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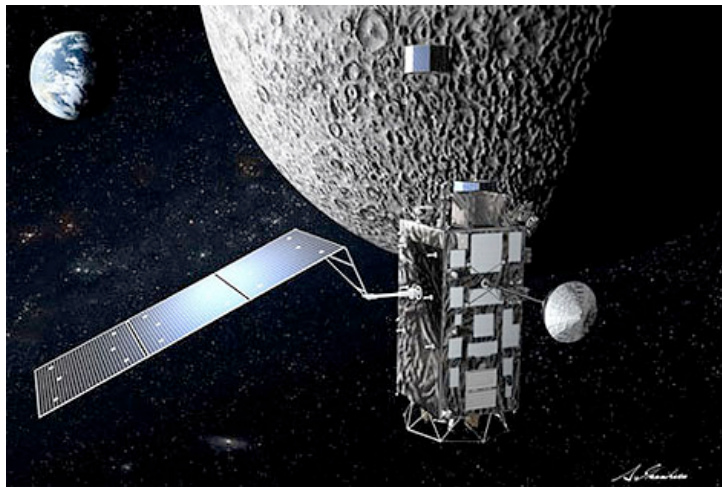


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Do We Really Need Another Satellite Orbiting the Moon?

NASA has successfully guided 12 astronauts to the surface of the moon, where they explored their surroundings and set up numerous surveys and studies. Earth-based telescopes have had no trouble recording physical details of the lunar surface. Recently, Japan sent Kayuga, a high-tech satellite that has returned the most detailed maps of the moon to date. Now NASA plans on sending another satellite—the Lunar Reconnaissance Orbiter. Do we really need more data on our already well-documented celestial neighbor? Here, a comparison of LRO and Kayuga addresses the question.

By Joe P. Hasler
Published on: June 17, 2009



(An illustration depicting Japan's Kayuga satellite. Image from JAXA/Kayuga)

It is a tale of two satellites, a shared destination, and two very different missions. Here on Earth, one lunar orbiter prepares to begin its voyage to the moon. Meanwhile, 235,000 miles away in space, the other plummets from orbit endings its mission in a heap on the lunar surface.

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This week at Cape Canaveral, Florida, NASA will launch its Lunar Reconnaissance Orbiter (LRO). Presently strapped to the top of an Atlas V rocket at the Kennedy Space Center, it is the \$579 million opening salvo of the space agency's "Vision for Space Exploration," the series of missions initially intended to return Americans to the moon, then eventually take them further into space. John Keller, a deputy scientist with the LRO mission, says the objective of the project is to determine whether it's safe—and if essential resources like water exist—to proceed with the plan to colonize the moon.

The Kaguya orbiter, launched by the Japanese space agency (JAXA) in late 2007, had strictly scientific objectives. The agency set out to answer some of the moon's remaining unsolved mysteries, not to mention be the first to map the moon using the latest in digital imaging technology. "LRO is not a science mission," Jim Garvin, chief scientist at the Goddard Space Center and one of LRO's founding fathers, told Popular Mechanics. "It has high science value, but it was conceived to provide engineering parameters for our eventual manned return to the moon."

Though the orbiters share a few similar instruments—both, for example, boast high-resolution cameras and laser altimeters to provide unprecedented, richly detailed topographic models of the lunar surface—the unique objectives of the mission mean that even seemingly comparable devices actually differ significantly.

"The scientific community is awaiting the tremendous data sets that will come from each of these missions," Keller says. But while the Kayuga data will be extremely useful to NASA, Garvin adds, "What we need to know is the terrain at civil engineering scales; temperatures, which they're not mapping; hydrogen, as a resource, at a few miles scale; imaging at the scale of a rock that will break a lander leg. When you start putting all those things together, it's beyond what you want in a general science mission."

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KAYUGA

LRO

COST

\$279 million

\$579 million

OBJECTIVE

To obtain scientific data on lunar origins and evolution, and to develop the technology for future lunar exploration.

To find safe landing sites, locate potential resources, characterize the radiation environment, and demonstrate new technology.

LIFESPAN

21 months (September 2007 to June 2009)

1 to 4 years (1 year exploration goal, with possibility of extended mission lasting 3 years)

CAPABILITIES

Lunar Radiation: A Charged Particle Spectrometer on Kaguya collected data on high energy particles as they peppered the moon, so that scientists might forecast radiation from cosmic rays.

Magnetic Anomalies: Perched at the end of a 12-meter mast, the Lunar Magnetometer obtained measurements on the varied direction, strength and intensity of the moon's magnetic fields, providing the data to produce the most detailed maps of the moon's magnetic anomalies.

Gravity Fields: Measurements of the interference in signals sent between Kaguya, a pair of sub-satellites (Usuda and Okina), and radio dishes on Earth provided data on the moon's gravity, and created the first complete maps covering the entire moon's gravitational make-up.

Lunar History: The Lunar Radar Sounder, a device emitting low frequency (5MHz) radio pulses into the moon, was used to analyze stratification below the surface, thus providing data for better understanding the moon's tectonic past.

HDTV: Kaguya employed a [high definition television](#) camera to film the first ever HD video of the lunar surface, and also capture a full Earth-rise as it orbited the moon.

Topography: A suite of imaging equipment, the Terrain Camera (TC) and Multi Band Imager (MI), swept over the surface in a continuous "push-broom" fashion. The TC was comprised of two, one-dimensional telescopes and captured black-and-white images with an unprecedented resolution of 10m/pixel. At the same time, a Laser Altimeter attached to the orbiter sent a constant laser pulse to the surface. By timing the reflection between the surface and the orbiter, the altimeter collected precise data used to create the first-ever "global, accurate and precise topographic map of the Moon."

Measuring Radiation: Two devices will measure the moon's volatile radiation environment. Similar to Kaguya's Charged Particle Spectrometer, the Lunar Explorer Neutron Detector (LEND), will measure the neutron flux produced by the barrage of cosmic rays that constantly showers the lunar surface. But LRO goes a step further with the Cosmic Ray Telescope for the Effects of Radiation (CRaTER). It will not only detect incoming solar particles as they pass the orbiter, but also carry a layer of Tissue Equivalent Plastic, specially engineered to simulate human tissue and measure the biological effects of particle bombardment.

Search for Ice: The LRO has several instruments aimed at determining whether or not water, in the form of ice, exists on the moon. Diviner, a radiometer, will create the first global temperature survey of the lunar surface, detecting cold traps where ice may exist. According to Garvin, it will "tell us where the super cold places are, and how cold they really are. No other mission is doing that, but it's really a fundamental question."

A new technology display called Mini RF, a small antenna attached to LRO, will send radio waves to the moon's poles, the signals that return will then be analyzed to determine whether ice is trapped in the poles' deep, unmapped craters. The Lyman-alpha Mapping Project (LAMP) will measure the faint reflection of light created by stars and hydrogen atoms in space to determine the composition of the moon's permanently unlit regions.

Search for Landing Sites: While Kaguya's cameras and altimeter created topographic models of exceptional, never-before-seen clarity and detail, NASA aims to better them. Its Lunar Orbit Laser Altimeter (LOLA) will provide terrain mapping data for choosing future landing sites. "It's not like the ones that have flown before," Garvin says. "It will actually map things at a spatial scale of just a few meters, and 10cm vertically. That's the scale [with which] we map ice

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sheets on the Earth."

The LRO's camera package consists of one wide angle lens with 100m/pixel resolution, along with a pair of narrow angle scopes with 50cm/pixel resolution. Together they will capture extremely detailed views—objects as small as 1 meter will be visible. "The cameras on the now impacted Japanese mission make mapping at a scale of like 15 meters, 20 meters, not 50 centimeters," Garvin says. "We will be able to make integrated maps of landing site regions that will predict safety and allow for better design of future landing systems. We massively over-designed Apollo because we had to. Now, we can be smarter."



(Scientists work on the Lunar Reconnaissance Orbiter. Image from NASA)

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Reader Comments (12)

12. RE: Do We Really Need Another Satellite Orbiting the Moon?

I strongly support the orbit. for those who are not sure is supporting will make a change. I don't event know if we land in the moon yet. We can create a base to get closer to Mars. materials can be ship to the moon to make the journey shorter. Today in technology 579 millions is nothing. I will like to see alittle more money invest like 3 trillions. we can not compared 1960, 10\$ was like having in your pocket 80 dollars in 2009. lol cheap cost

11. RE: Do We Really Need Another Satellite Orbiting the Moon?

As a huge supporter of any and all space exploration, both robotic and manned, I support this mission. Less than \$600 million doesn't qualify as even chump change these days, does it? And the Moon does offer some resource possibilities, with an eye towards supporting exploration beyond (read: Mars). Of course, if neither the Moon nor Mars have any water, then we may be stumped, in terms of manned exploration with a goal towards settling elsewhere. Unless there's some way to produce water from other materials that are present on one, the other, or both the Moon and/or Mars. Scientific exploration is almost always worth it, at the end of the day. I know, I know -- some wail and moan, "Just think how we could use that money to _____ [fill in your favorite charitable activity]." What they don't realize is that the sums we're talking about wouldn't go very far "at all" for the purposes they have in mind. Straying away from this article a bit, I wish we had never planned to retire the shuttle so soon, not only because of the gap that'll be left in terms of getting our astronauts up to the ISS, but because it never has really fulfilled that part of its originally conceived mission to "explore" via dropping of satellites, etc. Yes, it did some of that, but not as much as originally envisioned. And if we were to have a shuttle capability, at the very least, our astronauts would be getting more "at the wheel" time, time they need.

10. RE: Do We Really Need Another Satellite Orbiting the Moon?

LRO is crucial. This kind of debate is sophomoric. All money spent on space and defense technologies benefits all mankind. That is unlike the remainder of Congressional spending which seeks to maintain the



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status quo, at best. I am quite surprised the article bypasses the mentioning of the LRO Camera instrument (LROC), the star of this unearthly show.

9. RE: Do We Really Need Another Satellite Orbiting the Moon?

Any space science research is money well spent, no matter what it is, unlike any money going into war & defense technologies.

8. RE: Do We Really Need Another Satellite Orbiting the Moon?

In response to #5: Everything you say is true, but you left out the critical deciding factor that drives our missions to the Moon, as opposed to Mars. In the event of an emergency, the Moon is only 3 days away, bringing with it with the possibility of rescue, while Mars is 3 months away.

7. RE: Do We Really Need Another Satellite Orbiting the Moon?

Website: <http://www.satellitebroadband.org>

Each and every country can't depend on NASA for getting information, more and more developed and developing countries keeping % of their annual budget for collecting information. Even countries using satellites as spy to detect activities happening in other countries.

6. RE: Do We Really Need Another Satellite Orbiting the Moon?

will we actually see the apollo landing site with this high tech camera ?

5. RE: Do We Really Need Another Satellite Orbiting the Moon?

I feel like our satellite (LRO) is kind of a waste of time. In terms of colonizing space, we should be pumping all our resources into Mars. Other than taking more time in transit, it's easier to get there (smaller delta v and you can aerobreak your ship in Mars' atmosphere), can sustain a long-term human presence without the need for imports from Earth (unlike the moon), and is economically more attractive due to everything that it can export (the moon only has H3 as a viable export). As human explorers of the 21st century, I think we can set our sets further (and smarter) than the moon.

4. RE: Do We Really Need Another Satellite Orbiting the Moon?

If one has gone down it should be replaced. No question about that. More interested in the moon scrap.

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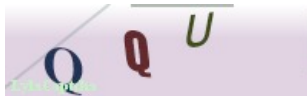
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