HIGH-ENERGY PHYSICS

Community Asks: Has Sam Ting Found a New Particle?

How does a new subatomic particle emerge? With a bang—and then a buzz. The bang is a collision in a particle accelerator, producing a shower of minute debris that could carry the signature of a hitherto unknown constituent of matter. The buzzing follows in the international physics community, as the field puzzles over whether the results are real, or just a flash in the particle pan.

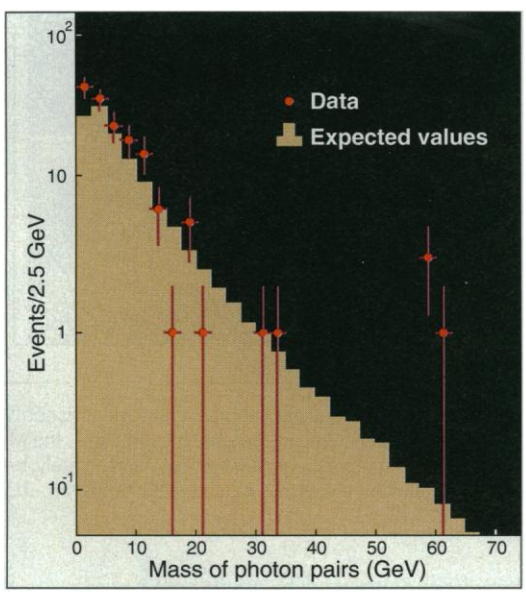
That's just what's happening now in the wake of a meeting at Fermilab earlier this month, when Nobel laureate Samuel Ting announced that his particle detector at CERN in Switzerland has picked up suspicious signals that might be the footprints of a new and unexpected particle. Ting's group presented their data straight, refraining from saying they had discovered anything. But that didn't stop physicists at the Division of Particles and Fields meeting from speculating whether Ting has actually found a new creature or is chasing a statistical fluke.

The object of all the attention is four unusual sets of collision products: each containing a pair of photons and either a pair of electrons or a pair of related particles called muons. The combined energy and mass of the photon pairs suggests that they originated from a single type of particle, with about 60 times the mass of a proton. But such a particle would come to physicists out of the blue, violating the Standard Model, which is the accepted picture of the submicroscopic world. "It really doesn't fit in anywhere," says Fermilab's William Bardeen.

But to some, that's what's so intriguing: "The fact that it doesn't fit current theories makes it even more exciting," says Fermilab theorist Chris Quigg. Many in the crowd at the particle physics meeting remained skeptical, however—especially since there are explanations for the photons that don't involve startling new discoveries. But people did prick up their ears when Ting announced that he had calculated the odds at a thousand to one that those conventional processes are responsible for his results.

People perked up even more when a physicist from another detector group, known as Delphi, reported two similar events. Ting's detector, known as L3, and Delphi sit at different positions on the same accelerator—the electron-positron collider known as LEP at CERN near Geneva. The detectors surround places on the collider where electrons traveling near the speed of light crash head-on into positrons, their oppositely charged counterparts; the detectors record the spray of particles that shoots out of the collision. Researchers search that spray for signatures of exotic, unstable particles, and to researchers at Ting's L3, the photon pairs looked suspicious.

In all six pairs the physicists measured the same invariant mass—a combination of mass and energy of motion that adds up to the mass of a particle needed to create the pair. All six came strikingly close to 60 billion electron volts. "The thing that makes this exciting is that they all cluster about the same mass," says Charles Baltay of the Stanford Linear Accelerator Laboratory. (Particle physicists express mass in energy units because of the equivalence of mass and energy dictated by Einstein's relativity; the proton, for example, weighs in at about 1 billion electron volts.)



Ting and his events. Photon pairs collected by Ting's experiment cluster curiously around a mass of 60 billion electron volts.

MIT physicist Bolek Wyslouch, who works with Ting on the L3 collaboration, says they measured the first two in 1991. But, Wyslouch adds: "This was not statistically significant." The next two came last summer. But even four such traces could have arisen from electrons by a commonplace process known as Quantum Electrodynamics (QED). "QED is known to produce hard [energetic] photon events," Wyslouch said at the meeting, "but there is no mechanism to produce a clustering"—four events of the same mass.

Wyslouch and his colleagues calculated the signals they would expect to see from QED. While there's no physical reason why the commonplace events couldn't have created the four photon pairs of the same mass, it's statistically unlikely—something like finding that everyone at a party has the same birthday. But that isn't out of the realm of possibility: "This could just be a statistical fluke," concedes Wyslouch. But when the Delphi experiment added two more events, bringing the total to six, the results began to look less flukey.

But physicist Jesus Marco of the Delphi collaboration says the case isn't settled yet. "We've seen one in a thousand flukes happen before." Marco says he'd be more convinced if evidence started coming in from the other two detectors catching particle collisions from LEP, called Aleph and Opal. At the meeting, rumors circulated that Aleph had also caught two similar events, though researchers on that collaboration made no pronouncement.

Ting says he doesn't want to speculate about a new particle until he has more data, saying he came forward because the results looked "curious." Some wondered aloud whether Ting hadn't learned from experience to overcome his native caution and be bold when he finds curious data. Many say caution forced Ting to share his 1976 Nobel Prize with Burton Richter of Stanford Linear Accelerator Center for the discovery of a new particle that Ting calls the J and Richter calls the psi and everyone else calls the J/psi. Physicists such as Melvin Schwartz of Brookhaven National Lab say Ting had evidence for the particle first but sat on it. By coming forward with his early results now, Ting ensures credit if a new particle comes up.

But Ting was careful not to take the next step by giving his putative particle a name. And if the experience of fellow Nobel laureate Leon Lederman is any guide, that could be a smart move. At the meeting, Lederman recalled that in 1976, when he saw evidence for a new particle, he dubbed it the upsilon. But when his signals started looking like a statistical fluke, his colleagues started calling it the "oops Leon." (He later found a real Upsilon at a higher mass.) Says Lederman: "This one might be the oops Ting." On the other hand, it might just turn out to be the real Ting.

–Faye Flam