NASA launched its second Mars Exploration Rover, Opportunity, in the evening of Monday, July 7, aboard a Delta II launch vehicle whose bright glare briefly illuminated Florida Space Coast beaches.

Opportunity’s dash to Mars began with liftoff at 8:18 p.m. Pacific time from Cape Canaveral Air Force Station. The spacecraft separated successfully from the Delta’s third stage 83 minutes later, after it had been boosted out of Earth orbit and onto a course toward Mars. Flight controllers at JPL received a signal from Opportunity at 9:43 p.m. Monday PDT via the Goldstone, Calif., antenna complex of the Deep Space Network.

All systems on the spacecraft were operating as expected, reported JPL’s Richard Brace, Mars Exploration Rover deputy project manager. “We have a major step behind us now,” said Project Manager Pete Theisinger. “There are still high-risk parts of the mission ahead of us, but we have two spacecraft on the way to Mars, and that’s wonderful.” NASA Associate Administrator for Space Science Dr. Ed Weiler said, “Opportunity joins Spirit and other Mars-bound missions from the European Space Agency, Japan and the United Kingdom, which together mark the most extensive exploration of another planet in history. This ambitious undertaking is an amazing feat for Planet Earth and the human spirit of exploration.”

Two days after launch, NASA announced that Opportunity had successfully increased its spin rate as planned and switched to celestial navigation using a star scanner.

Prior to the July 9 maneuver, Opportunity was spinning 12.13 rotations per minute. Onboard thrusters were used to reduce the spin rate to approximately two rotations per minute, the designed rate for the cruise to Mars. After the spinning slowed, Opportunity’s star scanner found stars that are being used as reference points for spacecraft attitude. One of the bright points in the star scanner’s first field of view was Mars.

All systems on the spacecraft are in good health. As of July 10, Opportunity has traveled 6.6 million kilometers (4.1 million miles) since its July 7 launch. The Mars Exploration Rover flight team at JPL is preparing to command Opportunity’s first trajectory-correction maneuver, scheduled for July 18.

Opportunity’s twin, Spirit, also continues in good health on its cruise to Mars. As of July 10, it has traveled 2.6 million kilometers (1.6 million miles) since its June 10 launch. Opportunity is scheduled to arrive at a site on Mars called Meridiani Planum on Jan. 25, 2004, Universal Time (evening of Jan. 24, Eastern and Pacific times), three weeks after Spirit lands in a giant crater about halfway around the planet. JPL’s Mars Global Surveyor orbiter has identified deposits at Meridiani Planum of a type of mineral that usually forms in wet environments. Both rovers will function as robotic geologists, examining rocks and soil for clues about whether past environments at their landing sites may have been hospitable to life.

For more information on the mission, visit http://mars.jpl.nasa.gov.

**Terrestrial Planet Finder concepts selected**

Where did we come from? Are we alone?

The Terrestrial Planet Finder mission seeks to answers these questions as part of NASA’s Origins Program, a series of missions to study the formation of galaxies, stars and planets, and to search for life elsewhere in the universe. It may seem hard to believe now, but until 1995, there was only one known solar system—the one we live in. Since then, scientists have discovered indirect evidence for more than 100 planets orbiting other stars, suggesting that there may be untold numbers of planetary systems. To date, the existence of such planets has been inferred primarily by careful observations of the periodic motions of their parent stars resulting from the gravitational pull of the orbiting planets. Furthermore, these planets are not Earth-like but rather are very massive bodies orbiting very near the stars.

Astronomers and planetary scientists are keenly interested in directly detecting planets by observing and characterizing reflected or emitted light from them and finding out whether there may be planets like the Earth and capable of harboring life. Thus the excitement is building in anticipation of NASA’s Terrestrial Planet Finder mission, managed by JPL.

Just last week, European astronomers announced the discovery of seven new planets orbiting other stars, bringing the total number of known extrasolar planets to 115. Six of the new planets orbit stars not previously known to harbor planets, while the seventh orbit a star where another planet had been detected earlier.

In another recent discovery, British astronomers, working with Australian and American colleagues, have discovered a planet similar to Jupiter in mass, circular orbit and distance from its parent star, HD 70642, which is very like our own Sun. Among the 100 found so far, this system is the one most similar to our solar system. "Most of the systems found so far with very massive planets close to the central star are not places we would expect to find Earths," said Terrestrial Planet Finder Project Manager Dan Coulter. "The exciting thing about the HD 70642 system is that it shows there are systems similar to our own out there where TPF might find something very interesting."

As part of its quest to find Earth-sized planets around stars and look for telltale chemical signatures of life, NASA has chosen two mission architecture concepts for further study and technology development for the Terrestrial Planet Finder mission. The two architectures being explored for the mission are an Infrared Interferometer and a Visible Light Coronagraph. Each would use a different means to achieve the same goal—to block the light from a parent star in order to see its much smaller, dimmer planets. That technology challenge has been likened to finding a firefly near the beam of a brilliant searchlight from far away. Additional goals of the mission would include characterizing the surfaces and atmospheres of newfound planets, and looking for the chemical signatures of life.

The Infrared Interferometer is made up of multiple small telescopes on a fixed structure or on separated spacecraft flying in precision formation would simulate a much larger, very powerful telescope. The interferometer would utilize a technique called nulling to reduce the starlight by a factor of 1 million, thus enabling the detection of the very dim infrared emission from the planets. The Visible Light Coronagraph is a large optical telescope, with a mirror three to four times bigger and at least twice as much precision as the Hubble Space Telescope, and would collect starlight and the very dim reflected light from the planets. The telescope would have special optics to block the starlight and reduce the scattered or diffraacted light by a factor of 1 billion, thus enabling astronomers to detect the faint planets.

The Terrestrial Planet Finder project selected the two
New technologies was the subject of the contest, sponsored by the Institution of Professional Engineers in New Zealand. Part of the prize for the winner was an all-expenses paid trip to the USA to attend the First Thru the Week at Kármán Auditorium on Aug. 12 from 10 to 1 p.m. RGB (48-inch) Oschin telescope.

The Quest camera is still under going commissioning trials," said Dr. STEVEN PAADO, project manager for the Near-Earth Asteroid Tracking Project at JPL. "But that doesn't mean we haven't seen some real science in the meantime. What we found was a near-Earth asteroid, estimated to be about 250 meters (820 feet) across. The detection of the near-earth object, 2003 NL7, occurred on the evening of July 9. It has been first by follow-up measurements from three other monitoring stations as sub- stently certified by the official clear- inghouse of the solar system's smaller inhabitants, the Minor Planet Center. While 2003 NL7 has been labeled a near-Earth asteroid, it is considered non-hazardous, with a 0.000027% risk of the Sun in which its closest ap- proach to Earth's orbit is about 25.1 million kilometers (15.6 million miles).

The Quest camera is being developed as a prototype instrument by Yale and indiana universities with DR. CHARLES BALTER, chairman of Yale's physics Department and Minor Planet Center investigator. It is designed for use in detecting and characterizing quasars, near-Earth asteroids, trans-Neptunian objects, supernovae, and a large variety of other astrophysical phenomena, by scientists from Yale, JPL and Caltech.
The complex camera consists of 112 electronic chips known as charged coupled devices (CCDs) arranged over the Oschin telescope's focal plane. This gives the camera a 1.5 by 2.2-meter field of view and a 0.27-arcsecond size of the Sun in which its closest approach to Earth's orbit is about 25.1 million kilometers (15.6 million miles).

CCD array

Philips and Melody Banks.

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Pathfinder had rather modest science objectives. MER is seeking to answer questions about past liquid water activity and past environments that may have been favorable for life. Landing site selection, science instruments calibration, and operations planning have all been done with the MER science objectives in mind.

**Once they land, the rovers have a three-month mission. How much of a set schedule will you have? or will it be day by day?**

First of all, we’ll be working on Martian days, called “sols,” which are equivalent to 24 hours and 39 and a half minutes on Earth. We have a fairly firm idea of what we want to do during the first six sols of the mission, which will include the rovers’ health checkout and stand up, setting the connection between the rover and lander, an assessment of the options for driving the rover off the lander, and the acquisition of color stereo and infrared science panoramas. But even during those first few sols, we will be ready to adapt to off-nominal situations that could arise.

Beyond that, each day we will respond to what the rovers have accomplished and to what science we’ve learned, and prepare a set of commands for the rovers’ next day’s activities. In our operations tests, we’re practicing the different kinds of typical rover activities that we can implement on Mars when the real science mission begins in January.

**Could the findings of one rover affect the plans for the other?**

Yes. This would most likely apply to the performance of an instrument. Insight or discoveries from science team members on one team might help the other team. One team might discover a technique for visualizing or interpreting the data that could benefit the other team, or a specific way to use an instrument that works well. The same thing could happen in the engineers’ assessment of rover performance, with lessons learned by one rover team benefitting the other.

**Based on what you know about the sites, Gusev and Meridiani, what could you find that would prove the conditions for life once existed?**

On the other hand, would a specific finding disappoint you, in terms of ruling out water or life conditions?

We would learn a lot about Mars geology. At Meridiani, if we’re not lucky, we could find out that an originally magnetite-rich lava flow was oxidized at high temperatures to form the hematite mineral signature, with no liquid water involved. An unlucky scenario for Gusev would be to find out that any lakebed sediments have been completely covered by wind-blown dust.

We're going to look for minerals and rock texture clues to try to confirm that. Meridiani contains gray hematite, which on Earth usually forms in association with liquid water. We will look there for other water-formed minerals, and things like water-related features such as ripple marks and layers, to confirm our suspicions.

If we can confirm the signatures for past water, we'll want to know how long the water was there, whether it was warm or cold, and if that environment was favorable for life. There are findings that could disappoint us with regard to past water activity on Mars, but we would still learn a lot about Mars geology. At Meridiani, if we’re not lucky, we could find out that an originally magnetite-rich lava flow was oxidized at high temperatures to form the hematite mineral signature, with no liquid water involved. An unlucky scenario for Gusev would be to find out that any lakebed sediments have been completely covered by wind-blown dust.

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It is anticipated that one of the two architectures will be selected in 2006 to implement the mission, which may include inter- national collaboration. NASA and JPL will issue calls for proposals seeking input on the development and demonstration of technologies to implement the two architectures, and on scientific research relevant to planet finding.

For more information on the Terrestrial Planet Finder, see http://planetquest.jpl.nasa.gov.