Galaxy M81 shines from 12 million light-years away. The image of this galaxy, observable with binoculars in the constellation Ursa Major, was created using data from the Spitzer and Hubble space telescopes and Galaxy Evolution Explorer. *(Image courtesy of Jet Propulsion Laboratory)*

LESLIE LIVESAY: EYES ON THE FUTURE

Leslie Livesay

BY SCOTT ROARK

ALTHOUGH MANY SUNS RISE on distant worlds in all corners of the universe, we have discovered no other life forms.

So far.

If other planets like ours do exist, people like **Leslie Livesay (MATH '85)** and her colleagues are going to find them.

Deputy director for astronomy and physics at the Jet Propulsion Laboratory in Pasadena, Livesay is spearheading the NASA Kepler mission, a space telescope designed to survey distant stars in a search of a planet similar to Earth.

To date, 273 planets orbiting a total of 234 stars have been discovered outside our solar system. All of these new worlds have proven to be nothing like Earth. Many are "gas giants" similar to Jupiter. Others are located extremely close or extremely far from their suns, leaving doubt whether life could survive due to temperature extremes. No trace of the telltale signs of potential life – the simultaneous presence of carbon dioxide, ozone or water – have been found. Current instruments lack the sensitivity needed to detect this chemical evidence.

Livesay hopes to change that. "Only a tiny fraction of our own galaxy has been searched for other planets and solar systems, and look what has been found so far," Livesay said. "We are focused on finding planets in the so-called 'Goldilocks Zone' around stars – not too close, not too far, leaving the temperature just right for potential life. Much like where Earth is now."

continued on next page…

The Kepler space telescope being prepared for launch in 2009.
(Image courtesy of Jet Propulsion Laboratory)

The longtime Southern California resident had her eye on the sky early on, beginning a professional ascent as a Cal Poly summer student working for Martin Marietta (now Lockheed Martin), where she was introduced to the manned space program. Livesay had been interested in math and science since high school. "When Voyager flew by Saturn in 1981, that did it," said Livesay. "I began to focus on robotic space exploration."

A career of discovery followed. On July 4, 1997, the first images of the arid, alien landscape began trickling in from the historic Mars Pathfinder mission. Livesay was one of the project engineers. "It was amazing to be a part of that Mars landing, the first in more than 20 years, and bringing a rover to another planet for the first time in history."

'WHEN VOYAGER FLEW BY SATURN IN 1981, THAT DID IT, I BEGAN TO FOCUS ON ROBOTIC SPACE EXPLORATION'

Still, she considers the Deep Space 1 mission her proudest accomplishment. Livesay and her team developed an entirely new navigation and ion propulsion system for the probe, which flew by the comet Borrelly in 2001. At that time, the fly-by resulted in the best images ever taken of a comet's nucleus.

Livesay also currently oversees other JPL spacecraft, such as the still-operating Voyager space probes, which inspired her as a young Cal Poly student nearly three decades ago. Both probes are now at the outer edges of our solar system, but still reliably transmitting data.

Another spacecraft under Livesay's direction is the infrared Spitzer Space Telescope, currently in orbit, studying stars, galaxies and disks around stars where planets form. Spitzer is observing processes that create planets and learning more about planets already found. Kepler will look for new planets.

In Kepler's case, direct observation is a challenge because of vast distances in space. Many stars, potential suns to other worlds, are thousands of light-years away. To put things in perspective, a light-year is the distance light can travel in a vacuum during one Julian calendar year, just under 5.9 trillion miles. That distance would only get you one-quarter of the way to Proxima Centauri, the nearest star other than our own sun.

If a planet orbited Proxima Centauri, which is 4.2 light-years away, it would be 7,000 times farther than the distance from Earth to Pluto. Trying to observe this planet would be like standing in Boston and looking for a moth near a spotlight in San Diego, according to Livesay. Many discovered planets outside our solar system range from 15 to more than a 1,000 light years away.

Because of the distance, Kepler will detect planets indirectly, using the "transit" method. A transit occurs each time a planet crosses the line-of-sight between the planet's parent star that it is orbiting and the observer. When this happens, the planet blocks some of the light from its star, resulting in a periodic dimming. Think of a grain of sand passing in front of a lighted flashlight.

This periodic signature is used to detect the planet, determine its size and figure out its orbit. Three transits of a star, or "passes" in front, all with a consistent brightness change and duration, provide a good method of planet detection. The measured orbit of the planet and the known properties of the parent star are used to determine if each planet has the possibility of supporting life.

Kepler is scheduled to launch in 2009 – one of only two missions from 26 proposals selected by NASA in 2001.

"If another potential Earth was found, it will be the discovery of many lifetimes. In addition, many new technologies emerge from these efforts" said Livesay. "Our eyes are on the future." □