

# NASA launching twin moon probes to measure gravity

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In this Aug. 25, 2011 photo made available by NASA, technicians add a payload fairing to the Gravity Recovery And Interior Laboratory (GRAIL) booster at the Kennedy Space Center in Cape Canaveral, Fla. (AP Photo/NASA)

Four decades after landing men on the moon, NASA is returning to Earth's orbiting companion, this time with a set of robotic twins that will measure lunar gravity while chasing one another in circles.

By creating the most precise lunar gravity map ever, scientists hope to figure out what's beneath the [lunar surface](#), all the way to the core. The

orbiting probes also will help pinpoint the best landing sites for future explorers, whether human or mechanical.

Near-identical twins Grail-A and Grail-B - short for Gravity Recovery and Interior Laboratory - are due to blast off Thursday aboard an [unmanned rocket](#).

Although launched together, the two washing machine-size spacecraft will separate an hour into the flight and travel independently to the moon.

It will be a long, roundabout trip - three to four months - because of the small Delta II rocket used to boost the spacecraft. NASA's [Apollo astronauts](#) used the mighty Saturn V rocket, which covered the approximately 240,000 miles to the moon in a mere three days.

NASA's Grail twins will travel more than 2 million miles to get to the moon under this slower but more economical plan.

The mission, from start to finish, costs \$496 million.

The moon's appeal is universal.

"Nearly every human who's every lived has looked up at the moon and admired it," said Massachusetts Institute of Technology [planetary scientist](#) Maria Zuber, Grail's principal investigator. "The moon has played a really central role in the [human imagination](#) and the human psyche."

Since the Space Age began in 1957, 109 missions have targeted the moon, 12 men have walked its surface during six landings, and 842 pounds of rock and soil have been brought back to Earth and are still being analyzed.

Three spacecraft currently are orbiting the moon and making [science observations](#). A plan to return astronauts to the moon was nixed in favor of an asteroid and Mars.

Despite all the exploration, scientists still don't know everything about the moon, Zuber noted. For example, its formation still generates questions - Grail's findings should help explain its origin - and its far side is still mysterious.

"You would think having sent many missions to the moon we would understand the difference between the near side and the far side, but in fact we don't," she said.

Recent research suggests Earth may have had a second smaller moon that collided with our present moon, producing a mountainous region. The Grail mission may help flush out that theory, Zuber said.

Grail-A will arrive at the moon on New Year's Eve, followed by Grail-B on New Year's Day. They will go into orbit around the lunar poles and eventually wind up circling just 34 miles above the surface.

For nearly three months, the spacecraft will chase one another around the moon, meticulously flying in formation. The distance between the two probes will range from 40 miles to 140 miles. Radio signals bouncing between the twins will provide their exact locations, even on the far side of the moon.

Scientists will be able to measure even the slightest variations in the gap between orbiting Grail-A and Grail-B - every single second. These subtle changes will indicate shifting masses below or at the lunar surface: mountains in some places, enormous lava tubes and craters in others.

The moon actually has the most uneven gravitational field in the solar

system, according to NASA. The moon's gravity is about one-sixth Earth's pull.

"We measure the velocity change between the two spacecraft to a couple of fractions of a tenth of a micron per second. It is an extremely accurate measurement that has to be made," Zuber said.

A tenth of a micron is about half the size of a red blood cell.

By the time their science mission ends in late spring, Grail-A and Grail-B will be within 10 miles of the lunar surface. Barring a change in plans, they will crash into the moon.

Each spacecraft holds one science instrument- for sending and receiving radio signals between the two - as well as a digital video camera system, MoonKAM, intended for use by middle school students worldwide. Sally Ride, the first American woman in space, and her science education company in San Diego is leading the photo-gathering effort. It's billed as "eyes on the [moon](#) for Earth's students."

This is NASA's second robotic mission to be launched since the end of the shuttle program in July. A probe named Juno is headed for Jupiter following an Aug. 5 liftoff.

NASA officials will be thrilled if Grail generates even a portion of the immense interest ignited by the Juno launch. A large crowd is expected at Cape Canaveral for Thursday's morning liftoff, which features a pair of split-second launch windows a half-hour apart.

"We're just delighted by the way the country is responding to these exciting missions," said Jim Green, director of NASA's planetary science division.

**More information:**

NASA: <http://www.nasa.gov/mission-pages/grail/main/index.html>

Sally Ride Science: <http://moonkam.ucsd.edu/>

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