UC Irvine physicists help unite “rival” neutrino experiments in breakthrough global study

Professors Jianming Bian and Henry “Hank” Sobel are part of the international collaboration.

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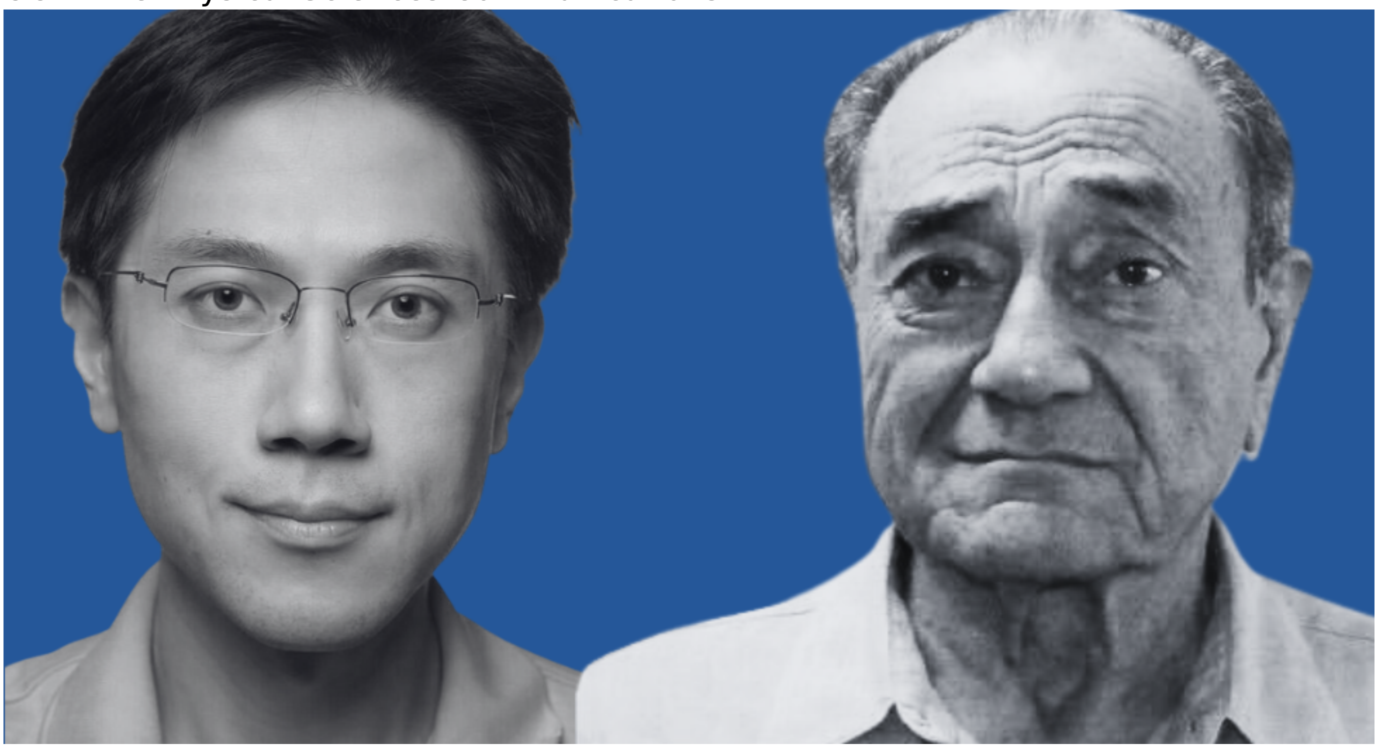

Professors Jianming Bian and Henry "Hank" Sobel.

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Scientists at the University of California, Irvine have played a key role in a newly-published joint analysis from the T2K and NOvA collaborations – experiments involving hundreds of scientists working together to answer questions about one of the most abundant subatomic particles in the universe, the neutrino. Two experimental groups led by professors Jianming Bian, Henry “Hank” Sobel and Michael Smy made essential and leading contributions to both sides of this unprecedented partnership.

“As soon as our NOvA and T2K results came out, we realized that combining the strengths of both experiments would give us a clearer overall picture than either experiment could alone, and we immediately moved forward to make that joint analysis possible on the NOvA and T2K side,” Bian said.

The Bian-led group works on NOvA, a U.S.-based experiment that studies neutrinos produced at Fermilab and detected at another site in northern Minnesota. The group plays a lead role in NOvA’s oscillation analysis – work that reveals insights into the mass of neutrinos – and also leads NOvA’s artificial intelligence and machine learning-based neutrino detection analysis efforts that provided the NOvA input for this joint analysis.

The group led by Sobel and UC Irvine physicist Michael Smy works on T2K and Super-Kamiokande – a large underground detector in Japan that detects neutrinos produced by T2K. Their group specializes in reconstruction of neutrino detection events at Super-Kamiokande.

“NOvA is especially sensitive to the neutrino mass ordering, which tells us which neutrino is heavier or lighter, while T2K could help explain why the universe has matter instead of antimatter,” said Sobel. “Bringing the two analyses together was extremely challenging because the experiments used different detector technologies and analysis methods. But it was worth the effort because only a combined result can reveal the full picture of neutrino behavior.”

Bian and Sobel’s combined expertise in detector calibration, data analysis and oscillation modeling helped enable the precise cross-comparison of the two experiments’ measurements that underpin this joint result – an achievement that sharpens our understanding of how neutrinos behave and how they may hold clues to why the universe is made of matter instead of antimatter.

“Now that we have this first joint result, the next step is to bring in new data from both experiments and pave the way for DUNE and Hyper-K — the next-generation successors to NOvA and T2K and the flagship particle physics projects of the U.S. and Japan — to build on this collaboration and deliver a definitive answer on neutrino mass ordering and CP violation,” Bian said.

The results from the joint analysis were published this week in *Nature*. Funding for the two groups came from the U.S. Department of Energy and the National Science Foundation.

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