University News

Detector Technology Could Help NASA Find Earth-like Exoplanets

RIT professor develops technology for NASA

BY <u>SUSAN GAWLOWICZ</u>, July 22, 2010 —
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The hunt is on for Earth-like planets outside of our solar system. Since the 1990s, astronomers have detected more than 450 extrasolar planets—mostly large Jupiter-sized bodies—around nearby stars. Advances in technology are fueling the quest to find smaller, rocky planets resembling Earth and, possibly, evidence of life.

Rochester Institute of Technology scientist Don Figer is developing detector technology funded by NASA's Technology Development for Exoplanet Missions Program and designed to directly image and characterize exoplanets. The two-year project will result in a detector array that can withstand the radiation in space, count individual photons or light pulses—thereby eliminating noise that could obscure the faint signal—and characterize exoplanets in one-third the time it takes using existing methods.

"If you can detect something much more quickly you can search many more systems," says Figer, director of the Rochester Imaging Detector Laboratory and professor in the College of Science at RIT. "A three-year mission becomes a one-year mission, or you can detect three times as many objects in the same fixed time. That's usually what astronomers like to do."

To accomplish this "super" detector, Figer and his colleagues at Massachusetts Institute of Technology Lincoln Laboratory are adapting technology they are currently developing for ground-based applications, such as the Thirty Meter Telescope. That project, funded by the Moore Foundation, supports the development of optical and infrared megapixel zero-read-noise detectors. Both initiatives build on detector technology originally invented at Lincoln Laboratory.

The primary work at RIT for the NASA Technology Development for Exoplanet Missions Program will focus on radiation testing. Figer's team is building the system to gauge the detector's performance in the high-energy radiation environment of space. Scientists at Lincoln Laboratory are fabricating the 256 by 256 pixel array. Each pixel will be 25 by 25 microns; each detector will span ¼ by ¼ inch.

"The goal in an exoplanet search depends on the question one wants to answer," Figer says. "If you want to characterize planetary systems around other stars then you probably need to detect the full mass spectrum of exoplanets. Right now, they're only discovering the big ones. If you think the real goal is to detect life, you might want to find smaller planets more like the size of the Earth."

Since the 1990s, large, gaseous exoplanets have been discovered using the Doppler shift method. Scientists using this approach measure the changing line-of-sight velocity of a nearby star and infer the planet's characteristics from the amplitude and frequency of those variations. In contrast, the coronagraphic technique images an exoplanet by blocking the starlight. Occultation, another method in exoplanet research, uses the planet itself to block light from the star, extracting information from the attenuation of light during the eclipse.

"One of the potentially most dramatic applications of zero-read noise technology might be in the occultation application because you're required to make quick measurements at very fine time intervals," Figer says. "But when you make quick measurements with detectors the noise is higher. For a detector that doesn't have read noise but detects individual photons, the noise would be zero regardless of how fast it is reading out."

"I think, if it's successful, it will pervade many applications in many fields," Figer adds. "In particular, for space astrophysics it would become a new standard."

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Notes: Rochester Institute of Technology is internationally recognized for academic leadership in computing, engineering, imaging technology, and fine and applied arts, in addition to unparalleled support services for students with hearing loss. Nearly 17,000 full- and part-time students are enrolled in more than 200 career-oriented and professional programs at RIT, and its cooperative education program is one of the oldest and largest in the nation.

For two decades, *U.S. News & World Report* has ranked RIT among the nation's leading comprehensive universities. RIT is featured in The Princeton Review's 2010 edition of *The Best 371 Colleges* and in *Barron's Best Buys in Education. The Chronicle of Higher Education* recognizes RIT as a "Great College to Work For."

Donald Figer was recruited by Rochester Institute of Technology's Chester F. Carlson Center for Imaging Science through a faculty development program grant awarded by the New York State Foundation for Science, Technology and Innovation. The grant provides interim state assistance to help attract distinguished faculty throughout the world to New York's academic research centers, and to retain leading researchers already in New York Institutions of Higher Education.