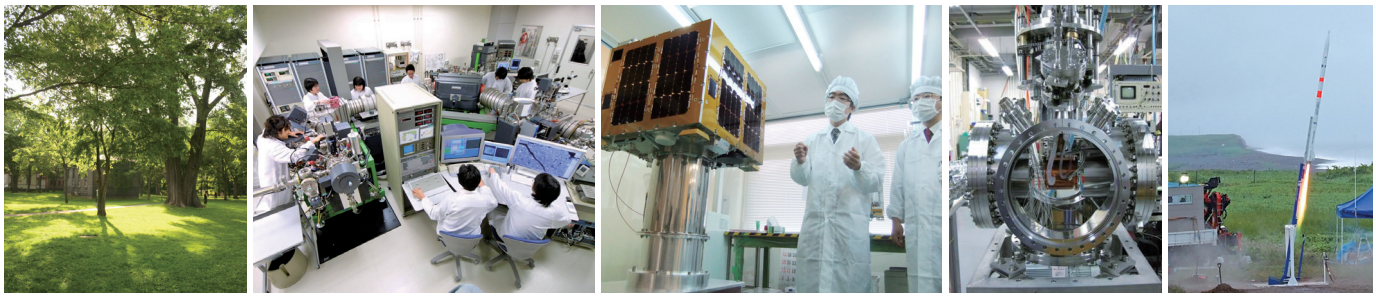

HOKKAIDO UNIVERSITY SUPPORT OFFICE FOR SPACE SCIENCE AND ENGINEERING

Elucidating the mysteries of space

Since its establishment in 2008 by 100 scientists from Hokkaido University, the Support Office for Space Science and Engineering (SOSSE) has been supporting the university's space research and coordinating new cross-disciplinary research. Through these activities, researchers from Hokkaido University have developed scientific instruments that are now used aboard an unmanned spacecraft orbiting Venus, discovered how certain compounds form in space, and even constructed a novel hybrid rocket.

Exploring Venus

Launched in 2010, the Japanese unmanned spacecraft known as Akatsuki or the Venus Climate Orbiter (VCO) contains onboard scientific instruments that were developed by two researchers from the Hokkaido University's Department of Cosmosciences, Shigeto Watanabe and Yukihiro Takahashi. The VCO will circle the Venusian equator in an elliptical orbit for at least two years, monitoring the atmosphere at different altitudes. The data obtained will allow researchers to reconstruct a three-dimensional model of the Venusian atmosphere's structure and dynamics, which will hopefully shed some light on the mysteries in which Earth's sister planet is shrouded.

One of the instruments, the Lightning and Airglow Camera (LAC) developed by Takahashi, will measure lightning flashes and airglow emissions on the nightside disk of Venus. It is hoped that the information gained from the lightning observations will answer once and for all how lightning can occur in Venus's hot, dry atmosphere without ice crystals, which on Earth drive the generation of static electricity responsible for lightning.

Another high-tech camera, the Ultraviolet Imager (UVI) developed by Watanabe, will be used to study the distribution of atmosphere gases at the tops of clouds surrounding Venus by measuring ultraviolet radiation. The data are anticipated to provide valuable insights into the energy balance and dynamics of the Venusian atmosphere.

Watanabe and Takahashi's ambitions do not stop there, however. In 2013, a microsatellite named RISING-2 developed by their group with the support of engineers from Hokkaido University and Tohoku University will be launched to observe the atmosphere of Earth and other planets.

Analysis of space matter

The Institute of Low Temperature Science (ILTS) at Hokkaido University consists of a team of researchers from a wide range of backgrounds, including physics, chemistry, geoscience and biology. These researchers collaborate on various unique research themes within the ILTS and also often conduct research in cooperation with institutions in other countries, including Catania University in Italy and Seoul University in Korea.

One of the ILTS's best-known achievements in the field of astronomy is its work on the formation mechanism of formaldehyde, methanol, water and hydrogen molecules in interstellar molecular clouds. Naoki Watanabe and Akira Kouchi, researchers in the Ice and Planetary Science Group of the ILTS, discovered the formation mechanism of these molecules and showed that surface reactions between methanol and heavy hydrogen atoms speed up the formation of deuterated methanol. Based on this finding, their group has proposed a novel heavy-hydrogen fractionation process that has been announced in several international journals.

In research that provides insight into the way stars work, Hisayoshi Yurimoto, a researcher in the Isotope Imaging Laboratory, has developed an isotope microscope that analyses presolar grains, isotopically distinct clusters of material, found in meteorites. His successful analysis of a meteorite sample brought back by the Japanese space probe Hayabusa from the 25143 Itokawa asteroid will shed light on the nucleosynthesis processes that drive the stellar machine.

Hokkaido University's hybrid rocket

In collaboration with scientists at one of Japan's core institutes for space science research, the Institute of Space and Astronautical Science (ISAS), Harunori Nagata has led a team of researchers in Hokkaido University's Division of Mechanical and Space Engineering in the development of a hybrid rocket known as CAMUI, or the Cascaded Multistate Impinging Jet, which dramatically reduces manufacturing and operation costs.

JAXA/ISAS

First observations of Venus using the Ultraviolet Imager (UVI) in 2010

Costs have been kept low by replacing the expensive explosives normally used as a propellant with a combination of liquid and solid materials. A novel combustion method has been devised to overcome the crucial problem of the slow combustion of solid fuel that normally occurs with hybrid rockets — the main reason why hybrid rockets have been overlooked in the past.

Non-explosive, non-hazardous liquid oxygen is injected into the combustion chamber of the CAMUI, which collides with fuel blocks to generate a combustion gas that flows along the body of the rocket, accelerated by an impinging jet that generates a thrust density three times greater than conventional designs. Successfully launched in 2002 and 2003, the CAMUI has already undergone engine flight tests, and will be used for atmospheric and space science research in the future.

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