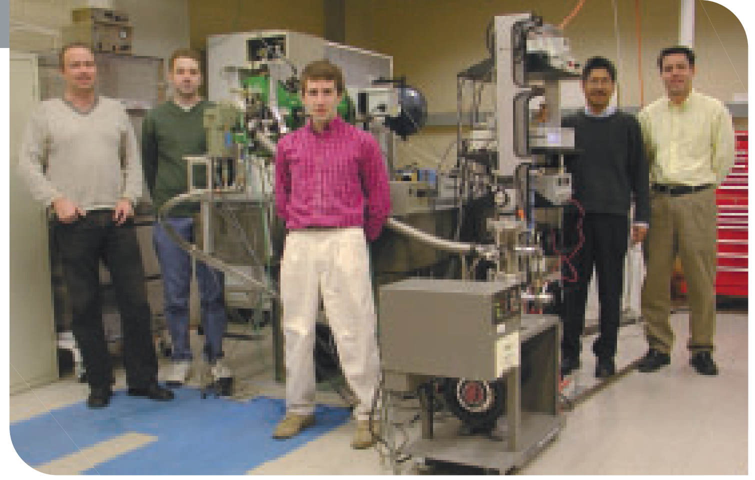

*IDTL personnel and detector characterization system. From left to right: Bernard Rauscher (project scientist), Ernie Morse (data analyst), Eddie Bergeron (data analyst), Sito Balleza (systems engineer), and Don Figer (PI). Not pictured: Mike Regan (software systems scientist) and Gretchen Green (detector head engineer).*

science essays

# Independent **Detector Testing** Laboratory

*— Don Figer*

Detectors are at the heart of scientific discovery, whether as 'simple' as the human eye or as complex as the sensors on the Hubble Space Telescope. In recognition of their importance to astronomy, the Institute and Johns Hopkins University (JHU) created the Independent Detector Testing Laboratory (IDTL), located on the JHU campus in the Department of Physics and Astronomy's Bloomberg building.

The vision of the IDTL is to provide world-class testing and development facilities for astronomical detectors and associated technology. While not an easy vision to fulfill, its success will bring several benefits. First, the IDTL enables the James Webb Space Telescope (JWST) Project Office, instrument teams, and wider community to select the best flight detector designs for JWST by evaluating prototype near-infrared detectors. Second, the IDTL serves the astronomical community by publishing all designs, software, procedures, raw data, analyses, and publications on its website, as well as in appropriate journals. Third, the IDTL provides the hardware, infrastructure, and local expertise that enable Institute and JHU scientists to participate in forefront space-based and ground-based astronomy missions. Lastly, the IDTL trains JHU and Institute staff, graduate students, and interns in the design and use of cutting-edge detector applications, and this training will ultimately benefit the development and operation of the JWST and future missions.

NASA has selected the IDTL to verify comparative performance of prototype near-infrared JWST detectors developed by Rockwell Scientific (HgCdTe) and Raytheon (InSb). The IDTL will obtain an independent assessment of the ability of the two competing technologies to achieve the demanding specifications of the JWST program within the 0.6 to 5 µm bandpass in an ultra-low background environment. In this project, we are measuring first-order detector parameters—dark current, read noise, quantum efficiency (QE), persistence, intrapixel sensitivity, and linearity—as functions of temperature, well size, and operational mode.

We have tested a half dozen prototype JWST detectors during 21 cool-downs of our system. During these runs, we have established that the IDTL system is 'darker' than the most stringent requirements for JWST, verifying ultra-low background levels of < 0.005 $e^{-}$ $sec^{-1}$ $pixel^{-1}$. This achievement demonstrates extraordinary baffling, given that at room temperature the instrument walls emit over $10^{20}$ photons $sec^{-1}$ in the instrument bandpass! In addition, we have verified low-noise electronics performance, allowing us to measure detector noise levels below the JWST requirements. Our QE measurements show that candidate detector materials can offer significant response from blue wavelengths (0.4 µm) to the desired long-wavelength cutoff near 5 µm. Finally, we have found that the detector material can trap persistent charge, which leaks out in subsequent images, appearing as a ghost image of previously observed targets. Certain detector reset schemes do appear to ameliorate the effects of persistent charge.

In the future, we look forward to enabling detector technology for other missions, on the ground and in space, like the Large Synoptic Survey Telescope (LSST) and the Supernova Acceleration Probe (SNAP). LSST is a proposed ground-based, 8-meter class, wide-field, synoptic survey telescope. The combined collecting power and field of view will be much greater than any existing telescope. Astronomers will use LSST to survey large regions of the sky to unprecedented depth to probe the nature of dark energy and to detect near-Earth objects. The IDTL is part of a proposal to develop the billion-pixel focal plane for LSST.

SNAP is a proposed space-based, two-meter telescope with a mission to determine the expansion properties and dark energy characteristics in the universe. The IDTL is currently working with the SNAP team to develop the best near-infrared detectors for use in this ambitious mission. ¤