National Science Council

ISSN: 1607-3509

Science Bulletin

July 2004/Vol. 36, No. 7

Taiwan's "Eye-in-the-Sky" Reaches Orbit

ROCSAT-2 Begins Environmental Monitoring Mission

As the countdown reached zero from the crowd in the US and Taiwan, the Taurus XL rocket carrying the ROC's first owned and self-controlled high resolution remote sensing satellite – the ROCSAT-2 – blasted off from Vandenberg Air Force Base in California on the morning of May 20 (1:47 AM, May 21 Taipei time). Approximately 15 minutes after launch, the ROCSAT-2 separated from the rocket and entered a parking orbit of 723 kilometers.

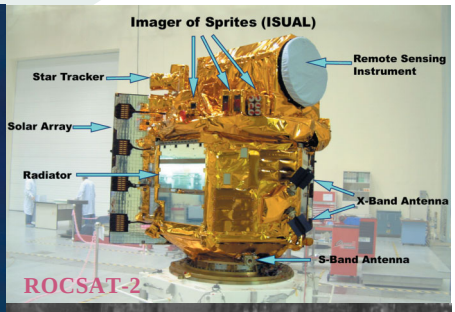
One hour and 14 minutes after liftoff (3:01 AM Taipei time), the ROCSAT-2 satellite made contact with the Swedish Space Corporation's ground station at Kiruna in northern Sweden. According to Dr. Lee Lou-chuang, President of the National Applied Research Laboratories (NARL) and Director of the National Space Program Office (NSPO), the trace of the rocket was tracked by radar at the US McMurdo Station in Antarctica at 2:18 AM (Taipei time). The Kiruna ground station received signals from the satellite at 3:02 AM and confirmed that the solar panels had deployed and communications were normal. US Orbital Sciences Corp. (OSC) handed over control of the satellite to the mission operation center at NSPO after the completion of launch mission.

At 8:25 AM on May 21, accompanied by NSC Minister Dr. Wu Mawkuen and Dr. Lee Lou-chuang of the NARL, President Chen Shui-bian held a ceremony to commemorate the first communication between the ROCSAT-2 and Taiwan via a video link between the Office of the President and the NSPO Mission Operation Center in Hsinchu. After the ceremony, President Chen gave a speech noting that the successful launch of the ROCSAT-2 was the greatest gift from the administration to the people of Taiwan. Apart from expressing gratitude to the satellite team for four years of tireless effort, Chen also called on everyone to continue working hard with professionalism and teamwork, so that the country can soon achieve self-reliant space technology.

At the same time the Taiwan ground station established contact with the ROCSAT-2, the operation team completed satellite health checks, performed calibration in accordance with telemetry data transmitted from the satellite, activated navigation instruments, and performed further testing for orbital transfer. On June 2, the ROCSAT-2 reached the mission orbit of 891 kilometers. After completing system operational checks, the first image was obtained on June 5 through the NSPO-developed Image Process System (IPS). This marked the start of ROCSAT-2's five-year earth observation mission.

The ROCSAT-2 is a 764-kg high-resolution remote sensing satellite carrying two payload instruments: a remote sensing camera and a science experiment instrument. The remote sensing camera is equipped with panchromatic and multi-spectral remote sensing instruments. The satellite will take photographs of the land and sea areas near Taiwan when it passes the island once every morning and evening. These images will be used to monitor and evaluate the environment and resources in Taiwan, adjacent offshore islands, the Taiwan Straits, and neighboring waters. The photographs yield high-quality images with a two-meter resolution for black-and-white images and eight meters for color images. The satellite will focus on photographing Taiwan during the eight-minute flyby at 10:00 AM each morning, and can download the data when it again passes at 10:00 PM each night. By using the maneuvering capability of the satellite, both planar and three-


Taurus XL rocket



ROCSAT-2


Chiang Kai Shek Memorial Hall

dimensional photographs of Taiwan and the surrounding waters can be obtained.

The scientific payload instrument carried by the ROCSAT-2 will perform observations of upper atmospheric transient luminous events. This experiment seeks to study the phenomenon of upward electrical discharges from charge-carrying masses of clouds, and will observe locations, times, and characteristics of discharges. The main goals of this research are (1) to collect statistics on the regional and seasonal distribution of red sprites, (2) to investigate the physical phenomena of red sprites and giant jets, and (3) to survey the global distribution of airglow and aurora. Continuous ground observations of red sprites and other forms of upward lighting are extremely difficult to accomplish due to the transient and dim nature of the phenomenon. The ROCSAT-2 will be the first satellite in the world to make continuous observations of these natural phenomena. Because it will not be altered by atmospheric absorption, the spectral data obtained by the satellite will be far superior to ground data, and is expected to give a major boost to scientific research in this field.

Promoting domestic development of satellite components is one of the main missions of the NSPO. For the ROCSAT-2 program, six domestic companies had been responsible for the development and manufacture of seven satellite components. All of these components have passed acceptance and certification reviews by ROCSAT-2's contractor, Astrium. In addition, the spacecraft's bus structure that was designed, analyzed, and tested by the NSPO was manufactured by private domestic companies.

The successful launch of ROCSAT-2 signifies that Taiwan now owns a self-controlled high-resolution remote sensing satellite. It also signifies that Taiwan has achieved another milestone in space technology development and strengthened the nation's confidence in accomplishing the ROCSAT-3 mission.

A Successful Strike for Sci-Tech Diplomacy

NARL Creates a Platform of International Collaboration for Advanced Research in Taiwan

Established in June 2003, the National Applied Research Laboratories (NARL) has been endeavoring to draw up collaborative projects with prominent research institutes and universities across the globe. NARL has also been working with the NSC's overseas Science and Technology Divisions to propel its affiliated national laboratories to world-class standings through collaborative research and international cooperation. The exchange of science and technology between Taiwan and other countries has not only created an international platform for the flow of advanced technologies, industries, and higher education, but has also accelerated the internationalization of Taiwan.

Taiwanese delegation with Japanese representatives after signing MOU, in front of the National Institute of Materials Science (NIMS).

Dr. Lee Lou-chuang, Academician and President of NARL, led a delegation from the National Nano Device Laboratories (NDL) from May 26 through June 1, 2004 to visit several well-known research institutions in Japan. The highlight of the trip came on May 31, when Dr. Lee and Vice President Dr. Mutsukazu Kamo of Japan's National Institute of Materials Science (NIMS) signed a Memorandum of Understanding for cooperation between the NDL and NIMS's BioMaterials Center. Both parties will draft specific plans for cooperative research in the fields of biochips and nanomaterials.

Also, thanks to careful itinerary planning by Director Yeh Ching-fa and staff members of the Science and Technology Division in Japan, the NARL delegation was able to visit several other institutions on this trip, including the Earth Simulator Center

(ESC), VLSI Design Center of Tokyo University (VDEC), Information Technology Center of Tokyo University (ITC), Institute of Physical and Chemical Research (RIKEN), and the Advanced Semiconductor Research Center (ASRC) of the National Institute of Advanced Industrial Science and Technology (AIST). During exchanges with these institutions, Dr. Lee introduced the visions and future objectives of NARL and its six affiliated national laboratories and impressed Japanese researchers and scientists with NARL's outstanding achievements, including the successful launch of the ROCSAT-2 space satellite and NDL's cultivation of large numbers of high-quality specialists, who have formed an important driving force behind Taiwan's semiconductor industry.

Representative Lo Fu-chen of the Taipei Economic and Cultural Representative Office (TECRO) in Japan and Minister Wu Maw-kuen of the NSC both expressed their appreciation and commendations for the excellent examples set by NARL and NDL in fulfilling government policies on diplomatic sci-tech exchange. Representative Lo and Minister Wu have also expressed gratitude to Dr. Lee and NDL Director Dr. Simon M. Sze for their contributions to sci-tech diplomacy.

New Findings Concerning ENU Mutant Mice

Use of Tandem Mass Spectrometry to Screen ENU Mutant Mice and Establish a Mouse Model of Human Disease Resembling MSUD

The post-genomic era has be gun with the completion of the human and the mouse genome map. To create animal models of human diseases, Academia Sinica has established an ENU (*N*-ethyl-*N*–nitrosourea) core facility (Mouse Mutagenesis Program Core Facility – MMP) specializing in the use of the genotoxin ENU to systematically induce mutations in mice on a large scale. The ENU mutant mice created were screened for more than a hundred phenotypes and clinical symptoms; when the genetic inheritance of the identified phenotypes/clinical symptoms were confirmed, the selected mice would possess the known and determined phenotypes. Thanks to the ease of mice breeding, as well as the close similarity between the mouse and human genomes, researchers could easily find disease-causing genes in the mutant mice and analyze the pathogenic mechanisms, and apply the knowledge gained in mouse models to human disease research. Dr. John Kung of the Academia Sinica Institute of Molecular Biology is in charge of the MMP.

Dr. Chen Yuan-tsong, director of the Academia Sinica Institute of Biomedical Sciences, is a specialist in clinical and biochemical genetics, who has used tandem mass spectrometry to study human genetic metaboloic diseases at Duke University. Drawing on his experience, Dr. Chen obtained support from the NSC and Academia Sinica for his proposal to employ a tandem mass spectrometeric approach to screen metabolites of ENU mutant mice with abnormal levels of amino acid, organic acid, and fatty acid. Apart from the Academia Sinica's MMP and National Genotyping Center, Dr. Tsai Fuu-jen's lab in China Medical University, Dr. Niu Dau-ming of Taipei Veterans General Hospital, and Dr. David Millington's lab in Duke University have also participated in Dr. Chen's work.

According to Dr. Wu Jer-yuarn, Director of the National Genotyping Center, their research team has succeeded in finding mutant mice with abnormal branched-chain amino acid metabolism after several months of work. The blood of these mice was found to contain more than 20 times the normal values of branched-chain amino acids (including valine, leucine, and isoleucine). Mice of this type typically display failure to grow, slow reactions, spasms, dull fur and a tendency to lose hair, and premature death (within four to eight weeks). In view of these symptoms, the researchers have suggested that the mice may serve as a model for maple syrup urine disease (MSUD).

Human MSUD, which usually occurs in newborns, is characterized by the flavor of maple syrup in urine. The blood of patients with MSUD contains elevated plasma branched-chain amino acids, and patients usually present with vomiting, lethargy, seizures, comas, mental retardation, hypertonia, cerebral edema, ketoacidemia, and even death in severe cases. This disease has been reported in all ethnic groups, and several newborn cases are diagnosed every year in Taiwan. The incidence of the disease is approximately 1/100,000, and most cases in Taiwan are among aboriginal children. Previous studies had indicated that the disease is generally caused by a defect in the genes encoding for branched-chain keto acid dehydrogenase. Treatment consists of a restricted diet of MSUD formulation powdered milk. There was no animal model of MSUD prior to Dr. Chen's work.

Dr. Chen and his research team confirmed the mouse model and found the disease-causing gene – branched-chain amino transferase – in less than a half-year. The establishment of a mouse model will facilitate (1) research on the pathogenic mechanisms behind MSUD, (2) research on the course of MSUD, (3) research on the nutrition of MSUD patients, and (4) research on the toxicity of branched-chain amino acids. The team's findings were published in the February

2004 issue of *Journal of Clinical Investigation*, and this prestigious journal also invited Vanderbilt University biochemical geneticist Dr. Arnold W. Strauss to write a special report on the research. "This new approach of pairing ENU mutant mice with tandem mass spectrometry is well-suited for widespread use in research on the genetic functions causing developmental and metabolic abnormalities," said Dr. Strauss concerning the project's significance.

Uncovering the Health Preserving Principles of Tea

Researchers Show Tea Polyphenols Protect Against Obesity and Cancer

The Chinese have enjoyed drinking tea for several millennia. But while the classics of Chinese medicine list at least 16 medicinal benefits of tea, until recently these still lacked scientific verification. Now Prof. Lin Jen-kun, Institute of Biochemistry and Molecular Biology, College of Medicine, National Taiwan University, has made groundbreaking discoveries in his scientific research on the health preserving properties of tea. Prof. Lin is an internationally prominent specialist on cancer prevention factors, and has made outstanding contributions to biochemical research on cancer prevention and the healthy effects of tea. Prof. Lin's molecular biology research team has found that "tea's health effects come about because of tea polyphenols, which can inhibit the expression of fatty acid synthase (FAS) and thereby protect against obesity and the emergence of cancers." This is to say that tea polyphenols possess weight loss and anti-cancer functions. The newest findings by Prof. Lin's team suggest that tea polyphenols (also known as "catechins," a collective name for various phenolic substances and their derivatives.) and other vegetable polyphenols can inhibit proteasome activity, induce the apoptosis and death of cancer cells, and inhibit the spread and metastasis of cancer.

Proteasomes are composite bodies containing a variety of enzymes. Their function includes regulating certain proteins responsible for controlling the cell cycle and apoptosis. Proteasomes are currently a hot topic of research, and some pharmaceutical companies are focusing their attention on proteasome inhibitors in hopes of developing anti-cancer drugs. Ubiquitin plays an important role in the functioning of proteasomes, and the ubiquitin-proteasome pathway regulates many different kinds of cellular activities. Defects in this pathway may induce cancer and disorders of the nervous system and immune system. The discovery that vegetable polyphenols and tea polyphenols can inhibit proteasome activity is therefore of extremely great significance.

Prof. Lin Jen-kun published an article on the biochemical mechanisms of tea and tea polyphenols in the *Pharmacogenomics Journal* in 2003, and has also published two articles on this subject in the authoritative American periodical *Journal of Biological Chemistry* in 2004. According to Prof. Lin, the main topic of his recent articles is his proof that tea and tea polyphenols can inhibit fatty acid synthase (FAS) in cells. Increased expression of FAS tends to cause increases in the amount of triglycerides, esterified cholesterol, and other lipids in cells. In addition, the articles also described how tea polyphenols can inhibit proteasome activity in cancer cells, increase levels of P27, P21, and Bax proteins in cells, and push cancer cells down the path to apoptosis.

Related research has discovered that the amount of FAS in most proliferating cancer cells, fatty adipose tissue, and liver cells is over three times that in normal human cells. In other words, the expression of FAS is exceptionally high in fatty tissue and cancerous tissue. This suggests that the inhibition of FAS expression and proteasome activity can help inhibit cellular proliferation, reduce lipid production, and lower levels of substances causing congestion of the cardiovascular system, including cholesterol and triglycerides. Prof. Lin and his research team have gradually uncovered these benefits of tea and tea polyphenols over the course of more than a decade of research.

According to Prof. Lin, tea's health benefits include anti-oxidant, anti-aging, anti-mutation, anti-carcinogenesis, cancer prevention, anti-inflammation, anti-allergy, lipid reduction, anti-obesity, and blood pressure reduction functions.

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http://nr.stic.gov.tw/ejournal/SciNews/scibulletin.htm
Subscription price for each copy: US$1.00
Payment must be made in US dollars by a check payable to National Science Council.

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戶　名：行政院國家科學委員會科學技術資料中心。

ISSN 1607-3509
GPN: 2005800003