get extended up to five years to serve as a communications relay for future lunar missions, such as a moon lander or rover.

Riding alongside the orbiter is LCROSS. This hitchhiker mission is designed to bite into Shackleton Crater, or other crater, on the south pole of the moon twice, with the main impact packing a punch equal to more than a ton-and-a-half of TNT. The impactor's final target depends on when it actually launches toward the moon, mission managers said Monday.

Smacking the moon

LCROSS is not the first mission to crash into the moon. Last week, Japan's Kaguya lunar orbiter was intentionally commanded to slam into the lunar surface at the end of a successful observation mission. China's Chang'e 1 orbiter also ended its mission with a lunar crash earlier this year.

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Images

NASA's Lunar Reconnaissance Orbiter will kick start the U.S. return to the moon. Credit: NASA/GSFC

An artist's

"Impacting the moon to do science ... has gone on since before I was born, frankly," Daniel Andrews, NASA's LCROSS project manager, told reporters in a Monday briefing. "What's different as LCROSS is that it is tactically employed as an impactor. So everything we do with our mission design is designed around maximizing the value of our impact."

Past missions have revealed the poles are rich in hydrogen - a possible sign of water - and by looking at the aftermath of the lunar double whammy, scientists hope to confirm once and for all whether ice exists on the moon. The moon's poles are mysteries in many ways - "we have much better maps of Mars than of our own moon's polar regions," said Craig Tooley, NASA's LRO project manager.

Instead of arriving at the moon in a few days like LRO will, LCROSS will orbit Earth twice for about 110 days, using Earth's gravity help sling it on a collision course with the lunar south pole in early October. This smaller, bare-bones probe has two main parts - the roughly 6-foot-wide (2 meter) Centaur rocket stage used to boost it to the moon, and a shepherding spacecraft that will accurately guide the Centaur at the crater and then separate.

When the rocket stage, which at 5,100 lbs. (2,300 kg) has roughly the mass of a big sports utility vehicle, slams into the lunar surface at a steep 85 degree angle, it will be hurtling through space at about 5,590 mph (nearly 9,000 kph). Although there is a fair amount of uncertainty as to exactly how big an effect this impact will have, Colaprete estimated it will toss up roughly 770 million pounds (350,000 metric tons) of debris into the sunlight, carving a crater about 12 feet deep (4 meters) and 80 feet wide (25 meters).

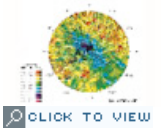
Impacts of similar size happen roughly three or four times a week on the moon.

"We're going to lift matter up from the crater that could have been in shadow for 2 billion years," Colaprete said. "For the first time, we'll see what it is composed of, what secrets it is guarding."

Copycat moon crash

The shepherding spacecraft will watch the plume of gas and dust rise about 3.7 miles high (6 km), "shaped kind of like an upside-down lampshade," Colaprete said. Matter could even be knocked up 30 miles (50 km) or more, he added, and the flash might be visible through amateur-class telescopes with apertures as small as 10 to 12 inches.

interpretation of NASA's LCROSS spacecraft observing the first impact of its rocket booster's upper stage before heading in for its' own crash into the Moon's South Pole. Credit: NASA.



The dark blue and purple areas in this image of the moon's poles indicate neutron emissions consistent with hydrogen-rich deposits covered by dessicated regolith. The signatures are possible indications of water ice or hydrated minerals. Credit: NASA.

This NASA illustration depicts how water ice may lie hidden deep at the bottom of deep south pole craters that are in permanent shadow on the moon. Credit: NASA/GSFC.

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The shepherding spacecraft will then fly through the plume the Centaur kicks up, using its five cameras and three spectrometers working in the visible, near-infrared, and mid-infrared wavelengths to scan for water or other compounds. An onboard photometer will also very quickly and precisely measure the faint flash of the impact itself, which in a few hundred milliseconds can reveal how far the rocket penetrated, how strong the lunar matter was, and even if water escaped.

Then, about four minutes after the Centaur's impact, the shepherding spacecraft will itself crash at a different spot about 2 miles (3 km) away to offer a second chance to study the south pole. Both impacts will be monitored by spacecraft such as the newly repaired and improved Hubble Space Telescope, the European Odin satellite and India's Chandrayaan-1 probe, as well as Earth-based observatories at Hawaii, California, New Mexico, Arizona, Korea and South Africa.

"We're going to be able to address some fundamental questions about the moon," Colaprete said.

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mikecrane wrote: posted 16 June 2009, 9:48 am ET

A couple of dates would of been nice.

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EECOM wrote: posted 16 June 2009, 10:00 am ET

A lot of the dates and times are vague in this article. Maybe they haven't pinned down the exact launch window yet. Once they do launch, I hope they advertise the expected impact times. This should be really cool...

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normancopeland wrote: posted 16 June 2009, 10:01 am ET

Crystaline rocks glittering from the pole...

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GoodnessOfWheat wrote: posted 16 June 2009, 10:25 am ET

Very cool stuff... I can't wait to see images of the apollo landing sites :)

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HanShotFirst wrote: posted 16 June 2009, 10:52 am ET

Very cool! Moon is the new Mars!

On a related topic, could we point the new and improved Hubble to the Apollo 11 landing site and take a photo of it, for the 40th anniversary of landing? I know the old Hubble couldn't do it, but perhaps the new and upgraded optics?

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normancopeland wrote: posted 16 June 2009, 11:13 am ET

Perhaps these days of satelite reports won't be like what we're anticipating from future space missions.

http://redtape.msnbc.com/2009/06/when-you-live-in-a-place-where-every-starbucks-offers-wireless-access-and-every-salesman-seems-to-have-a-web-anywhere-laptop.html

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SpaceTas wrote: posted 16 June 2009, 1:01 pm ET

No the New Hubble can not get a good enough image of the moon to pick out the landers or their shadows for the same reasons as the Old Hubble
1: it is not large enough: spatial resolution depends upon diameter of the
mirror.
At best Hubble would have spatial resolution near 90m on the moon,
ie a 2 pixel resolution of 180m. This is much bigger than the LEM
2: it cannot track fast enough to follow the Moon as it moves against stars.

3: the Moon is too bright for the Hubble cameras.

The factor 2 in improved image quality, not the basic resolution of the optics, is due to decreasing the size of the pixels. Previously the wide field camera had pixels too large to fully use the optical resolution, it is like using a binning mode on your fancy digital camera.

The improvement

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High_Evolutionary wrote: posted 16 June 2009, 1:35 pm ET

Here comes google Moon! I hope the flight simulator on this one has the Apollo sites so I can swing by low for a look.

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TimeTheFinalFrontier wrote: posted 16 June 2009, 1:53 pm ET

Once the mapping is complete I can stake my claim. I intend to do some exploration on my lot and possibly some mining, based on the results of my exploration.
http://en.wikipedia.org/wiki/Extraterrestrial_real_estate

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ScottCarpenter wrote: posted 16 June 2009, 2:11 pm ET

Well, I don't hear anyone worried about killing a microbe living meters beneath the lunar topsoil, nor about contaminating and littering on the moon. So why don't we go for it... and use a small nuke. We could learn a lot fast from the bigger plume and the deeper hole.

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