

How physics moves from wild ideas to actual experiments

In the case of the AMANDA experiment, early tests in Greenland and later tests at the South Pole began to provide these happy accidents. “It was discovered that the ice was even more exceptionally clear and has no radioactivities—absolutely quiet, so it is the darkest and quietest and purest place on Earth,” said Karle.

AMANDA was much smaller than the IceCube experiment, and theorists had already argued that to see cosmic neutrinos, the experiment would need to cover a cubic kilometer of ice. Still, the original AMANDA experiment wasn't just a prototype; if neutrinos arrived at a sufficient rate, it would spot some. In this sense, it was like the original LIGO experiment, which ran for many years in the early 2000s with only a minimal chance of detecting gravitational waves, but it provided the information needed to perform an upgrade in the 2010s that led to repeated detections. Similarly, the hope of pioneers like Halzen was that AMANDA would be able to detect cosmic neutrinos despite its prototype status.

“There was the chance that, with the knowledge at the time, one might get lucky. He certainly tried,” said Karle.

Prototype experiments often follow this pattern. They're set up in the hope that they could discover something new about the Universe, but they're built to at least discover any unexpected challenges that would stop a larger experiment.

Major facilities and the National Science Foundation

For experiments that don't need huge amounts of funding, these prototypes can lead to the real thing, with scientists ratcheting up their ambition at each stage. But for the biggest experiments, the governments that provide the funding tend to want a clearer plan.

Since Prohira is based in the US, let's consider the US government. The National Science Foundation has a procedure for its biggest projects, called the Major Research Equipment and Facilities Construction program. Since 2009, it has had a "no cost overrun" policy. In the past, if a project ended up costing more than expected, the NSF could try to find additional funding. Now, projects are supposed to estimate beforehand how the cost could increase and budget extra for the risk. If the budget goes too high anyway, projects should compensate by reducing scope, shrinking the experiment until it falls under costs again.

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