it is possible to use that data to as been scattered. Using computers, unperturbed and what muons had sees what muons made it through the muons pass through the object, another, and an object in between. consider two detectors, on above and can penetrate through materi raining down onto the surface of the Earth, as atoms and are in the lepton family, which in electron. They fall to Earth as by uranium and plutonium. He hopes to use muon scanning to search for hidden threats to near-equatorial region. He hopes to discover the cliffs at many different latitudes, making a global scanning the likely explanation. Mars Exploration Rovers The Mars rover Opportunity continues to drive toward Endeavour Crater. Mars Odyssey The Mars Odyssey spacecraft put itself into safe mode on July 14. Opportunity: the problem stemmed from an electronic encoder that controls the motion of the spacecraft’s solar panel. Odyssey switched to a backup encoder and went into safe mode. Science activities resumed with the Opportunity rover was out of contact with ground controls while Odyssey was in safe mode. MESSENGER has made observations of Mercury's thin atmosphere, which is composed of materials like sodium, potassium, magnesium, and calcium. These elements are liberated from the surface of Mercury by the intense solar radiation. Sodium is released through a process called photodissociation (PD). MESSENGER will enter Mercury orbit on March 18, 2011. Spitzer Space Telescope The Spitzer Space Telescope is now on a campaign to observe 700 near-Earth objects. It has already observed 150 and has surprising results. The near-Earth object population is very diverse, and may be continually changing. Space Shuttle and International Space Station Space Shuttle Discovery is due to test out all of the Orbiter Processing Facility and into the Vehicle Assembly Building on September 9. It will then be moved to the already-esteemed External Tank and Solid Rocket Boosters. The International Space Station is preparing for the arrival of a Progress automated unmanned supply vehicle that will dock to the aft port of Zvezda on September 12. The last resupply ship undocked on August 31. The station residents have also been photographing hurricanes from orbit. Flight Engineer Calidwell Dyson observed a balking final link aboard the European Laboratory module Columbus. She collaborated with Columbus Control Facility in Munich, Germany to repair the link. The station crew members Al- exander Skvortsov, and Flight Engineers-Michael Fakir and Tracy Caldwell Dyson are preparing to dock to the Progress automated resupply on September 12. They will undock Salyut-TM 18 on September 18. New crew members, Flight Engineer Scott Kelly, Alexander Kaleri, and Olga Serebrova will launch aboard an improved Soyuz vehicle, Soyuz TMA-6. They will then send Flight Engineer Christopher Tew to a tomography workshop to discuss new technologies and approaches. Dr. Hohlmann would also like to bring others working on similar projects here to Florida Tech for a tomography workshop. He says there are teams at Los Alamos and in Canada working to solve the same problem with different technologies and approaches. Dr. Hohlmann is also work- ing on the Compact Muon Solenoid on the Large Hadron collider at CERN. The next Campus Research Report will have more on that topic.

Christopher Tew

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Dr. Hohlmann of the Physics and Space Science Department is using technology developed at the European Organization for Nuclear Research (CERN) for upgrades of the Large Hadron Collider for practical purposes. He hopes to use mass scanning to detect dangerous substances like uranium and plutonium. Muons are negatively charged subatomic particles that are in the lepton family, which includes electrons, but they are about 200 times as massive as an electron. They fall to Earth by protons of cosmic ray interactions with the Earth’s atmosphere, where they can be detected using a variety of methods. The process Dr. Hohlmann is using, muon tomography, is not a new process. A process of using muons to scan through materials is a fairly simple pro- cess. Since muons are always running down the surface of the Earth, they have very high energy, and can penetrate through material, they are ideal candidates for tomography. For an example array, consider two detectors, on above and on below. They may be used to detect a bomb. One detector is on the top and the second detector is underground. As the muons pass through the object, they may be disturbed by the atoms of the material. The lower detector sees what muons made it through unaltered and what muons had been blocked. It is possible to use that data to as- semble a model of what was inside the device. Muon tomography has been used in practical applications before. In the 1960s, Dr. Luis Walter Alvarez, a Nobel laureate of the University of California, used many mass scanners to scan for an Egyptian pyramid for Raiders of the Lost Ark. He found none in the part he surveyed. A team at the National Autonomous University of Mexico has discovered the Mayan pyramid. Geologists have used masses to scan volcanoes for activity. The Los Alamos National Laboratory used muons for the same purpose Dr. Hohlmann uses them: detecting hidden uranium and plutonium. The key difference between Dr. Hohlmann’s and all everyone else’s is the detector technology. The others used old, bulky equip- ment that makes deployment of this technology to places like air- ports (to scan carry-on luggage) (to scan incoming cargo contain- ers) difficult. Dr. Hohlmann uses a brand new technology called a Gas Electron Multiplier, or GEM. GEMs use a special copper-plated foil that has tiny holes, about 70 microns wide, etched into it chemi- cally. A voltage is applied across the foil that creates powerful elec- trical fields inside the holes, which are also filled with gasses like argon and carbon dioxide. When a muon passes through the detector, it ionizes some of the gas atoms. The low voltage, accelerated by the electric field, goes on to ionize other atoms and ionize a kind of avalanche. Once the “avalanche” reaches a threshold intensity, a chain reaction starts that can result in more ionization, or in other words, it can increase the count rate. Dr. Hohlmann’s GEM detectors were assembled by his team at CERN in Switzerland, but the detectors only work here at Florida Tech in the future. Dr. Hohlmann’s current prototype array is about 30 cm by 30 cm. This prototype was already able to tell the difference in shape and density between an iron cube and a cylinder of tantalum (a similar metal). Dr. Hohlmann says his next step is to construct a “cube. From here, it will enclose a volume of one cubic foot with detectors on four sides. This will increase the abilities of the detector, making it easier to see its targets of uranium and plutonium. The next step after that is the construction of a “cubic meter station,” which will be large enough to put packages and lug- gage through. Dr. Hohlmann’s prototype array: Above, Dr. Hohlmann’s first array (30 cm by 30 cm) tomography that sits inside the Station Control Center (courtesy of Dr. Hohlmann). Above left, Dr. Hohlmann’s second array (30 cm by 30 cm) tomography that sits inside the Station Control Center (courtesy of Dr. Hohlmann). Above right, Benson hold a GEM detector in front of the soon-to-be-cubed foot detector. (Image courtesy of Christopher Tew).