

LEADING THE WORLD IN MUOGRAPHY: A NOVEL WAY OF IMAGING VOLCANOES

A REMARKABLE IMAGING TECHNOLOGY PIONEERED BY THE UNIVERSITY OF TOKYO RESEARCHERS enables scientists to peer into the heart of mountains using subatomic particles. The university is playing a leading role in its global application and development as a prime example of the university's strategic plan for global research leadership.

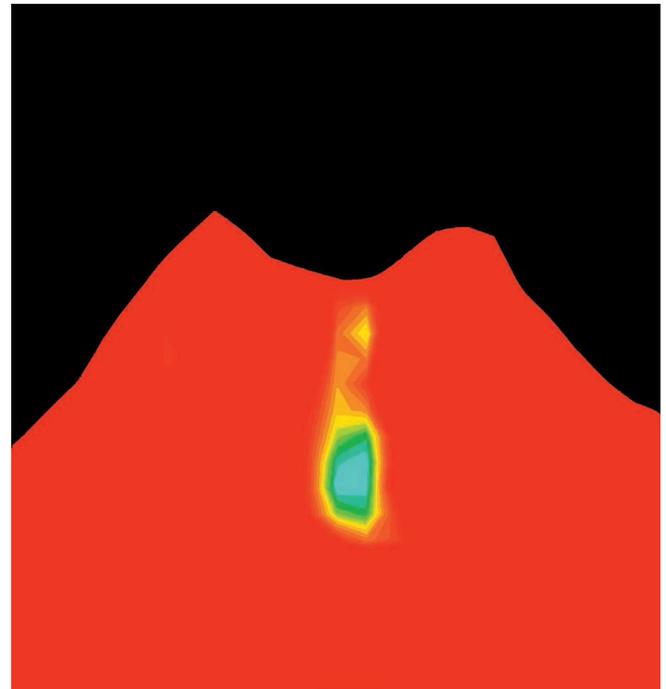
By any measure, the University of Tokyo is one of the top research universities in Asia and a peer to the most prestigious institutions in the world. Its role as a global research leader brings with it both the challenge of continued excellence and the responsibility to apply research for the betterment of society. In recognition of this duality, President Makoto Gonokami has launched an ambitious plan to put in place the systems and support needed for the university to play a pivotal role in international research as a global base of knowledge collaboration.

The Vision 2020 plan includes measures such as restructuring the research

employment system, reforming the undergraduate education system to bring it in line with international norms, promoting world-class research and expanding interactions with the international scientific community. These measures will help to make the University of Tokyo more accessible, capture the synergy between excellence and diversity, and strengthen its relevance and contribution to an increasingly global society.

A high-profile example of the type of research to be promoted and supported under Vision 2020 is the pioneering research on muography being conducted by Hiroyuki Tanaka.

"Muons are elementary particles similar to electrons



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but much heavier," explains Tanaka. "This allows them to penetrate deep into the ground. In an underground laboratory, muons are some of the only particles that can be observed. This means that, in the same way that we

use X-rays to look inside our bodies, we can use muons to visualize the internal structure of gigantic objects such as volcanoes and pyramids."

Muons are constantly being generated by the interaction of cosmic rays with particles

A LEADER IN COLLABORATION

THE UNIVERSITY OF TOKYO is consistently ranked one of the top in the world across the full range of subjects in Nature Index. It places a high importance on collaboration with researchers and institutions in Japan and overseas.

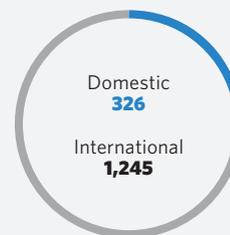
TOP RANKED ACADEMIC INSTITUTION IN ASIA PACIFIC (ALL SUBJECTS) (2012-2016; WFC)

#1

NUMBER OF INTERNATIONAL COLLABORATING INSTITUTIONS (2012-2016)



NUMBER OF COLLABORATING INSTITUTIONS (2016)

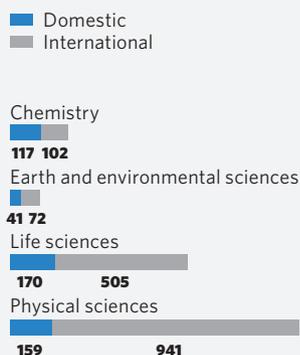


TOP 10 INTERNATIONAL COLLABORATORS (2016; FC)

1. French National Centre for Scientific Research, France **27.79**
2. Max Planck Society, Germany **27.51**
3. Chinese Academy of Sciences, China **16.15**
4. Harvard University, USA **14.68**
5. Helmholtz Association of German Research Centres, Germany **14.60**
6. Stanford University, USA **12.69**
7. Academia Sinica, Taiwan **12.56**
8. National Institute for Nuclear Physics, Italy **11.57**
9. California Institute of Technology, USA **10.58**
10. University of California Berkeley, USA **9.77**



NUMBER OF DOMESTIC AND INTERNATIONAL COLLABORATING INSTITUTIONS BY SUBJECT (2016)



SUBJECT MIX (2016; WFC)

- Chemistry
- Earth and environmental sciences
- Life sciences
- Physical sciences

Source: Nature Index

in the atmosphere — over a million muons pass through our bodies every day — making them ubiquitous and seemingly perfectly suited to universal imaging. The challenge has been developing equipment that is sufficiently portable to be used at locations of interest, such as near volcanoes.

“Physicists have known about the potential of muons for density measurements and imaging for many decades, but the conventional high-energy particle physics equipment used to capture muons is large and requires

an electricity supply and stable laboratory conditions,” says Tanaka. “We solved this problem by using a nuclear emulsion, which doesn’t require electricity and can be located almost anywhere. In 2006, we successfully imaged the magma pathway underneath the crater floor of a volcano using this technique for the first time. We have since developed an ultra-low-noise muography camera that can be used to take muographic images from a distance, making volcano muography much safer and more practical.”

This successful demonstration in 2006 opened up the research field of muography, and other teams around the globe have started working in it. The University of Tokyo is playing a pivotal role in advancing muography through its leadership of the Global Muography Network (GMN) and the International Virtual Muography Institute (VMI). The GMN is a network of scientists and engineers that facilitates information sharing, while the VMI provides education and support for research projects.

“The GMN, VMI and Muographers conferences will be a driving force to generate more applications and achievements in muography,” says Tanaka. “Our global leadership will help establish muography as a standard technique for visualizing gigantic objects in the same way that we use X-rays.” ■



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