Sindhujha Kumaran’s ghost story

The UC Irvine postdoctoral researcher studies neutrinos, or “ghost” particles.
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UCI postdoctoral researcher Sindhuja Kumaran is on a quest to understand a subatomic particle first discovered by UCI physicist Frederick Reines. In July, Kumaran will take her expertise to the Lindau Nobel Laureate Meeting in Germany as part of the UC President's Lindau Nobel Laureate Meetings Fellows program.

Picture Credit:
Sindhuja Kumaran

Sindhujha Kumaran, a postdoctoral researcher in the UC Irvine Department of Physics & Astronomy, chases ghosts.

And if there’s a corner of the cosmos that’s best for chasing ghosts, it’s the UC Irvine Department of Physics & Astronomy, where one of the most common “ghosts” in the universe was discovered: the neutrino.

Co-discovered in 1956 by UCI physicist and Nobel laureate Frederick Reines, the neutrino is, after the photon, the second-most abundant subatomic particle in the universe. Physicists call neutrinos ghosts because, unlike other subatomic particles, they rarely interact with the matter that we can see and touch – they just float through that matter without resistance.

“I was listening to a seminar on neutrinos during my bachelor's, and I remember being really fascinated by their ghostly nature,” said Kumaran, who’s originally from India.

Kumaran followed her curiosity and set out to study neutrinos, which she’s still doing today in the lab of UCI’s Professor Pedro Ochoa-Ricoux. At UCI, Kumaran is part of the DUNE and JUNO experiments, which aim to tackle some of the biggest questions in modern neutrino physics.

But as a brown, queer woman physicist, Kumaran’s path through the field of particle physics wasn’t as resistance-free as a neutrino’s path through the cosmos might be.

“I grew up in a country that’s relatively more patriarchal and queerphobic, and that’s one of the reasons I moved away,” Kumaran said. “I always had to fight for what I wanted, especially when I wanted to move to another country to pursue my love for neutrinos.”

Even when she left India to study in Germany at RWTH Aachen University, she met resistance when she suddenly became a student from an underrepresented group. “‘Oh, I did not expect you to answer all those questions,’” she recalls one instructor telling her. ‘Especially since international students never answer all those questions.’”

“It’s the microaggressions that have been really hard to tackle after I moved to the West,” Kumaran added. “I suffered from severe imposter syndrome during the first year of my master’s. It can feel very much like a boy’s club — especially in the experiments that I work, it’s predominantly men.”

Nevertheless, she kept ghost-chasing.

In 2017, while working at Aachen and also Forschungszentrum Juelich in Germany, Kumaran was part of the Borexino experiment, which is a neutrino detector located deep underground at the LNGS lab in Italy. “I was scanning some newly-recorded data looking for geoneutrinos – neutrinos emitted from nuclear fission reactions inside Earth,” said Kumaran. “There are about a million of them passing through your fingertip in a second, but only about five geoneutrinos get detected by Borexino in a year due to their weakly interacting nature – and I was the first one to look at them, on a computer using code I wrote.”

Then, after analyzing neutrinos emanating from our sun, the Borexino team discovered a process that involves the fusion of carbon, nitrogen and oxygen, which may be generating most of the energy for stars many times the mass of our sun. Their results appeared in the journal *Nature* and won the Borexino team the Guiseppe and Vanna Cocconi prize from the European Physical Society.

It’s a story Kumaran works to tell so others from similar backgrounds can know what’s possible for themselves. Last year, Kumaran shared her journey in a talk she gave to UCI’s UNITY (Underrepresented Genders in Physics and Astronomy) group.

“The most encouraging thing I could tell others is that there is no one way a physicist needs to think, and your way is valid, too,” said Kumaran.

And there’s nothing spooky about that.

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