

Xing Tian and Qing Cai at the NYU-ECNU Institute of Brain and Cognitive Science study perception, action, language and their underlying mechanisms.

## CATCH THEM IF YOU CAN

*In institutions everywhere from super-cities to remote desert locations, researchers are setting the world of discovery on fire and pushing their institutions up the Nature Index rankings.*

**T**he performance of research strongholds like the Chinese Academy of Sciences and the University of Oxford have improved dramatically in the past few years.

As the research world's equivalent of Apple or Google, these well-established organizations have big budgets, some of the best brains and top-notch equipment.

So, what about the new kids on the block? As a database that tracks articles published in top-tier science journals, the Nature Index is well placed to identify the world's research rising stars.

The top 100 most improved institutions in the index between 2012 and 2015 are ranked by their contribution to 68 high-quality journals, a metric known as

weighted fractional count (WFC). Here we profile 25 institutions. Some made the grade by improving most in their country, and others were highlighted for their meteoric rise up the index's global rankings.

China has so many institutions in the latter category, we could have produced a whole magazine about them.

# SOOCHOW UNIVERSITY

CHINA

2012 WFC: 56.04

2015 WFC: 108.47

Founded in 1900 during the Qing dynasty, Soochow University is named after its birthplace of Suzhou on China's east coast — 30 minutes from Shanghai via bullet train. The institution has strengthened key areas of research over the past decade, a strategy that has culminated in the doubling of its Nature Index score since 2012. "The university decided to use its limited resources to strengthen a few selected departments," says Soochow materials science professor, Lee Shuit-Tong.

Research centres that focus on central government research priorities, such as nanotechnology, biomedicine and energy research, have boosted the university's published papers overall, while fuelling researchers' drive to produce higher quality research, says Lee.

"It was not until 2008 that the development of Soochow University drastically sped up," says Lee, the founder of the institute of functional nano and soft materials (FUNSOM), which opened in 2008 with US\$22 million from the university. FUNSOM contributes more than 40% of the university's peer-reviewed articles published in high-impact journals, with only 2% of the total staff. Lee and a colleague were recognized by Thomson Reuters in its 'Highly Cited Researchers' list of 2015. Their team is exploring how cellular imaging can be used in cancer therapy and in the development of green-energy devices. **\$0**

# INSTITUTE FOR BASIC SCIENCE

SOUTH KOREA

2012 WFC: 1.04

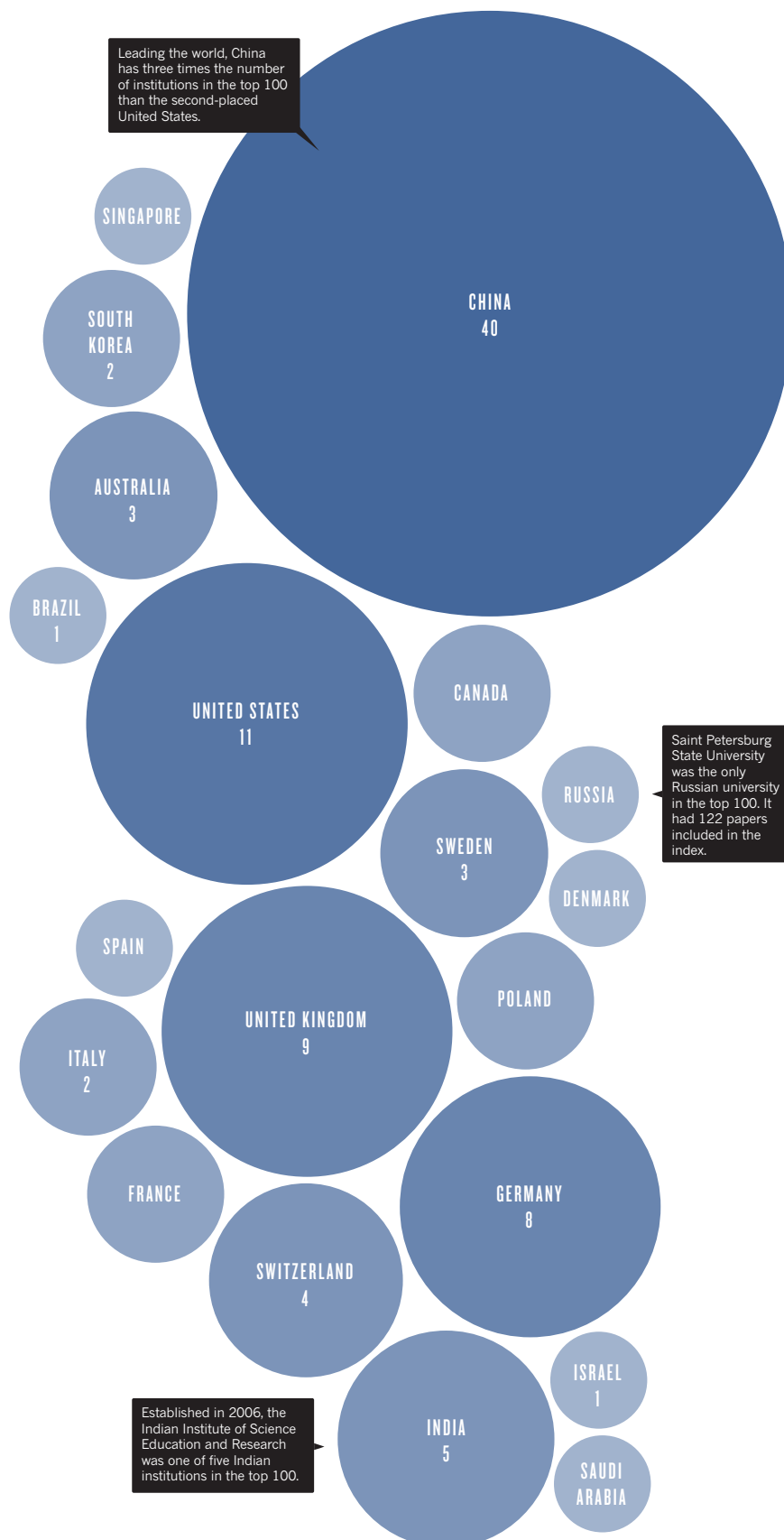
2015 WFC: 50.31

For decades, South Korea has propelled its economy by investing in applied research — often in tandem with industry — while basic science was neglected. The Institute for Basic Science (IBS) was intended to reverse that trend, becoming Korea's equivalent of Japan's RIKEN and Germany's Max Planck Institutes.

Founded in 2012, IBS is a new player even in a line-up of rising stars. It has grown to 26 centres with focuses ranging from dark matter to gene editing to graphene to nanomedicine. Each centre has an average annual budget of US\$8.5 million, and there are plans to establish 50 centres

## TOP 100 MOST IMPROVED

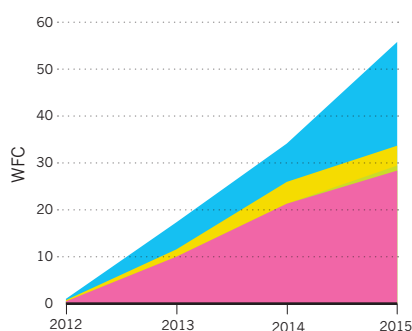
Countries are sized by the number of institutions in the top 100 institutions with the highest increase in their absolute contribution to the index, a metric known as weighted fractional count (WFC), between 2012 and 2015.



## GROWTH SPURT

Since the Institute for Basic Science in South Korea was founded in 2012 its WFC has skyrocketed. In 2015, 189 papers were included in the index.

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



by 2021. About a third of these will be at a headquarters campus to be constructed in Daejeon; the rest hosted by universities and institutes around the country.

"The funding is generous," says Jin-soo Kim, who heads the Center for Genome Engineering. "I don't have to write a grant."

South Korean leaders hope IBS will deliver on the dream of a scientific Nobel prize. "The phenomenon is aggravated by Japanese success," says IBS president Doochul Kim, referring to the 21 scientific Nobels won by the country's rival. "Korean people have always compared and tried to catch up to Japan. Politicians ask us, 'What have you done?'"

South Korean president, Park Geun-hye, has also argued that IBS has many benefits. With Korea's economy slowing, the technological rise of China, and renewed competition from Japan spurred by a weak yen, she is betting on IBS and basic science as a catalyst for growth. **MZ**

## EAST CHINA NORMAL UNIVERSITY

CHINA

2012 WFC: 35.55

2015 WFC: 83.90

East China Normal University (ECNU) evolved from a teacher training university to a multi-disciplinary institute and is fast gaining a reputation for its world-class research. Between 2012 and 2015, the university's contribution to articles in the index has more than doubled, lifting it more than 200 places in the Global 500 ranking to 142nd position in 2015.

The university prides itself on its

international collaborations, and its most recent partnerships have led to fruitful research. In 2011, ECNU and New York University joined forces to establish China's first Sino-American university — New York University Shanghai (NYU Shanghai). A 2015 study by researchers at NYU Shanghai's Institute of Brain and Cognitive Science found physical evidence that the brain arranges words in a hierarchy using a form of 'internal grammar'. The findings, published in *Nature Neuroscience*, suggest the human mind can intuitively configure a string of words such as 'ancient history is drinking tea' into a structure that has meaning, such as 'drinking tea is ancient history'. **SO**

## HUNAN UNIVERSITY

CHINA

2012 WFC: 49.22

2015 WFC: 92.47

Hunan University is one of China's oldest and can trace its roots back to the year 976 CE. The campus sits on the Xiang River in Changsha, the capital city of the province of Hunan.

The university has almost doubled its contribution to the index between 2012 and 2015, a rise attributed to its recruitment of top-level researchers, according to Weihong Tan, a professor of chemistry and biomedical engineering. In 2013, Hunan established the Institute of Chemical Biology and Nanomedicine under the direction of leading US scientists, Chad Mirkin from Northwestern University and David Walt from Tufts University.

Tan's team are focusing on research in biomedicine, which he hopes will lead to new industries for the province. **SO**

## SICHUAN UNIVERSITY

CHINA

2012 WFC: 44.88

2015 WFC: 83.22

Sichuan University's position in the Nature Index has soared in recent years, climbing from 278th place in the Global 500 institutions ranking in 2012 to 145th in 2015. New facilities, well-funded salary start-up packages and accessible research grants have attracted eager young researchers to the university in Chengdu in southwest China. Fifty international researchers have been recruited in the past two years to the university's National Key Laboratory of Biotherapy, which opened in 2005. The

multidisciplinary research centre enables discovery and development of innovative drug candidates.

"Basic research, preclinical development, translational and clinical medicine are seamlessly integrated," says Wei Yuquan, who is director of the laboratory as well as the university's vice president.

He says: "We want to bring disciplines together to try to solve the major problems in medicine, science and technology." **SO**

## KING ABDULLAH UNIVERSITY OF SCIENCE &amp; TECHNOLOGY

SAUDI ARABIA

2012 WFC: 40.51

2015 WFC: 72.19

KAUST is more than just a university — it's practically a city. Occupying 36 square kilometres on the Red Sea, KAUST is separated from conservative Saudi society. Courses are coeducational, women can drive and are not required to wear veils, and the campus has one of only two sanctioned movie theatres in the kingdom.

The graduate-only research university was founded in 2009 at the behest of the late King Abdullah. He hoped to create a premier institute to kickstart Saudi Arabia's research scene — and to help develop clean

**"We want to bring disciplines together to solve major problems in science and medicine."**

energy technology to wean it off oil. He left the university with an endowment estimated at US\$20 billion, and it recruited foreign researchers with start-up funds, reportedly worth up to US\$1 million

each, to set up labs. In the early days many faculty members left, claiming the university had failed to deliver on its promises. But the institution's contribution to high-quality research had surged by 2015 to levels 80% higher than in 2012. **MZ**

## NANYANG TECHNOLOGICAL UNIVERSITY

SINGAPORE

2012 WFC: 177.60

2015 WFC: 207.83

Nanyang Technological University is one of Asia's research powerhouses, ranked 37th in the index's Global 500. Most of the Singaporean university's high-quality research output is in chemistry, but it has



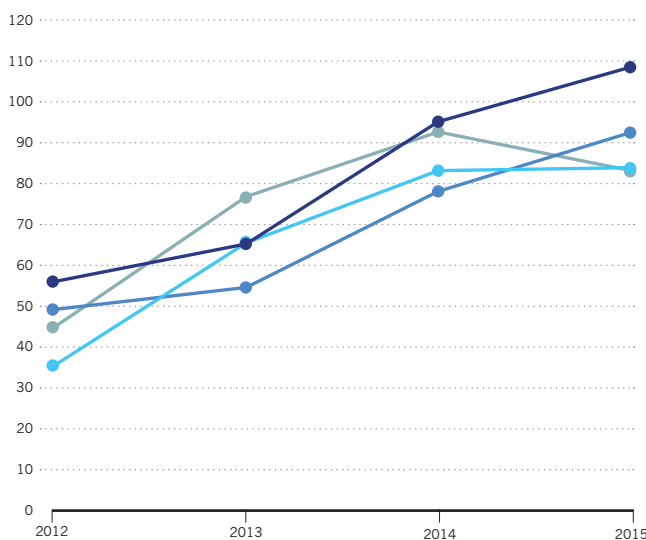


KAUST's Center for Desert Agriculture works toward food security solutions in arid climates.

## CHINA'S DOMINATION

The upward trajectory of many of China's less well-known research universities is reflected in the WFC growth of four Chinese universities in the top 100.

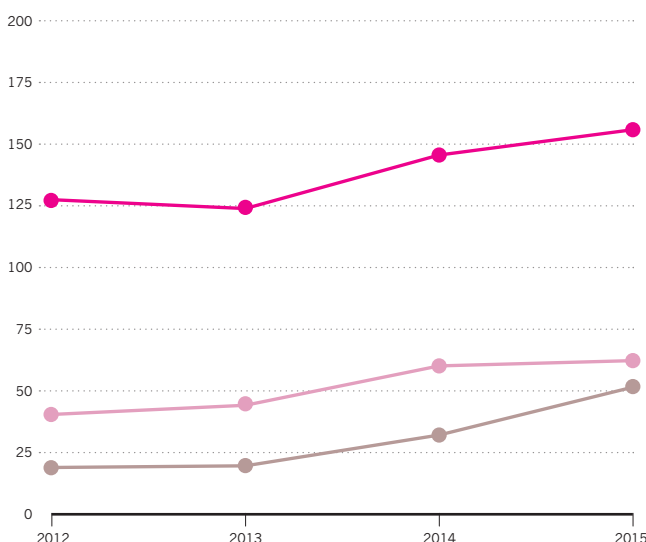
- Soochow University
- Hunan University (HNU)
- East China Normal University (ECNU)
- Sichuan University (SCU)



## CHEMISTRY CHAMPS

Chemistry output was a significant driver of the performance for several research institutions in the top 100 most improved institutions in the index.

- Nanyang Technological University (NTU)
- Indian Institute of Science Education & Research (IISER)
- King Abdullah University of Science & Technology (KAUST)



also invested heavily in sustainability and environmental research.

Founded in 1991 through a merger between an engineering university and the national institute for teacher training, it was granted autonomy from the state in 2006 and swiftly transformed into a research-intensive institute, taking advantage of increased public funds. MZ

ANASTASIA KHRENOVA/KAUST

## INDIAN INSTITUTE OF SCIENCE EDUCATION & RESEARCH

INDIA

2012 WFC: 50.97

2015 WFC: 78.67

The Indian Institute of Science Education and Research (IISER), in Pune, was only founded in 2006. A decade later, the Indian government has established six additional IISERs, in Kolkata, Mohali, Bhopal, Thiruvananthapuram, Tirupati and, most recently, in Berhampur. Collectively, they have risen to become the fourth-ranked Indian organization in the Global 500 by boosting their contribution to high-quality science by more than 50% since 2012.

The IISERs were set up to build on the success of India's highest entrant to the Global 500, the Indian Institutes of Technology, says HariPriya Rangan from the Australia India Institute in Melbourne. "We have a very strong reputation overseas, but in India there has been not much reflection of that," she says.

The IISERs, with an emphasis on fundamental scientific research, might address that. "They have been well funded, with state-of-the-art facilities," says Kartik Shanker, an ecologist at the IIT in Bangalore. "They have hired good young, faculty with very active research programmes."

But, the IISERs have their critics. The institutions were set up to span the fundamental sciences, and yet there has been a perceived bias toward chemistry, sources say. The Scientific Advisory Council to

**"We have a strong reputation overseas, but in India there is not much reflection of that."**

the Prime Minister, which recommended the IISERs be established, is headed by a prominent chemist, and chemists were appointed as directors to four of the first five IISERs to open. In the index,

chemistry research accounts for almost 80% of the organizations' contribution to world-class natural science research.

JMC

## ISRAEL INSTITUTE OF TECHNOLOGY (THE TECHNION)

ISRAEL

2012 WFC: 68.75

2015 WFC: 95.59

It's difficult to pinpoint the factors that have pushed the Technion up the Nature Index Global 500 ranking of top-performing research organisations, according to Ehud Keinan, a chemist at the institution and, since 2009, the president of the Israel Chemical Society. "If the recipe was easy and clear, everybody would do it." But the Technion's chemists have certainly got some of the reagents right.

Established in the port city of Haifa in 1912, Israel's oldest university has 18 academic departments, including all scientific areas from engineering to medicine. But, of the university's 565 academic faculty, it's primarily the chemists that have powered the Technion's rise up the index rankings, from position 179 in 2012 to 108 in 2015. They have more than doubled their contribution to chemistry papers published in top-tier journals since 2012, the first year the index was compiled.

The Technion's overall contribution to high-quality science papers jumped almost 40% in that time.

Keinan identifies one probable reason for the institute's performance: the awarding of the 2004 Nobel Prize in chemistry to Technion researchers Aaron Ciechanover and Avram Hershko for their discovery of how the body tags proteins for recycling. This success was followed in 2011 by Technion chemist Dan Shechtman who won the same gong for his discovery of quasicrystals, an unexpected form of matter that combines order and disorder.

"Success is an autocatalytic process," Keinan says. "When you get good faculty, you can attract even better faculty members, and good graduate students."

Keinan is now working to establish a branch of the Technion in Guangdong, China, to leverage its strength in chemistry. **JMC**

## BAYLOR COLLEGE OF MEDICINE

UNITED STATES

2012 WFC: 66.29

2015 WFC: 92.15

Baylor College of Medicine (BCM) is the self-proclaimed 'intellectual heart' of the world's largest medical complex, Houston's Texas Medical Centre.

Despite its enormity now, BCM was



The neurosurgery department at Baylor College of Medicine, whose other areas of strength are paediatrics, immunology and the study of cardiovascular disease.

small for much of its 116-year history. A key figure in setting the college on its current trajectory was a paediatrician called Ralph Feigin.

"Feigin was an impressive dude and a very successful leader," says Scott Simon, a former faculty member, now at the University of California, Davis. Feigin led the paediatrics department from 1977 to 2008, and was Baylor's president and CEO from 1996 to 2003. "I've never seen a physician who was as good an administrator," Simon adds.

Baylor has grown by building on existing strengths, says Simon — including paediatrics, immunology and cardiovascular disease. "They went for three or four areas they did really well at, and pulled in the best people — and then other programmes grew around it."

In 2009 and 2010, BCM considered merging with neighbouring Rice University

or with Baylor University in Dallas, from which it had split in 1969 — but decided to stay solo. Remaining independent hasn't hurt its output: BCM's contribution to high-quality research rose 39% from 2012 to 2015. **JMC, MZ**

## NORTH CAROLINA STATE UNIVERSITY

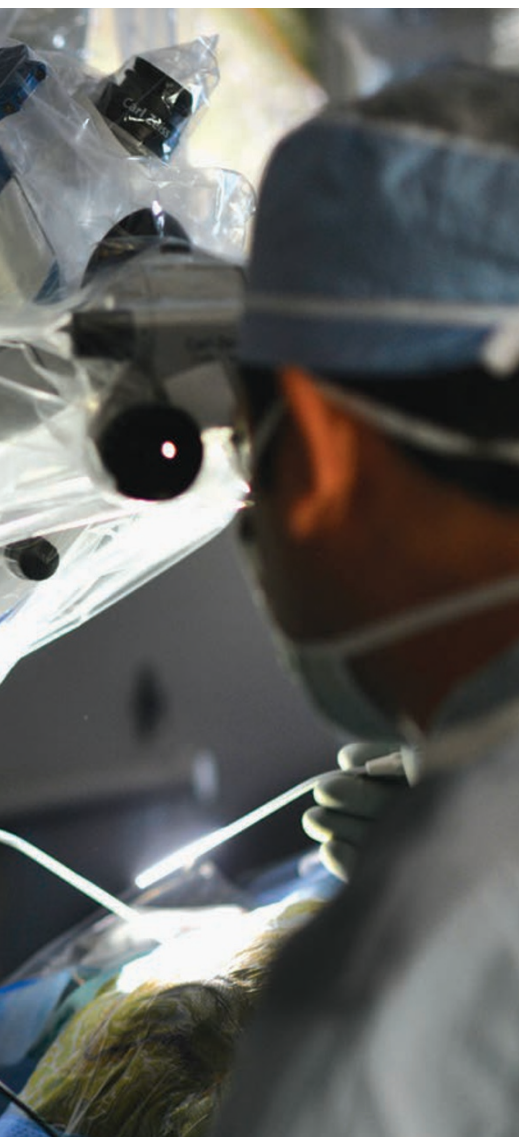
UNITED STATES

2012 WFC: 51.71

2015 WFC: 76.29

Located in Raleigh, North Carolina State University is at the heart of a region quickly becoming a major research and technology hub. In 2015, *Forbes* magazine reported it had the highest rate of STEM job growth in the US for the preceding decade, topping





Silicon Valley. NCSU is one of the three academic anchors of the so-called Research Triangle, along with Duke University in Durham and the University of North Carolina in Chapel Hill. More than 100 start-ups or spinoffs have emerged from North Carolina State, attracting \$US1.6 billion in venture capital.

Both its total number of articles in the index and its contribution to those articles spiked by roughly 50% between 2012 and 2015, vaulting 91 places in the index's Global 500 to rank 164. Traditionally strong in engineering, it hosts two United States National Science Foundation (NSF) Engineering Research Centers: one that focuses on smart electrical grids and one specializing on health wearables.

In the mid-2000s, North Carolina State became mired in controversy by claims that three of its scientists had falsified data

in a 2004 study finding that RNA could regulate the growth of the metal palladium. A university investigation in 2008 found the paper, which had been published in *Science*, included false data, but stopped short of finding intentional misconduct. A more thorough 2013 investigation by the NSF inspector general concluded the pair had indeed "recklessly falsified data," although the NSF eventually ruled it had not been intentional. *Science* retracted the paper in February 2016. The scientists in question no longer work at the university. **MZ**

## XI'AN JIAOTONG UNIVERSITY

CHINA

2012 WFC: 30.27

2015 WFC: 50.78

In the past four years, Xi'an Jiaotong University, in the ancient former capital city of Xi'an in central China, increased its high-quality natural science in all subject areas, but most dramatically in chemistry and the physical sciences.

The university is home to the State Key Laboratory for Mechanical Behavior of Materials. State key laboratories are centrally-funded institutions that are designed to funnel resources to government priority areas. Materials science and its industrial applications are considered key to China's economic development.

The team at Xi'an Jiaotong are exploring ways in which materials behave at the nano scale. They recently developed a nanospring that can efficiently store and release mechanical energy, a component that could be useful in more complex nanomechanical systems.

Four years ago, Xi'an Jiaotong established a multidisciplinary research institute called the Frontier Institute of Science and Technology (FIST) which now has 11 centres focusing on life sciences, medicine and mathematics, and has recruited 40 international scientists. Among them are Timothy Bliss and Graham Collingridge from the UK, who in March 2016 were awarded the European 'brain prize' for their work on memory mechanisms. **SO**

## HARBIN INSTITUTE OF TECHNOLOGY

CHINA

2012 WFC: 19.30

2015 WFC: 39.73

In the capital of the far northern province of Heilongjiang, the Harbin Institute of Technology (HIT) is synonymous with

**"China's goals include establishing a space station and sending astronauts to Mars."**

research supporting the country's space science programme. China's goals include establishing a space station, sending astro-

nauts to Mars, and industrializing rocket technology to more efficiently transport vessels into space.

Over the past decade, Harbin's researchers have worked on China's Shenzhou spacecraft programme, including its first manned spacecraft, Shenzhou 5, and more recently, a satellite for emergency data monitoring and imaging, Kuaizhou-1, which was launched in 2013.

The university, established in 1920, is a member of China's elite C9 alliance — nine institutes in China that receive 10% of the country's research and development funding, and are relied on by the central government to produce world-class results.

HIT has experienced rapid growth in the index, doubling its contribution to top journals in four years and moving up 208 places in the Global 500 to reach 304th position in 2015. **SO**

## UNIVERSITY OF REGENSBURG

GERMANY

2012 WFC: 56.86

2015 WFC: 72.58

The University of Regensburg's improvement in the index is driven mostly by chemistry, with the university placing 11th among the country's academic chemistry institutions in 2015.

As head of the chemistry department, Oliver Reiser points out, "that puts Regensburg above many universities a lot bigger than us." The department has a mere 18 tenured academics, compared to more than 25 at the University of Stuttgart (ranked 13th) and more than 40 at the Ruhr University Bochum (19th).

In 2010, Regensburg, in south-east Germany, won special status from the national funding agency for its studies of photocatalysis — chemical reactions accelerated by sustainable sunlight — which secured the department additional funding until 2019.

Regensburg's physics department hosts a similar centre researching carbon-based nanostructures. Overall, the university's contribution to index papers grew by almost 28%, the largest surge by any German institution in the top 100 most improved institutions. **JMC**

## ITALIAN INSTITUTE OF TECHNOLOGY

### ITALY

2012 WFC: 22.42

2015 WFC: 41.39

When the Italian government decided to establish a research organization in 2004, it sought inspiration from the world-renowned research organizations of Germany, in particular the Max Planck Society.

The Max Planck Society is funded by the state, but operates as a private foundation. "They are a little bit more agile than universities," says Roberto Cingolani, scientific director at the Italian Institute of Technology, which opened its main laboratory in Genoa in 2009.

The institute's 1,300 research staff are spread across 11 labs around the country and two small units at premier US universities, Harvard and the Massachusetts Institute of Technology. Since 2012, the institute's scientists increased their contribution to index papers more than any other Italian institution.

The institute concentrates on nanotechnology, robotics and brain science. The work is more connected than it might first sound. "Our general mission is 'translating evolution into technology,'" Cingolani says. The institute's best-known piece of research is its humanoid research robot, iCub, developed to test the idea that a robot, like an infant human, can develop an understanding of the world around it via physical interaction with its environment. **JMC**

## UNIVERSITY OF SUSSEX

### UNITED KINGDOM

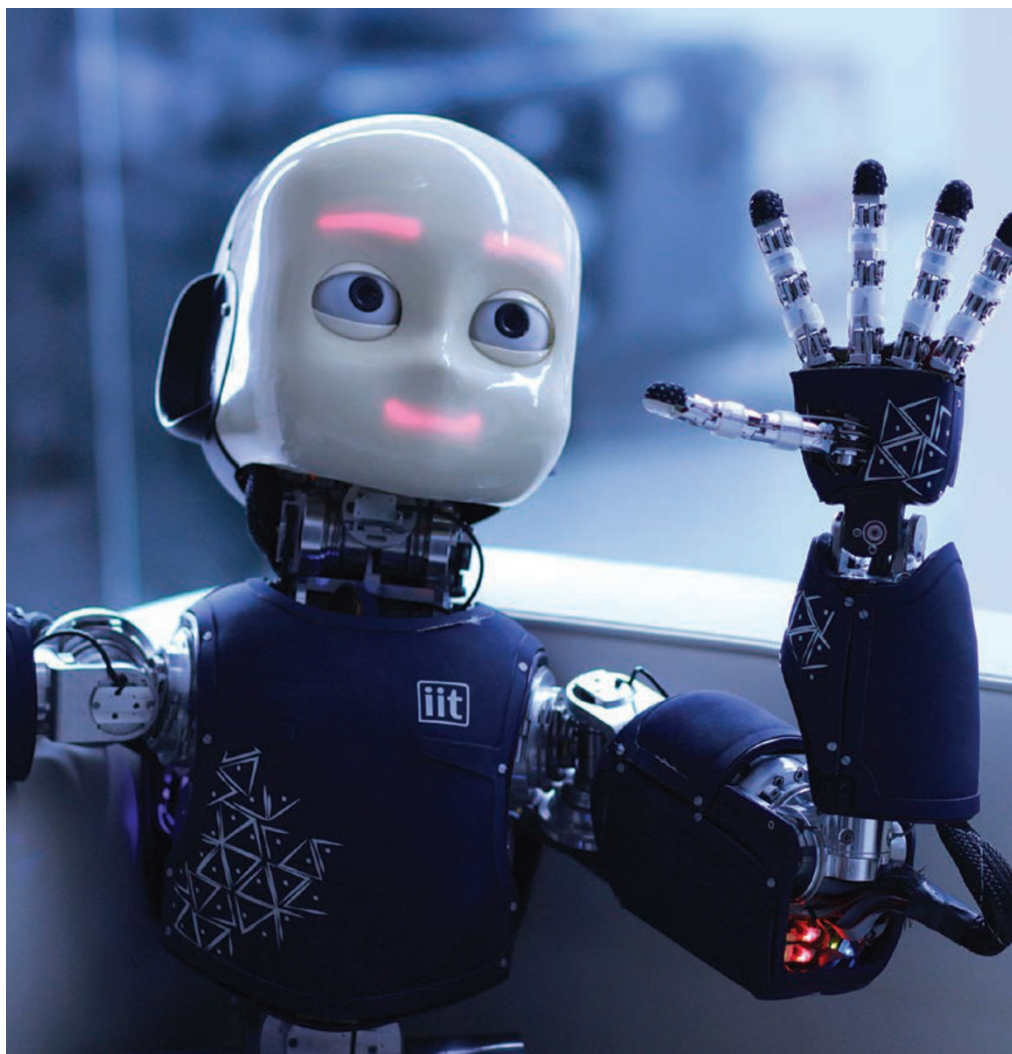
2012 WFC: 18.09

2015 WFC: 33.26

There's no great mystery behind the rapid rise of the University of Sussex in the index. In 2012, the university didn't place in the first Global 500 ranking. But that year, it began strategic financial investment in key disciplines, in particular, physics and astronomy. The number of research staff has increased by more than 60%, from 23 in 2012/13 to 40 today and is still growing, says astrophysicist, Peter Coles, who leads the school of mathematical and physical sciences.

Recruits were brought in to reinforce existing strengths in astronomy and particle physics, and to establish programmes in quantum technologies and condensed matter physics.

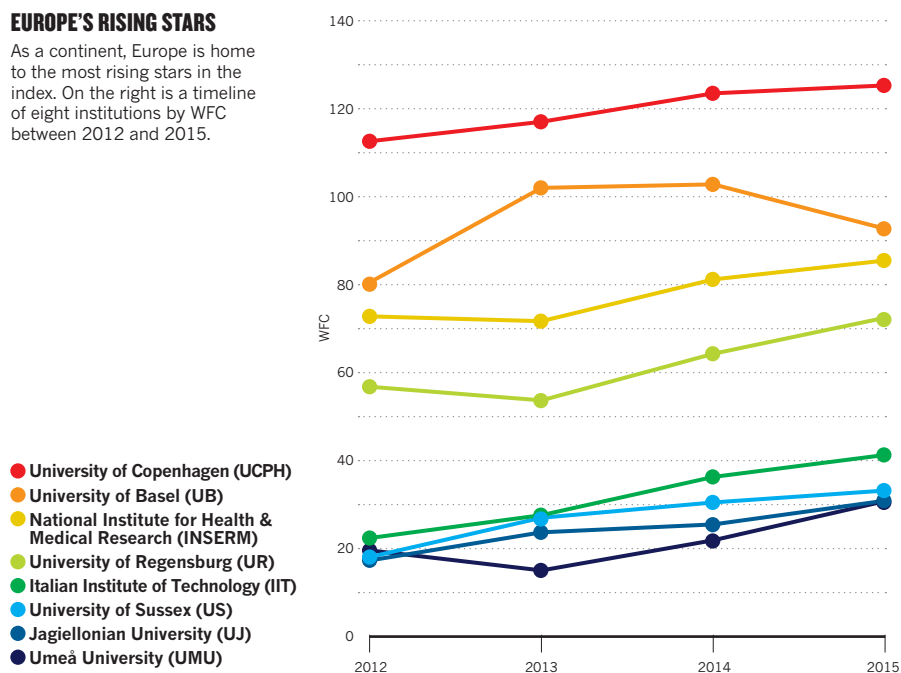
Mainly thanks to a quadrupling of its physical sciences score, the university



The Italian Institute of Technology's iCub was built to test whether a robot can learn through physical interaction.

## EUROPE'S RISING STARS

As a continent, Europe is home to the most rising stars in the index. On the right is a timeline of eight institutions by WFC between 2012 and 2015.





reached 351 in the Global 500 in 2015. That represents an 83.9% rise in its contribution to index papers since 2012 — the biggest jump of any UK research organisation in the top 100 most improved institutions. **JMC**

## PERIMETER INSTITUTE FOR THEORETICAL PHYSICS

CANADA

2012 WFC: 32.26

2015 WFC: 46.54

When Canadian prime minister, Justin Trudeau, visited the Perimeter Institute for Theoretical Physics in Waterloo, Ontario in April 2016, he wowed reporters by nailing a 30-second explanation of quantum computing that instantly went viral. But, the telegenic PM's visit didn't just burnish his image. He announced the Ontario government would contribute CDN\$50 million (US\$38 million) to its budget over five years.

That's only one funding avenue this unique public-private institute attracts. Since its founding in 2000, it has lured funding from foundations, corporate sponsors, and philanthropists — including CND\$150 million from its founder, Mike Lazaridis, also the co-founder of BlackBerry. The institute now has 25 full-time faculty and counts famed theoretical physicists Stephen Hawking and Leonard Susskind among its 160 scientists-in-residence. The institute's contribution to index papers increased by 44% between 2012 and 2015, pushing it from position 362 in the index's Global 500 ranking in 2012 to position 267 in 2015. **MZ**

## JAGIELLONIAN UNIVERSITY

POLAND

2012 WFC: 17.37

2015 WFC: 31

The standing of Jagiellonian University in Krakow, Poland, has fluctuated since its foundation in 1364, often buffeted by shifts in the balance of power in central Europe. But, the oldest university in Poland is also the country's rising star, having increased its contribution to high-quality research papers by 79%, the largest increase of any Polish institution in the top 100 most improved institutions.

In 2010, Jagiellonian was awarded a European Union regional development grant to host Poland's first synchrotron. Completed in late 2015, the synchrotron has

yet to contribute directly to the university's performance in the index. However, the synchrotron was integral to Jagiellonian's successful 2012 bid, with partner research organizations in Krakow, to become Poland's flagship research centre for physics and chemistry — a status that guarantees additional government funding. The research financed by this grant is already helping boost Jagiellonian up the Global 500 in which it ranked 370 in 2015. **JMC**

## FRENCH NATIONAL INSTITUTE FOR HEALTH AND MEDICAL RESEARCH

FRANCE

2012 WFC: 72.95

2015 WFC: 85.55

The French government shook up its science funding in 2009, introducing a €47 billion 'Investments for the Future' fund to boost national competitiveness in targeted sectors. Some €5 billion of the fund was allocated to biomedical research, according to Yves Lévy, CEO of the French National Institute for Health and Medical Research (INSERM). "Given INSERM's focus, we were very well placed and have won many of these grants," Lévy says. All INSERM's researchers work in research units embedded in French universities, most of them in university hospitals.

Since 2012, INSERM's contribution to the index grew the most of any French institution in the top 100 most improved list, and it placed 136 in the Global 500 ranking in 2015. But as Lévy notes, some of its highest impact research is published in medical journals such as the *New England Journal of Medicine*, which are not included in the index. **JMC**

## UNIVERSITY OF COPENHAGEN

DENMARK

2012 WFC: 112.63

2015 WFC: 125.32

The oldest and most prestigious university in Denmark, the University of Copenhagen ranked 72nd globally in the index in 2015, with strengths in life and physical sciences. The university's researchers published 25% more articles in top natural science journals in the index in 2015 than in 2012.

The rise came despite declines in state funding, which the university sought to offset with external sources, including six major laureate grants from the Novo Nordisk Foundation between 2012 and 2014

totalling US\$36 million.

But, the funding cuts are now a major crisis that could jeopardize the university's gains: In February 2016, due to budget constraints, the university announced it would lay off 7% of staff — 500 people, including more than 100 researchers — and impose a hiring freeze. **MZ**

## SÃO PAULO STATE UNIVERSITY

BRAZIL

2012 WFC: 11.21

2015 WFC: 23.52

São Paulo State University (UNESP) is fairly new to Brazil's burgeoning research scene, but it arrived with intent. Founded in 1976 by a merger of previously independent institutions, this multi-campus university is modelled on the University of California's state-wide system and consists of 24 campuses across São Paulo State, including its eponymous capital. In 2009, it embarked on a hiring frenzy of more than 1,000 faculty and researchers, and from 2012 to 2015, its contribution to high-quality science in the index more than doubled.

The university's research strengths are in physics and astronomy. Its Institute for Theoretical Physics was founded in 1951, predating the university itself. It also hosts the ICTP South American Institute for Fundamental Research, an offshoot of the International Centre for Theoretical Physics in Trieste, Italy.

However, Brazil's economic crisis has put science funding on the chopping block, cutting it by 25% in 2015. After the May impeachment of President Dilma Rousseff, the science ministry was merged with the telecommunications ministry, leaving many researchers wondering if science will remain downgraded for many years to come. **MZ**

## UNIVERSITY OF BASEL

SWITZERLAND

2012 WFC: 80.50

2015 WFC: 92.77

Switzerland's city of Basel is a hub for life sciences research and home to the headquarters of pharmaceutical giants, Novartis and Roche. In 2007, the University of Basel decided to play to this strength and make life science its key focus.

This concentration of effort has helped power the university's 40-place leap up the Global 500 since 2012, to 109 in 2015.

The university's strategy was supported by the regional government, says Christian





Chris Spencer of Curtin University at the basalt outcrop of the Semail Ophiolite in Wadi Jizzi, Oman.

Sengstag, deputy vice-rector for research at the university. “Lots of resources have been pumped into life science research,” he says. New research groups have been established, and the university has invested “in top-notch infrastructure and buildings.” Last year Basel scientists used single-molecule spectroscopy to show how *E. coli* bacteria fold the proteins that form their outer membrane — a long-standing drug discovery target.

Political support can be fickle, however. Federal elections held in 2015 saw a strong swing toward the right-wing SVP party, which has vowed to cut government spending. “In the future we will probably have to live on a lower budget,” says Sengstag. **JMC**

## SAINT PETERSBURG STATE UNIVERSITY

RUSSIA

2012 WFC: 13.97

2015 WFC: 25.36

Saint Petersburg State University is known for educating generations of Russia's elite: it counts current president Vladimir Putin and prime minister Dmitry Medvedev among its alumni.

After the fall of the USSR in 1991, funding plummeted and national science output slipped. But, budgets are slowly building

up, and the country's oldest university leapt into the Global 500 in the index in 2015, at position 410, by more than doubling its contribution to high-quality science over the previous four years.

Part of its upswing has come from increased state funds, including seven projects funded by the Russian education and science ministry's so-called ‘mega-grants’. These grants of 90–150 million roubles (US \$1.3–2.2 million each) are open to scientists around the globe, and have played a key role in the nation's strategy to attract foreign talent and revitalize its research scene. Three of the university's mega-grant projects involve nanomaterials, reflecting a traditional strength in chemistry and physical sciences, but others focus on the geomorphology of the polar regions, genomics and bioinformatics. **MZ**

## UMEÅ UNIVERSITY

SWEDEN

2012 WFC: 19.64

2015 WFC: 30.84

Sweden's temperate environment is a world away from tropical Latin America, where the Zika virus continues to wreak havoc, but researchers at the country's Umeå University have joined the fight to stop Zika spreading further. Global health is one of Umeå's key

strengths, and that includes an EU-funded consortium, established at the university in 2011 to fight Dengue fever. (Zika and Dengue are transmitted by some of the same species of mosquito.)

Umeå University's contribution to high-quality science increased by 57% from 2012 to 2015, placing it in the top 400 institutions globally. Founded in 1965, the university prioritizes biotechnology and life sciences, and its regional forests in particular have yielded plenty of research. In 2013, The Umeå Plant Science Center, a collaboration between Umeå University and the Swedish University of Agricultural Sciences, mapped the Norway spruce genome, which comprises 20 billion base pairs — more than six times as many as the human genome. Its energy research portfolio also includes developing biofuels from trees. **MZ**

## CURTIN UNIVERSITY

AUSTRALIA

2012 WFC: 13.23

2015 WFC: 24.16

The state of Western Australia has two distinguishing qualities: it is rich in mineral resources and its interior is sparsely populated. Both factors feed into Curtin University's focus on Earth sciences.

A decade ago, the university, located in Perth, reorganized its mining school to incorporate key aspects of applied geology, says Graeme Wright, Curtin's deputy vice-chancellor for research. Wright cites this transformation as the key to the 54% increase in Curtin's contribution to articles in Earth and environmental sciences in the index since 2012. Overall, the university's contribution to journals in the index increased more than 80%.

Western Australia's vast, people-free interior also makes it among the most radio-quiet places on the planet and an ideal site for the Square Kilometre Array (SKA), an internationally funded next-generation radio telescope, scheduled to be fully operational in 2030. The SKA will peer deeper into the universe than ever before and help answer questions about how stars, galaxies and the universe formed and evolved. The state's ‘pathfinder’ radio telescopes are already boosting Curtin's physical sciences index score. “From small beginnings, we built a strong radioastronomy group,” says Wright.

For Wright, the key to Curtin's index success is its collaborations. “We are a modestly-sized university. We know we've got great people, but that there are even better people outside. That's key to what we do.”

**JMC**