was clearly the undisputed leader," says Rao. "But she's never been given fair recognition within China."

Artemisinin has "saved possibly millions of lives", says Stephen Ward at the Liverpool School of Tropical Medicine, UK. And the work of Campbell and Ōmura, who together discovered a class of compounds known as avermectins that kill parasitic roundworms that cause infections such as river blindness and lymphatic filariasis, has protected millions from disease, he adds.

Working in Japan, Ōmura isolated strains of a group of soil bacteria called *Streptomyces* that were known to have antimicrobial properties. In 1974, he pulled a promising organism out of soil near a golf course and sent it, along with others, to a team led by Campbell at the Merck Institute for Therapeutic Research in Rahway, New Jersey. (Ōmura's institute had signed a research partnership with Merck in 1973.)

Campbell's team isolated avermectins from the bacterial cultures and tweaked the structure of one of the most promising compounds to develop it into a drug — ivermectin. In 1987, Merck announced that it would donate the drug to anyone who needed it for treatment of onchocerciasis (also known as river blindness). A decade later, the firm began giving away the drug to treat lymphatic filariasis. Each year, Merck gives away some 270 million treatments of the drug, according to the Mectizan Donation Program in Decatur, Georgia.

Ward notes that the Nobel this year highlights the global acceptance of the importance of parasitic infections and of neglected tropical diseases in general. "It may refocus us on the idea that the immense diversity of products out there in the natural world is a great starting point for drug discovery," he says. ■

Additional reporting by **Alison Abbott**.

NOBEL PRIZE

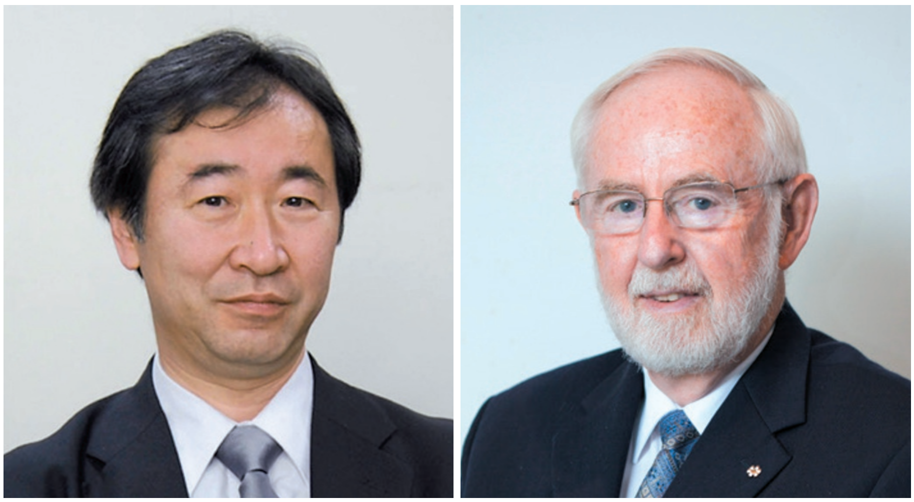
Neutrino flip wins physics prize

Physicists share Nobel for solving puzzle about the subatomic particles' changing identities.

BY ELIZABETH GIBNEY & DAVIDE CASTELVECCHI

Two researchers who helped to demonstrate that neutrinos oscillate between types, or 'flavours', as they travel — which proved that the elusive particles have mass — have won this year's Nobel Prize in Physics.

Takaaki Kajita at the University of Tokyo and Arthur McDonald at Queen's University in Kingston, Canada, share the prize for their discoveries with teams at two deep, underground neutrino detectors — Kajita at the Super-Kamiokande neutrino detector in Hida, Japan, and McDonald at the Sudbury Neutrino Observatory in Canada.



REUTERS/KYODO N

Takaaki Kajita and Arthur McDonald share the 2015 Nobel Prize in Physics.

The standard model of particle physics — the current best explanation of the Universe's particles and forces — struggles to explain why neutrinos have mass. So the two teams' discoveries, in 1998 and 2001, spurred a wave of new experiments seeking to pin down the neutrino's properties. "Other than the Higgs boson, I'd say this is the biggest discovery in particle physics in the last 30 years," says Daniel Hooper, a theoretical physicist at the University of Chicago in Illinois.

Neutrinos come in three flavours: electron, muon and tau, names that relate to the sister particle they are produced with. They are more abundant than any other particle in the Universe except for the photon: each second, billions of them stream through every square centimetre of Earth. But they interact so weakly with other matter that remarkably little is known about them.

The first hint that neutrinos were stranger than expected came in the 1960s. But an experiment at the Homestake gold mine in South Dakota threw up a mystery: it detected fewer electron-type neutrinos streaming from the Sun than theorists had predicted. (Alongside Masatoshi Koshiba of the University of Tokyo, Raymond Davis, who led the Homestake experiment, later shared half of the 2002 Nobel Prize in Physics for developing techniques to detect such neutrinos from space.)

Kajita's group began unravelling this conundrum in 1998, when it reported that neutrinos might change flavours as they travel. Muon neutrinos created in collisions between cosmic rays and Earth's atmosphere seemed to disappear on their way to the Super-Kamiokande detector, a steel tank filled with pure water located in a zinc mine.

Conclusively proving this, however, meant not just spotting 'disappearing' neutrinos, but showing that they had turned into other flavours. The Sudbury team, using a tank of water in a nickel mine more than 2,000 metres beneath Earth's surface, announced in 2001 that neutrinos oscillated between flavours as they travelled from the Sun to Earth.

The discovery has profound implications. Rather than the three neutrino flavours having no mass, or indeed any fixed masses, physicists now reason that neutrinos must be made from mixtures — or quantum superpositions — of three different mass states, which change in proportion as the particles travel. Pinning down the neutrino properties and their antimatter counterpart, antineutrinos, could lead to an understanding of physics beyond the standard model, says André Rubbia, a neutrino physicist at the Swiss Federal Institute of Technology in Zurich.

"We believe that differences in the way neutrinos and antineutrinos oscillate, for example, is the best possible explanation we have for why the Universe is today dominated by matter and not antimatter," says Rubbia. ■