Lunar CRater Observation and Sensing Satellite

Q & A with Dr. Jennifer Heldmann, Co-Investigator

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As I pondered about which questions to inquire about, I tried to come up with questions that were not easily available online or that required personal interpretation. What I wanted to know most from the scientist was how the LCROSS instrumentation worked in simple terms, what the suspected results would be which she evaded, and how the mission might affect future mission objectives and activities. After compiling a questionnaire and e-mailing it, I anxiously awaited the results. They are as follows:

1. What methods were used to select the area which LCROSS will impact? There is a lot of scientific and engineering analysis that goes into selecting the site where LCROSS will impact. There are lots of things to consider to pick the best impact site. For example, since LCROSS is looking to see if there is water ice on the Moon, and since we know that water ice would most likely be in a cold permanently shadowed region near one of the lunar poles, we need to hit in one of these spots. (And how do we know where the permanently shadowed regions are?? From analysis of data from lots of spacecraft and also from Earth-based telescopes)! We also want to impact on a location that is on the near-side of the Moon, meaning that the impact site will be visible to observers from Earth. Since people on Earth will be observing the impacts with telescopes, we need to impact during the nighttime (particularly over Hawaii and the western U.S., where there are a lot of big telescopes we can use). We also need to impact in a place where the impact plume will rise high enough to go above the crater rim and reach the sunlight, since it is only when the debris reaches the sunlight that we'll actually be able to see it! We'll also use data from other spacecraft orbiting the Moon (including the Lunar Reconnaissance Orbiter, which shares a ride to space on a rocket with LCROSS) to provide even more information about the Moon to help us choose the best place to impact. So there are a lot of criteria to be met, and we use a rigorous and systematic analysis to help choose the best spot.

2. What do you personally think the results the LCROSS mission will be? That is a great question! We have the LCROSS mission to answer many of the unknown questions about our Moon -- is there water ice? What is the form of the hydrogen that has been observed? In what quantity are these materials present on the Moon? -- we don't know yet, so as a scientist I will wait for the data to be returned and see what we find out!

3. How would water have amassed on the Moon? Water could have been delivered to our Moon in much the same way as water was delivered to our Earth -- through impacts of water-rich comets and/or asteroids. Early in the formation of our solar system (by the way, our solar system formed about 4.6 BILLION years ago!), there were many more impacts of rock, debris, ice, etc. than there are today. So with all these impacts, some water was delivered to the inner part of our solar system (including the Earth and Moon). The permanently shadowed regions near the Moon's poles are really cold, and that is an excellent place to trap and preserve any water ice that might have made its way there.

4. What is the projected expense of the LCROSS mission and how will the LCROSS findings justify that expense? LCROSS has been a $79 million dollar mission. That might sound like a lot of money to you and to me, but in the grand scheme of exploration, this is actually a very cost-effective mission. We are answering several very fundamental questions about our Moon which are critically important from both a scientific perspective and also as preparation for any future human exploration of the Moon. So this modest investment now will have tremendous benefits.

5. How would the discovery of water affect future space missions? The discovery of water would be important for several reasons. Scientifically, knowing how much (if any) water ice is on the Moon will yield great insights into the past history of our solar system, and can help tell us about the earlier conditions of our solar system during its formation when there were many more bombardments by asteroids, comets, etc. We're interested in learning about this time in our history, and also learning about the history and behavior of any water that could have made its way to the lunar polar cold traps. Knowing if there is water ice on the Moon can also be important for enabling future exploration of the Moon by people because if there is water ice there, that could be an important resource for people to use (water is made up of hydrogen and oxygen, so this can be used to make things like rocket fuel). It might be easier to use the hydrogen and oxygen already on the Moon instead of launching it from Earth.

6. Specifically, what water detecting instrumentation will be used? LCROSS has several instruments key to looking for water ice and vapor. The payload has a visible camera, mid-infrared cameras, visible-ultraviolet spectrometer, infrared spectrometers, and a total luminance photometer (TLP).

7. In simple terms, how does the above instrumentation work? The visible camera works much like your own digital camera -- it will take pictures of the impact plume as it rises and falls above the lunar surface. The mid-infrared cameras work in a similar way and will take pictures of the impact plume -- but at a different wavelength that is very sensitive to heat, so we can actually make a temperature map of the plume (and the temperature of the plume will be sensitive to the amount of water present). The spectrometers measure the plume at different wavelengths and look for special signatures of various materials. Much like a fingerprint, materials such as water ice give a unique spectral signal, and so using the spectrometers we can look for this signal and see if there is water there or not. The TLP will detect the impact flash - a bright burst of light emitted at the moment of impact. This bright flash can tell us about the target material that we just impacted into.

8. How did you become a NASA AMES's scientist and why did you choose that profession? I chose to become a scientist because I really like learning about the universe that we live in. It is fascinating to explore our own planet and also other planets within our Solar System and beyond (plus all the stars, galaxies, nebulae, etc). I became a NASA Ames scientist by working very hard in school and studying a lot of math and science. In college I studied subjects like math, physics, astronomy, chemistry, geology, etc. Working hard and working on projects that you find very interesting are important! If you like math and science then keep study hard in school, learn as much as you can, and you can be a scientist, too!

Jennifer Heldmann's responses were extraordinarily insightful and complete. She did not merely answer in one sentence, but usually through an entire paragraph. That level of attention and interest surprised me; however, I guess it was to be expected from a top NASA scientist. I thoroughly enjoyed reading her responses to my inquiries. She skillfully explained most of the details of the LCROSS mission including how the impact crater was selected and how the instrumentation on the reconnaissance orbiter functioned. Although she declined to answer what she thought the findings of the mission would be, she did explain the significance of discovering water on the moon and what that might entail for prospective missions by NASA. Additionally, she explained how she became interested in science and space and her personal career path on becoming a NASA AIMS scientist. Her biography at http://quest.arc.nasa.gov/people/bios/space/heldmann.html was fascinating to read. Her hobbies as a child such as telescope gazing with her father were touching. The manner in which she writes and even the life she leads is rather inspiring. This opportunity to converse with a real scientist was spectacular.