Abstractions

SENIOR AUTHOR

In 1996, 20 neuroscience students in Iran signed their names in blood, pledging their commitment to studying the brain despite limited funding and facilities and US sanctions limiting travel and trade (see *Nature* **465**, 264–265; 2005). In the same year, Hossein Esteky, an Iranian who earned a PhD in Texas and did a fellowship in Japan, returned home to Tehran. He and several of the students who had taken the pledge joined forces, set up an electrophysiology lab and began studying cognition in monkeys. Their work shows how electrical stimulation of a few key neurons can help monkeys better perform facial recognition and categorization tasks (see page 692). *Nature* caught up with Esteky to discuss his work.

What obstacles did this research face?

It was hard. We didn't have the basic research infrastructure, and no one else in Iran was working with non-human primates. It took me about a year and a half to set up the first lab. Most of the equipment had to be obtained from the United States. Fortunately, medical instruments are not on the sanctions list.

Have you had any difficulties keeping in touch with research in the West?

We have tried to stay in touch. I've visited the United States several times since I left, but I have to go through Dubai in order to get a visa because there is no US embassy in Iran. Some of my students have not been able to get visas to attend US conferences.

How have your students progressed?

To begin with, I had to oversee the surgery on the monkeys that was required for the experiments, but the students soon learned to operate alone. Many of them are now in the United States. Seyed-Reza Afraz, the first author on the paper, is doing a PhD at Harvard University.

Why did you return to Iran after success in the United States and Japan?

To be with my family. I love my country. The brain drain going on the world is not healthy.

How do you think the current Middle East conflict is affecting research in the region?

At the moment Iran is relatively stable, and as a result science has been able to grow. Fifteen years ago, Iranians published 300–400 papers a year. Last year, we published about 4,000. But there are still few top-tier papers.

How has your work been received in Iran?

During the past five days I've been on TV and radio, up to six times a day. The public's understanding of the need for scientific progress is increasing here. Science can help us to improve our standard of living. ■

MAKING THE PAPER

Hsiang-Kuang Chang

How a neutron star can spot small rocks over long distances.

Beyond Neptune lies the Kuiper belt, an area of the Solar System that astronomers believe is made up of billions of rocks. These are thought to be the result of collisions, and some are huge, measuring 1,000 kilometres or more in diameter. Well-known examples include Pluto and its moon Charon. Although astronomers believe they exist, the smaller rocks have been harder to find. Now, a team of researchers has hit on a new way of looking for them (see page 660).

The use of optical methods has not been particularly successful in the hunt for the smaller members of the Kuiper belt. So, a group of astronomers led by Hsiang-Kuang Chang at Taiwan's National Tsing Hua University looked for an alternative. They came up with the idea of using X-rays from Scorpius X-1, a neutron star 9,000 light years away. From time to time, the number of X-ray photons reaching an observing satellite from Scorpius X-1 dips significantly. The researchers thought that these dips might result from small bodies passing in front of the star. Such dips are known as occultations.

Much shorter occultations can be detected with X-ray than optical methods, and this is crucial for finding tiny bodies. Whereas visible-light occultation events of 0.1 or 0.2 seconds might be detectable, researchers can detect X-ray occultations as short as one millisecond. This is because the instrument they used, NASA's Rossi X-ray Timing Explorer (RXTE) satellite, can process incoming data much faster than optical instruments.

Chang and his colleagues analysed seven years' worth of publicly available archive data from the RXTE. They used a computer program to sift through each time bin — a prescribed time interval during which the total number of photons was recorded. This was a much more thorough analysis than usual. "No one has ever looked into every time bin," Chang says.

The researchers found records of 58 occultation events. On the basis of their findings, they estimate that the Kuiper belt contains some 10^{15} small bodies (of 100 metres or less in diameter). Initially, however, they couldn't be sure that the effects they were seeing were not the result of instrumental error. So they turned to another batch of RXTE data, reporting observations of another major X-ray emitter, the Crab nebula, as a control.

Because of its large size, the Crab nebula is an extended source of X-rays. Scorpius X-1 is a point source. So whereas the tiny Kuiper-belt bodies would all but completely block Scorpius X-rays, they would barely obscure any of the Crab nebula's. The team reasoned that if there was an instrumental effect, both the Crab and the Scorpius data would contain similar dips in photon count. If there were none, only the Scorpius data would reveal the X-ray photon dips. They found the latter to be true.

In future work, Chang hopes to pin down the distance to these small bodies. The key could be in their diffraction effects. Although diffraction levels are much lower with X-rays than with optical light, diffraction effects are still seen in X-rays and can be used to determine how far objects are from Earth. This should lead to a better estimate of the size of these occulting bodies. Chang will also look at data from future RXTE observations in order to find more occultation events and to improve the accuracy of estimates of the size distribution of the Kuiper belt's rocks. ■

KEY COLLABORATIONS

The success of a team that produced three-dimensional images of prehistoric embryos (see page 680) is down to the group's tenacity, says Philip Donoghue, an Earth scientist at the University of Bristol, UK.

The field caught the interest of another Earth scientist, Xi-Ping Dong of Peking University in China, during a visit to Harvard University in 1996. "He didn't discover these embryos by chance," says Donoghue. "He saw presentations of other rare embryo finds, and wanted to find some himself. It got him thinking about biology rather than geology."

Dong teamed up with Donoghue, who has expertise in scanning electron microscopy. They began by looking at conodonts — tiny eel-like creatures dating back 510 million years. By chance, Dong found embryos of a prehistoric segmented worm in his samples. He eventually processed 12 tonnes of rock into sand-like particles and found five embryos.

A 2004 paper then drew the attention of Marco Stampanoni at the Swiss Light Source near Zurich. He had developed a technique in 3D X-ray tomography that held promise for imaging the tiny fossils in great detail. Stampanoni invited Donoghue to Zurich and gave him 24 hours of beam time.

Donoghue, who never used to work on embryos, now devotes much of his time to them. ■