

NASA/Bill Ingalls

Greg Olsen, space flight participant, signals with two thumbs up following the successful landing of the Soyuz TMA-6 in Kazakhstan on Oct. 11.



## Olsen Visits the Space Station—Without His Camera

Civilian astronaut Gregory Olsen has finally realized his childhood dream of flying into space. Because of U.S. export regulations, however, he couldn't bring along the handheld near-infrared camera that he had hoped to use in flight.

In early October, Olsen, an OSA member and chief executive officer of the Princeton, N.J.-based Sensors Unlimited Inc., and two crewmates launched into Earth orbit from Baikonur, Kazakhstan, aboard a Russian *Soyuz* capsule. He spent eight days aboard the International Space Station (ISS) and returned to Earth with the two-man crew that had flown on the station for the past six months. A private company, Space Adventures Ltd., arranged Olsen's trip for a \$20 million fee.

In May 2005, he began intensive training for the mission at the Yuri Gagarin Cosmonaut Training Center, which Olsen described as "a combination of a

college campus and a military base."

Olsen had initially planned to grow semiconductor crystals in microgravity and perform spectroscopy on reflected Earthlight while aboard the ISS. Unfortunately, however, he was not able to perform that work, although he conducted some life-science experiments. The indium gallium antimonide (InGaSb) crystal growth work was canceled because the necessary equipment aboard the ISS wasn't working.

As for the spectrographic work, the U.S. State Department did not permit

Olsen to send the handheld infrared camera that he needed for his studies to the Russian space contractor, Energia, for pre-flight qualification. (Because handheld infrared cameras have important military applications, they fall under the jurisdiction of the State Department's Defense Trade Controls [DTC] program.)

"That's putting that technology under a microscope in a country where it normally wouldn't be exported to," said astronomer Michael Skrutskie, who worked with Olsen to plan his proposed experiments.

Olsen had planned to observe the Earth with a miniature spectrograph designed to be attached to his Sensors Unlimited camera by Skrutskie and his colleagues at the University of Virginia, where Olsen earned his Ph.D. in materials science. The experiment would have helped scientists to characterize what the spectra of other Earth-type planets would look like—key data for NASA's future Terrestrial Planet Finder missions (OPN, February 2005, p. 24).

Olsen had asked Skrutskie last year whether he could perform any useful astronomical observations while up on the ISS. The station is not a stable enough platform for astronomical imaging, but Skrutskie realized that it would be suitable for capturing near-infrared spectra of the Earth's atmosphere as seen from off the planet. From off-the-shelf components, he and his students built a small spectrograph that was designed to work with Olsen's handheld camera.

Olsen's congressman, Rush Holt (D-N.J.), a physicist by profession, helped the team to apply to DTC for an export license, but the last air flight out to Baikonur—two weeks before the launch—passed by without a chance to get the camera to Olsen.

"We just took our best shot, hoping that we could get really quick attention if we had a congressman pushing it, and we didn't get there in time," Skrutskie said.

Nevertheless, upon landing at Baikonur, Olsen told reporters: "I feel great."

—Patricia Daukantas



Astronomers built three handheld spectrographs; one flew on the ISS, without the handheld near-infrared camera to record data.

# Checking Chickens for That Wholesome Color

Visual inspection of slaughtered chickens for diseases and improper bleeding is a key step in providing a safe meat supply. The color of the poultry flesh provides clues to the wholesomeness of the meat. For example, septicemia-toxemia often causes chicken flesh to appear dark red or bluish, rather than a healthy pink. A team of U.S. Department of Agriculture scientists are developing a color-observation tool to help food safety inspectors pinpoint birds that are unfit for human consumption.

Yud-Ren Chen and his colleagues at the USDA's Instrumentation and Sensing Laboratory in Beltsville, Md., described a prototype set of low-cost color-mixing binoculars and color charts (Appl. Opt. 44, 5454).

The tool is based on the color differences of the flesh of safe-to-eat (or "wholesome") chicken carcasses and the flesh of chickens that had septicemia-toxemia or other diseases. Three derivatives of a pigment called myoglobin are present in varying amounts in healthy and

diseased chicken flesh, and spectroscopy in several 10-nm bands between 431 nm and 591 nm reveals these pigments.

The researchers took reflectance spectra from a set of carcasses—some healthy, some not—that came from a poultry slaughterhouse in Maryland. They used the spectra to produce color charts that could be placed just behind a moving row of chicken carcasses within an inspector's field of view.

The inspector could look at the chickens through a pair of  $8 \times 42$  binoculars equipped with two narrowband filters and a light source and compare the flesh colors to the standard colors of wholesome and diseased flesh. In the 454- and 578-nm bands, wholesome flesh appears pale lavender, while tumors stand out as a dark gray-green.

According to Chen and his team, the color-mixing binoculars could be used in poultry processing plants that are too small for the complex spectral-imaging systems used in large meatpacking facilities.



## Did You Know?

Educators teaching the science of light may wish to enliven their lessons with some catchy tunes. The site [Physicssongs.org](http://Physicssongs.org), hosted by Haverford College in Haverford, Pa., offers lyrics and audio and video clips of musical numbers on optics and electromagnetic waves. The site includes some re-imagined holiday carols, such as "Rudolph the Bright Red Photon":

*Rudolph the bright red photon  
Had momentum  $h\text{-bar } k$ ,  
But if you ever saw him,  
He'd collapse his state they say.  
Michelson interference  
Used to make him scratch  
his head—  
"Should I take this or  
that path—  
Maybe I'll take both instead!"*

Try the Snell's law ditty set to the "Macarena" dance tune, hear "new" songs by satirist Tom Lehrer, or follow links to the sites of other science-themed performers, such as Lynda Williams, the "Physics Chanteuse," or the Chromatics, a vocal group that got its start at NASA's Goddard Space Flight Center, and offers educational astronomy songs ("Doppler Shifting").

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