

Triton Fun Company

Science Newsletter December 2007

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The Moon is Flat: Lunar Exploration Becomes A Truly Multinational Endeavor

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Special points of interest:

5 Moon Missions !

Triton Fun stuff

Superfluous questions

Fifteen years ago, when I was a much younger space enthusiast, I remember reading a *National Geographic* article about the transformation of China under the leadership of Deng Xiaoping and his technocrat protégés. The article mentioned one interesting indicator of Chinese practicality: China's main rocket factory in Shanghai doubled as a refrigerator factory. "How funny!," I thought, "In China, Maytag is NASA."

Well, I suspect that factory in Shanghai is not making many refrigerators these days as China launches more and more communications and scientific satellites each year. The flagship of this growing fleet is **Chang'e 1**, China's first extraterrestrial satellite, whose first images of the lunar surface were released recently. Note the "1"; Chang'e 1 (named after a Chinese moon goddess) is intended to be the first in a planned series of Chinese lunar missions that may culminate in Chinese astronauts landing on the Moon in 2017.

Chang'e 1 is also a sign of global proliferation, not of weapons technology, but of the desire and technical ability to explore Earth's nearest neighbor. Between September of 2003 and the end of 2008, five different space agencies have launched or plan to launch lunar orbiting satellites.

What follows are capsule descriptions of these orbiters and the relevance of the data they have collected or will collect to scientific questions about the Moon and future human presence on the Moon, particularly with regards to water resources.

SMART-1: The European Space Agency (ESA) launched this orbiter in September of 2003 and crashed it into the surface nearly three years later. The mission had two purposes. First, it tested new technologies that would be useful for future missions to more distant objects, such as *ion engine propulsion*, in which a gas is charged and then electrically focused into a beam to produce thrust. Second, it investigated the composition of the lunar surface using *Infra-red*, *X-ray* and *fluorescence* instruments. Perhaps, its most important achievement was high resolution imaging of the poles of the Moon. It has been hypothesized that water ice might be concentrated and preserved in permanently shadowed regions at the poles, so SMART-1's polar imaging allowed identification of such areas as well as determining safe polar landing sites. Since SMART-1 impacted the Moon at a velocity comparable to that of a typical meteorite landing, its impact behavior provided additional information about the mechanics of cratering on the Moon.



KAGUYA (SELENE): Launched by Japan's Aerospace Exploration Agency (JAXA), this lunar orbiter (and two companion probes), so nice they named it twice, has a rather dense suite of instrumentation capable of collecting information about the Moon's composition, topography, and interactions with the solar wind. Particularly interesting is Kaguya's ability to measure the gravitational field on both the near and far side of the Moon by transmitting a signal to the Earth through its relay satellite. This precise gravitational field data will allow better constraints on the size of the Moon's small iron core.

We are always looking for contributors to the Science Newsletter. If you would like to write an article about a science subject you are excited about, or contribute a superfluous question, or if you would like to be on our mailing list for future newsletters, please e-mail us at:

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Lunar Exploration—International Cooperation among Nations, continued

Photos/Info: NASA/ESA/ISRO/JAXA

CHANG'E 1: Launched by the Chinese National Space Agency (CNSA) in collaboration with the European Space Agency, Chang'e 1 is intended to be the orbiter component of an exploration program preparing for human occupation and mining on the Moon. Its primary goals are to produce high-resolution topographic maps of the Moon, a task that has proven tricky for ESA, and to identify potential mineral resources for future exploitation and commerce.

CHANDRYAAN 1: The Indian Space Research Organization (ISRO) intends to launch this orbiter in collaboration with other space agencies in early 2008. The collaborative nature of this mission is one of its most interesting features; NASA, ESA, and Bulgaria all have provided instruments. One important instrument is a *miniature synthetic aperture radar*, which can be used to search for lunar ice deposits and will identify regions of interest for further investigation with Lunar Reconnaissance Orbiter. Another instrument is the *infrared spectroradiometer* which could possibly detect water or at least the spectral bands of the related hydroxyl molecule (OH). **Chandryaan 1** will also have a small probe which will actually detach from the orbiter part of the spacecraft and land on the moon. Other instruments in the international payload include an *X-ray spectrometer*, a *near infra-red spectrometer*, a *moon mineralogy* instrument and a *sub KeV atom reflecting analyzer*.



Chang'e 1

LUNAR RECONNAISSANCE ORBITER (LRO): NASA intends to launch this orbiter in October 2008. Like Chang'e 1, LRO is to be a precursor to a new era of humans landing on the Moon and is the first mission to emerge out of the Vision for Space Exploration created by the Bush Administration. Like the other lunar missions, LRO is heavily focused on generating high-resolution topographic maps of the lunar surface and studying the radiation environment of the Moon. LRO, however, is more focused on water and less focused on geochemistry because of the information expected from the NASA-funded mineralogical mapping spectrometer on Chandryaan 1.

The *Diviner lunar radiation experiment* will provide information useful for modeling the surface and sub-surface temperatures on the Moon, allowing better information about the location of water ice deposits. The *Lyman-Alpha mapping project* will use ultraviolet light from the stars and scattered sunlight to look at permanently shadowed regions of the Moon, where ice could be preserved on the surface. A *neutron detector* will measure the degree of scattering of neutrons generated by cosmic rays in the lunar surface, which can be a strong indicator of the presence of water. Finally, LRO will have a *synthetic aperture radar* like that on Chandryaan 1. It is said among planetary scientists that, with all of these advanced instruments, if LRO does not detect ice deposits on the Moon, then they do not exist !

Chandryaan 1 and LRO will work together to simultaneously image the surface with radar to get very accurate measurements



SMART-1

The likely end result of these missions is that by 2015, we will have a much better idea of whether the Moon has the water and mineral resources to make future occupation for non-scientific purposes practical. We will also understand more about various hazards that future astronauts will face. In addition, we will have some exceptionally high-resolution maps of lunar topography and compositional information that will tell us about the evolution of the Moon from its origin as a chunk of rock splashed off of the Earth in a gargantuan collision to the familiar and beautiful celestial body we see today. It is wonderful to see so many different nations dedicating their resources to space exploration and developing the technical knowledge base to do sophisticated engineering and science. Let us hope such efforts continue in the future.



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** Send us your superfluous questions for a future issue ! They can be on any subject. The funnier, the better. M.D., our editor, appreciates the help and will send you a free Triton Fun coffee mug as compensation for your question. Or write an article for us and be read by professional and amateur astronomers and scientists in the U.S. and Canada ! **

Superfluous Questions:

- In the TV show "The Fresh Prince of Bel-Air", Will is originally from *what city*?
 a) South Chicago b) East Newark c) North Miami d) West Philadelphia
- Who invented the animated character *Gumby*?
 a) Jim McToun b) Art Clokey c) Ponsonby Britt d) Walt Disney
- Which of these states has a border that was part of the original Mason-Dixon line (dividing the north and south U.S.)?
 a) Tennessee b) North Carolina c) Ohio d) Pennsylvania
- What year did Canadians officially proclaim the song "O Canada" as their national anthem ?
 a) 1966 b) 1946 c) 1980 d) 1971

--> ANSWERS in next months issue of the Science Newsletter ! <---

** ANSWERS to November's Superfluous Questions: 1. c) the "Wow" signal 2. c) 10^{120} 3. b) 10^{75} 4. c) Vancouver, B.C.