Bubble-chamber images reveal the unseen beauty of particle physics

by Scott_LaFee

For all the vastness of the universe, its real work occurs at the scale of elementary particles - subatomic entities with names like proton, positron, quark and baryon.

These are the stuff of matter and the known universe. Yet these particles are so incredibly tiny that they are essentially invisible. Indeed, it has been only in the last several decades that technologies emerged to prove they existed at all.

Among those technologies is the bubble chamber, invented by American physicist Donald Glaser in 1952. Widely used through the 1970s, bubble chambers produced visual evidence of charged particles racing and looping through space, splitting and combining in mere billionths of a second.

POP ART - Lylie Fisher took bubble-chamber images of trails left by subatomic particles and turned them into works of art by adding colored resins and varnishes. 'What attracted me was the interaction between the bubble tracks and the spaces they created,' she said. CNS Photo courtesy of Lylie Fisher.

"These devices allowed physicists to reconstruct and study high-energy subatomic interactions with an unprecedented level of detail," said Vivek Sharma, a professor of physics at University of California San Diego. "Bubble-chamber pictures have played an important role in conveying science without oversimplifying the fundamentals. It's like, 'What you see is what you get.' These pictures are, in my mind, masterpieces of nature's abstract art."

Some of that art can be seen in the work of San Francisco-based artist Lylie Fisher, who has taken original bubble chamber images from the Stanford Linear Accelerator Center archives and embellished them with colored resins, pigments and varnishes to bring out and emphasize their innate grace and beauty.

"I first learned about bubble chambers while watching a 'Nova' program on string theory about a year ago," said Fisher from her home in Alameda, Calif. "I understood maybe a quarter of it, but I liked the theory, and I loved the pictures.

"What attracted me was the interaction between the bubble tracks and the spaces they created. The tracks are the tangible evidence of the universe. They represent our understanding of it. The spaces between them, it seemed to me, were the emotional and intellectual places we inhabit. They're nebulous and hard to describe. That's humanity."

TINY BUBBLES

To understand the art, start with the science. A bubble chamber is basically a pressure cooker with windows. It consists of a sealed vessel filled with a transparent liquefied gas, typically hydrogen or helium, though more exotic liquids can be used. The liquid is maintained under pressure at a temperature just below its boiling point. For liquefied hydrogen, that's very cold indeed, just a few degrees above absolute zero, or minus 459.67 F. The chamber is encased in magnetic coils to create an internal magnetic field. High-resolution cameras are mounted at various angles looking into the chamber to record three-dimensional images of what happens inside.

As charged particles or rays are beamed into the chamber, the floor of the chamber is suddenly lowered (in just a fraction of a second), simultaneously expanding the vessel's internal space and reducing its internal pressure.

Lower pressure means the boiling point of the liquid drops, too. The liquid becomes superheated - hotter than its boiling point but not actually boiling.

The beamed particles, moving at near light-speed, collide with other particles in the superheated liquid, splitting or combining into new and different kinds of particles, each of which leaves behind it a distinctive trail of tiny atomized bubbles, not unlike the contrails of flying jetliners.

By photographing and analyzing these bubble tracks, scientists infer much about the structure and nature of the particles, and their fundamental rules of engagement and interaction. For example, positively charged particles leave helical tracks that curve in one direction, while negatively charged particles leave tracks in the opposite direction. The degree of curvature depends upon the mass, speed and charge of the particle.

"Bubble chambers contributed in very important ways to the discovery of many, many new elementary particles," said Han Paar, a UCSD physicist.

Nowadays, bubble chambers are largely relegated to the dustbin of particle physics history, replaced by more powerful, computerized accelerators capable of detecting and analyzing hundreds of subatomic "events" per second with greater speed, finesse and accuracy. But their legacy endures, scientifically and aesthetically. Bubble chambers laid the foundation for subsequent fundamental discoveries. And they have done so in grand style.

With Fisher's help, bubble-chamber images permit us to see what can't be seen and admire the stuff we are made of.

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For more examples of Lylie Fisher's bubble-chamber images, visit Fisher's Web site at www.lyliefisher.com.