

# EXPANDING A SUCCESSFUL RESEARCH CENTER INITIATIVE

World Premier International Research Center Initiative (WPI) in Japan is transcending disciplines and borders in science. Now it aims to double its number of centers.

**Yasunori Nomura speaks**, at breakneck speed while drawing on a blackboard. His hands caked with chalk, he repeatedly jabs a chart with the side of his palm for emphasis. "If the vacuum energy of space had been this much above or below zero, we would not exist!" he says.

Nomura, director of the Berkeley Center for Theoretical Physics at UC Berkeley, is talking about the multiverse, a theoretical collection of universes including our own. He was attending the regular mandatory teatime for physicists, mathematicians and astronomers at the Kavli Institute for the Physics and Mathematics of the Universe (Kavli IPMU) at the University of Tokyo. Collaboration and interdisciplinary dialogue are key here. About 20 visiting researchers from Japan and overseas scribbled equations and munched on biscuits beneath a pillar bearing a quote from Galileo: "The Universe is written in the language of mathematics." Their discussions related to some of the deepest mysteries of the Universe.

"We have five questions about the Universe that we want to address at this center: how it began, what it's made of, what is its fate, what are its basic laws, and why do we exist in it?" says Hitoshi Murayama, director of

Kavli IPMU and a professor of physics at UC Berkeley (image 1). "We can formulate these big questions in a concrete scientific fashion, test theories that may answer them with experiments or astronomical observations, and the data are fed back into the theory. We can make progress that way."

In one example, center researchers are working with the Japan Aerospace Exploration Agency (JAXA) and other research institutes to develop a satellite named LiteBIRD that will look at the cosmic microwave background to observe gravitational waves generated in the instant of creation during the Big Bang. This could provide new ways to test theories related to superstring theory and other areas of theoretical physics.

## CENTERS OF EXCELLENCE

The Kavli IPMU started from scratch in 2007 as one of five founding centers in the World Premier International Research Center Initiative (WPI Program), set up by Japan's Ministry of Education, Culture, Sports, Science and Technology (MEXT). The program's aim is to provide long-term funding to establish brand-new centers of research excellence in Japan that can have both an outstanding global profile and the means to attract top-class scientists from



anywhere. The WPI Program, administered by the Japan Society for the Promotion of Science (JSPS), only provides funds for startup, salaries, and activities such as international collaborations; not the actual research grants. Annual funding per center ranges from ¥700 million to ¥1.35 billion. Program guidelines include targets such as having 20% of principal investigators and more than

30% of researchers from abroad.

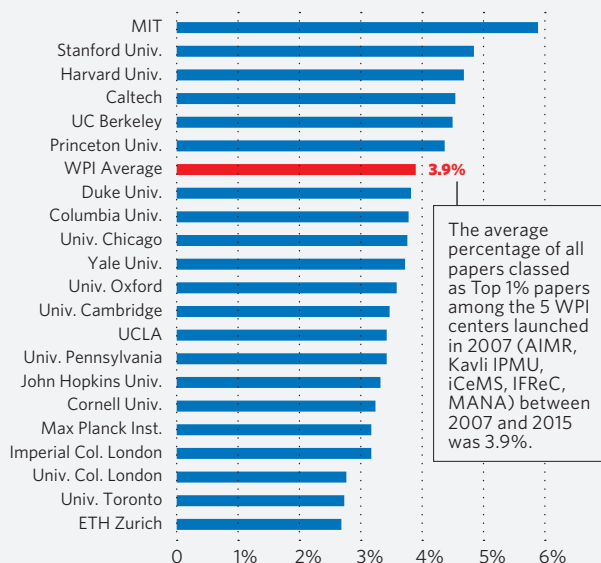
The nine WPI centers are undertaking scientific research in fields as disparate as the origin of Earth and life (Earth-Life Science Institute, ELSI, Tokyo Institute of Technology), sustainable energy (International Institute for Carbon-Neutral Energy Research, I<sup>2</sup>CNER, Kyushu University), sleep medicine (International Institute for Integrative Sleep

## PROPORTION OF HIGHLY CITED ARTICLES

Based on the Top 1% of cited articles by document type, year and subject, 2007-2015.

This chart ranks universities and research institutions by the percentage of all published papers that are classed as "Top 1% papers".

Data provided by the Japan Society for the Promotion of Science based on the Clarivate Analytics' Web of Science and InCites Benchmarking.



### SPANNING JAPAN

Japan's World Premier International Research Center Initiative aims to create "globally visible research centers".



Medicine, IIS, University of Tsukuba, image 3) and materials science (Advanced Institute for Materials Research, AIMR, Tohoku University and International Center for Materials Nanoarchitectonics, MANA, National Institute for Materials Science). All are straddling two or more fields, for example, immunology and imaging (Immunology Frontier Research Center, IFReC, Osaka University). One example of the synergy created by such interdisciplinary research was the discovery at Nagoya University's Institute of Transformative Bio-Molecules (ITbM) of a new compound to detect the growth of *Striga*, a parasitic plant, also known as witchweed, which has destroyed countless food crops in Africa.

"Three ITbM researchers,

one specializing in plant biology and two in synthetic chemistry (image 2), were chatting in a ramen noodle restaurant and realized they could do joint research," says Akira Ukawa, director of the WPI Program and deputy director of the RIKEN Advanced Institute for Computational Science. "In a few weeks, they came up with a molecular tool that can be applied to help wipe out *Striga* and reported the results in *Science*."

#### LOOKING TO THE FUTURE

In international rankings of scientific papers, the WPI centers' output is comparable to that of leading US and European universities. Recent Nobel laureates Takaaki Kajita, a principal investigator at Kavli IPMU, and Shinya Yamanaka,

principal investigator at the Institute for Integrated Cell-Material Sciences (iCeMS) in Kyoto University, are further examples of the WPI Program's talent and international recognition. The WPI Program also has evaluation committees of outside experts that meet every year to check on the work being conducted at each center.

**"THE WPI PROGRAM IS SHAPING THE FUTURE OF SCIENCE."**

In April 2017, the WPI Program began its next phase of development, with plans to establish up to 20 WPI centers. The WPI Academy network was also set up as a means to share the accumulated know-how

of the WPI centers with the broader scientific community in Japan.

"To do top-class world science, we need internationalization, fusion studies and reforms of the university system," says Toshio Kuroki, a professor emeritus at the University of Tokyo, who was also the director of the WPI Program for 10 years from its inception in 2007 until March 2017 and is the current director of the WPI Academy. "The WPI Program is shaping the future of science in this country beyond borders and barriers." ■

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