NZASE scientist profile

Pauline Harris

Born where and when

Wellington, 1974: Te Rakatoa, Ruawharo, Kahungunu are her marae; Te Ara-a-Paikea, Moumoukai are her maunga; Kopu Awhara and Nuhaka are her awa; her iwi are Rongomaiwahine, Ngāti Rakaipaaka and Ngāti Kahungunu ki Wairoa.

School

Porirua East and Paraparaumu Primary, Kāpiti College: Studied chemistry, electronics, physics and biology.

How she got into science

"I was a *Star Trek* fan, I always loved space. I was fascinated with science; I remember staring at lemonade and wondering how the bubbles work. I loved a series of books called *Tell me why,* about why the sky was blue and lots of other questions."

Training and jobs

BSc, Victoria University of Wellington
Masters in astronomy, Canterbury University
PhD in astrophysics, Canterbury University
Research fellowship in Physics, VUW
Lecturer in Mātauranga Māori & Science, VUW.

Fields of science

Cosmology, high energy astrophysics, extra-solar planet astrophysics, tātai arorangi.

How she finds things out

Universe expansion after the Big Bang

"We examined how galaxies are distributed in the universe, how they clump together,

Society for Māori Astronomy, Research and Traditions (SMART) members and collaborators - Back row, left to right: Dr Pauline Harris, Professor Rangi Matamua, Jude Cornelius Nuku, Ockie Simmonds; front row, left to right: Rereata Makiha, Kalei Nuuhiwa, Liliana Clarke.

and then looked at data from the cosmic microwave background (below), made up of red-shifted (increased wavelength) photons from when the universe was 300,000 years old. Then we worked out ways to describe how the universe evolved."

High energy neutrino production

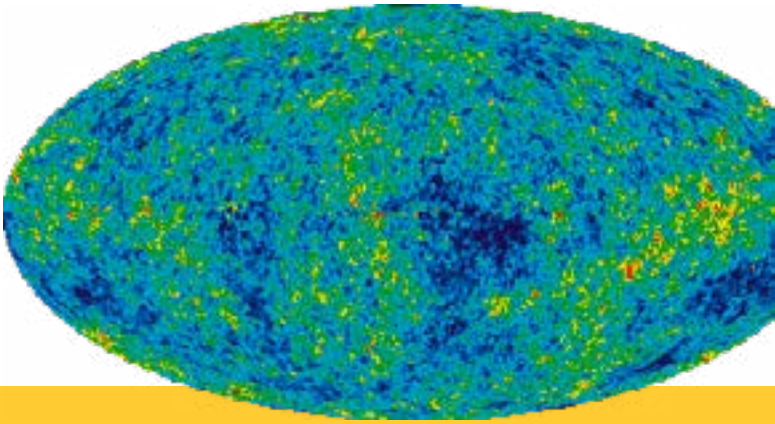
Neutrinos are elementary particles with very little mass and no charge, which travel directly from their source, passing through ordinary matter and rarely interacting with it.

They are produced by nuclear reactions in the centre of stars, by supernovas, and were thought to be produced in gamma ray bursts when cosmic rays strike photons or other particles. Ultra-high energy (UHE) neutrinos travel enormous distances.

Pauline searched for correlations between UHE neutrinos and gamma ray bursts, thought to be released when large stars implode or when black holes collide with neutron stars.

"We used a radio frequency detector at the

Map of the temperature of the cosmic microwave background, across the whole night sky. Red regions are warmer and blue regions are colder. NASA/Wikimedia.



Part of the night sky: The ecliptic, in red, indicates the path of the sun during the day, and the path the planets follow. Names may vary by iwi. Image: A review of Maori astronomy, SMART.

South Pole, and analysed the observations with sophisticated computer software to search for neutrino signals from background noise. We ran millions of calculations to determine how good our detector was. From that we were able to tell how big a burst would need to be for us to see it."

Looking for exoplanets

"When the earth aligns with a closer and a more distant star, the gravity of the middle star can act like a lens, pulling light rays around, and magnifying the light of the distant star. If the middle star has a planet, the lens is distorted, like a magnifying glass with a chip, so it is possible to calculate whether the distortion comes from a planet or another star."

Climate change and Maramataka

Maramataka, Māori calendars, relate the movement of the earth, moon and the stars to telling time, for fishing, planting and harvesting crops, building, exploration, and holding festivals. They are part of Tātai Arorangi, Māori astronomy, which in turn is part of the celestial knowledge of creation, the gods, stars and time. Karakia were spoken to acknowledge celestial beings during planting and harvesting.

Traditional maramataka use ngā tohu (signs) o te tau (of the year) and a lunar cycle. Some of these tohu have been aligned with the months of the Gregorian calendar that originated in Europe. Traditionally, Māori seasons are marked by tohu, such as the appearance of certain stars or the blossoming of certain flowers. Tohu vary depending on whether iwi live on the coast or inland, in the far north or south. Pauline says that hundreds of maramataka exist; many are unpublished and held by experts.

"UNESCO asked whether Māori calendars could inform their climate change policy", she says. To answer this question her team used interviews with experts from around the country and in Hawai'i, as well as oral history, surveys, wānanga, and environmental and ecological observations.

The project included a citizen science component using a survey app called KoBo Toobox. Pauline's team created a survey where participants log their observations of moon phases, take photos and answer questions.

The team collated all the data to understand where maramataka are being used, and help regrow community observations of our natural world.

"My role was to oversee the research, design the questions, guide the researchers, including students, and analyse the data, as well as include the knowledge in educational programmes."

"Our people have noticed seasonal

Te Mangaroa, the shark, and the home of the stars (the Milky Way). Image by SMART illustrated by Kāterina Kerekere, photographed by Fraser Gunn.

Ngā Kupu

Te ao tukupū – Universe
Ariā Pahū Nui – Big bang theory
Hihi kama – Gamma ray
Korakora – Particle
Mahana o te ao – Global warming
Mātai tuarangi – Cosmology
Whare rangihori – Planetarium

From Paekupu

Pauline at Space Place at the Carter Observatory.

shifts," she says; like other indigenous communities, they attribute these changes to pollution, human encroachment, and global warming. Results for this project, called Ngā Takahuringa o te Ao, will be published soon, possibly including videos and a 2021 conference in Rotorua.

Other projects Pauline works on collate, preserve and revitalise Māori astronomical knowledge, and produce educational resources from pre-school to higher-level education, including books, a website, and planetarium programmes.

Most valuable results

"I'm really proud of my contribution to the revitalisation of Matariki and maramataka - I've been doing Matariki talks for 23 years. I'm also really proud of finishing a PhD in astrophysics when I had a baby during it - it was really difficult. I value contributing to mātauranga Māori in science, and for sustainability."

Pauline was a co-founder of the Society of Māori Astronomy, Research and Traditions (SMART) and is currently the chair. She has designed programmes that can deliver lessons about Tātai Arorangi in SMART's portable planetarium in te reo as well as English. The society aims to "preserve Māori astronomical knowledge, encourage Māori into science, and to launch Māori success".

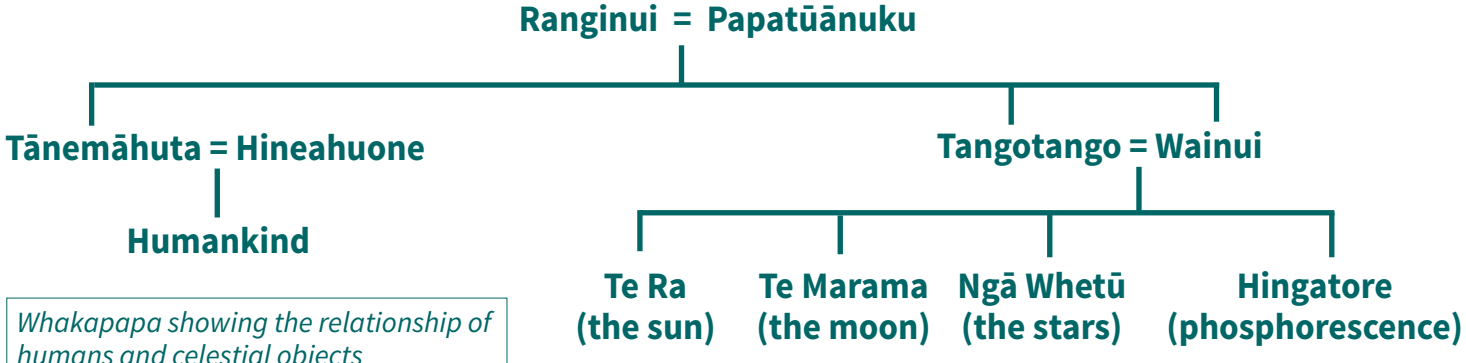
What she likes about science

"It's the fascination with the beauty of the world around us. The light's glistening off the leaves outside at the moment; all those processes, all the beauty and complexity of it.

I love hearing kids say, "Oh wow, that's cool", in awe of the things we show them in the dome. In wānanga adults get really excited about learning to make their own observations. It's really important to follow your passion, your true calling, don't let anyone tell you that you can't do it."

Links

- SMART website and Facebook page
- Tātai Arorangi video on Project Mātauranga
- Pauline's profile on Curious Minds
- Te Papa's Maramataka poster
- Early Māori measurement, Science Learning Hub
- Maramataka, Manawhenua website.



Whakapapa showing the relationship of humans and celestial objects