

Hong Kong

Hong Kong has enjoyed 17 years of prosperity and academic freedom since the transfer of sovereignty from the UK to China. But with political unrest and increasing competition from mainland cities, it needs to rethink its long-term strategy.

ARTICLE COUNT (AC): **517**
 FRACTIONAL COUNT (FC): **250**
 WEIGHTED FRACTIONAL COUNT (WFC): **241**

Hong Kong, the former British colony turned special administrative region, has always been China's favoured city for science and technology (the city is ranked 10 among 143 economies worldwide in the Global Innovation Index 2014) because of its robust intellectual property protection and legal system. The city has transformed itself into an educational hub for serving the Asia-Pacific region. However, in recent years Hong Kong has faced a challenge — it must keep pace with China's scientific development or risk losing its competitive edge to nearby cities on the mainland, including Guangzhou and Shenzhen.

To give the city an edge, on 29 October 2014 the Hong Kong Legislative Council passed a resolution to establish the Innovation & Technology Bureau. The aim of the bureau is to support start-up companies and provide financial assistance for universities and research institutions to commercialize research.

While most cities in China have only one or two major contributing universities, Hong Kong has six — each comprising between 5% and 29% of the city's weighted fractional count (WFC; see 'City WFC breakdown'). In the index, WFC is a measure of the contribution of an institution to the papers its scientists have co-authored.

The University of Hong Kong (HKU) is the city's premier institution for higher education

and its largest contributor to high-quality journals — as shown by its WFC. In 2013 the 103-year-old establishment published five articles in *Nature* and *Science*, representing 1.2% of its WFC — a larger proportion than any other Hong Kong institution (see 'Nature and Science ratio'). HKU is responsible for half of Hong Kong's 10 articles in these two journals, but represents 71% of the city's WFC in this count.

“HKBU IS A SMALL UNIVERSITY BUT THE DEPARTMENTS WORK TOGETHER VERY CLOSELY”

Although it derives only 17% of its WFC from the life sciences (see 'Institutional subject spread'), HKU is strong in the field of microbiology/virology. A closer look at the index data reveals that Yi Guan and Joseph Sriyal Malik Peiris from HKU's school of public health are the most significant contributors in this area, with three articles in the index on the infectivity and transmission of avian and swine influenza viruses (including one in *Nature* and one in *Science*). “We have identified the source and

provided a detailed assessment on the infectivity, transmissibility, and pathogenicity of H7N9 influenza viruses,” says Guan. An avian flu virus, H7N9 caused 130 human infections and 40 deaths in China in March 2013. “Our work is thus far the most comprehensive piece of research on H7N9 influenza viruses.”

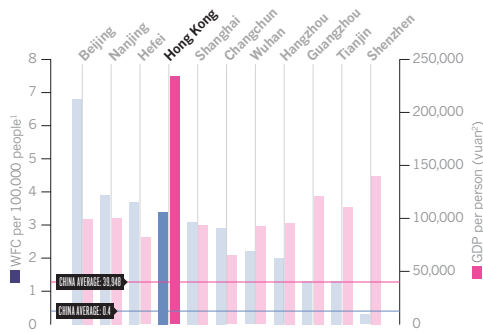
HKU also has the highest WFC of any Hong Kong institution in the physical sciences, having published 70 articles in this area (WFC = 26) mostly concerning advanced materials. Prolific researchers in the index include Wallace Chik Ho Choy at the department of electrical and electronic engineering, with four articles on organic solar cells, and Shunqing Shen and Haizhou Lu from the department of physics, who published three articles on the quantum properties of topological insulators — novel materials whose interior behaves like an insulator but whose exterior behaves like a conductor.

The Hong Kong University of Science and Technology (HKUST) has Hong Kong's second highest WFC in the physical sciences, with 49 articles in this field (WFC = 22). Two researchers from the department of physics are responsible for many of these publications. Ping Sheng is the largest contributor, with four articles in the Nature Index on graphene and metamaterials (engineered materials with optical properties not found in nature). The second is Penger Tong,

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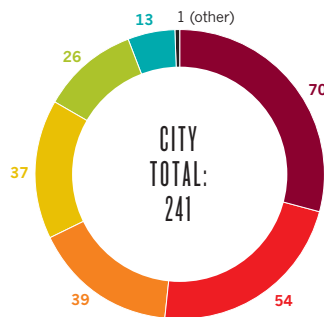
Hong Kong data

Hong Kong has the third highest GDP of any Chinese city, but the highest GDP per person.



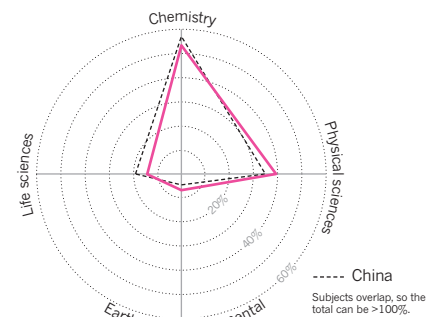
City WFC breakdown

Hong Kong has six major contributing institutions.



City subject spread

The distribution of Hong Kong's research is similar to that of China's overall.





Not yet 25 years old, yet HKUST is challenging much older institutions

who published three articles on colloidal monolayers, a model system for studying the structure and dynamics of complex fluids.

“This year we have developed acoustic metamaterials that can absorb low-frequency sound,” says Sheng. He adds that these types of materials will be useful in soundproofing homes and music studios from environmental noise.

The Chinese University of Hong Kong (CUHK) is also heavily focused on a range of physical sciences, and has many papers in the index published wholly by in-house researchers. The work of four researchers stands out from the data in 2013: Daniel Hock Chun Ong from the department of physics published two articles on the direct imaging of surface plasmon polaritons, which have important implications for Raman spectroscopy and hence molecular identification. Jianbin Xu from the department of electronic engineering published one article in *Nature Photonics* on graphene-based photodetectors with high responsivity, which increases the wavelengths of light that can be detected and hence widens the range of applications for such sensors. Qian Miao from the department of chemistry published four wholly authored articles on the synthesis of organic materials, while Zuowei Xie from the State Key Laboratory of Synthetic Chemistry published four articles on the preparation of derivatives of

carborane (a cluster composed of boron, carbon and hydrogen atoms).

Hong Kong Polytechnic University (Poly U) is the city’s institution most focused on geosciences, which account for 9% of its WFC. In 2013, it published five articles in this field, including astrogeologist Bo Wu’s landmark paper in *Earth Planetary Science Letters* on lunar topographic models. In physical sciences, which make up more than a third of Poly U’s output, the largest contributor to the Nature Index journals is Jianhua Hao from the department of applied physics. Working alone, Hao wrote three articles on functional thin films and heterostructures (all in *Applied Physics Letters*).

Poly U stands out in another measure in the Nature Index as the Hong Kong institution that has collaborated most actively, with an AC/FC ratio higher than the city’s other major universities.

City University of Hong Kong (City U) shows its strengths in physical sciences, with 44 articles in the index in this field — mainly from its department of physics and materials science. And it is in the materials science subset where it is particularly strong. Three researchers are responsible for the majority of these publications, led by Wenjun Zhang, who published four articles on nanowires and graphene. “Our materials help enhance the signals from surface-enhanced

Raman spectroscopy, a technique often used in bioimaging and medicine,” says Zhang.

The other two major contributors are Jensen Tsan Hang Li and Johnny Ho. Li has three articles on metamaterials and transformation optics, and Ho published three articles on the electronic properties of nanowires. “Our expertise has been traditionally in materials science, but in the future we would like to broaden our scope,” says Jian Lu, who is also vice-president of research and Technology at City U.

Of the Hong Kong institutions in the index, Hong Kong Baptist University (HKBU) has the highest proportion (66%) of publications in chemistry — well above the national average. Ricky Man Shing Wong from HKBU’s Institute of Advanced Materials is the largest contributor by WFC, with two articles on the development of fluorescent probes (WFC = 1.8). “We created an efficient multi-photon system for turning red light blue,” says Wong. “Such systems can serve as high-energy coherent sources for use in lasers and imaging applications.”

Edmond Dik Lung Ma from the department of chemistry published three articles (WFC = 1.7) in the related field of luminescent probes; work that came from an internal collaboration. “HKBU is a small university but the departments work together very closely,” he says. In 2013, Ma teamed up with researchers from the School of Chinese Medicine to detect proteins, measure enzyme activities and screen novel inhibitors. This collaboration ultimately led to the discovery of novel metal complexes for treating skin cancer.

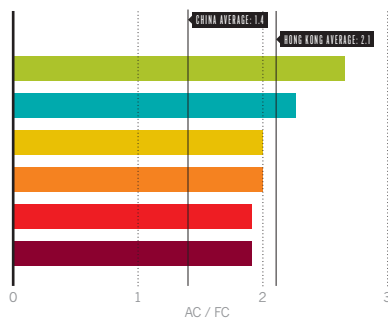
In 2011, HKBU established the Institute of Creativity in order to enhance interdisciplinary research and academic exchange. Chemist Raymond Wai Yeung Wong, associate director of this new institute, says it has helped him receive valuable advice from colleagues outside his field to help his research. Wong has six articles (WFC = 1.6) in the index covering heterometallic complexes, which are used in highly efficient organic solar cells and light-emitting diodes. ■

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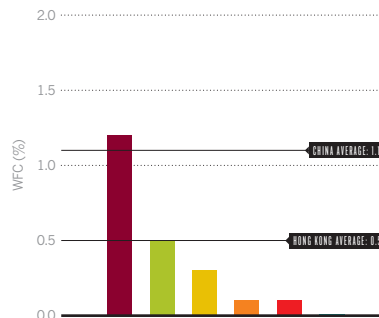
Collaboration rate

Hong Kong Polytechnic University has the highest collaboration rate.



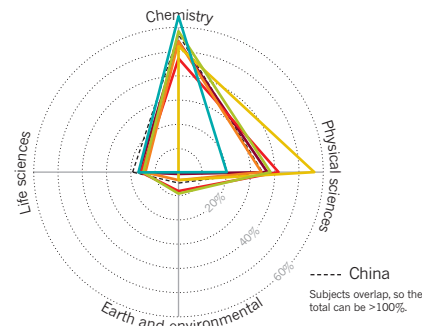
Nature and Science ratio

Only HKU exceeds the national average for papers in these two journals.



Institutional subject spread

Chemistry and physics are preferred across all institutions.



■ Hong Kong Polytechnic University ■ Hong Kong Baptist University

1. China Network; 2. HKTC Research; yuan = US\$0.16