WIRED

The art of the particle

How CERN inspired two artists to create a sound and light show based on the Big Bang

Artists Joe Gerhardt and Ruth Jarman inside *Halo*, a musical installation that turns CERN data into sound

Deep beneath the French-Swiss border, creative duo Semiconductor turns particle physics into art. Their subject? The moment two bunches of protons travelling close to the speed of light collide, with roughly the same amount of energy as particles had fractions of seconds after the Big Bang.

"Really, what we're interested in is nature and physical matter," says Ruth Jarman, one half of Semiconductor. In 2015, Jarman and her collaborator, Joe Gerhardt, spent a three-month artistic residency at CERN, where they spoke with particle physicists working on the Large Hadron Collider (LHC). "It was a very intense research period," she says. "We were in the lab every day, delving around."

The result is *Halo*, an immersive digital installation that depicts the aftermath of proton bunch collisions. Inside the LHC, a single collision lasts just 25 nanoseconds, but Semiconductor slowed things down by a factor of a billion so every collision plays out in 25 seconds across a 360-degree projection screen. Particles released from proton collisions scatter across the display as dots of light, triggering notes from piano wires suspended floor-to-ceiling in a circle surrounding the screen.

What started as a collision of light particles inside a tunnel near Geneva will end up as a cacophony of musical notes when the work is installed this June at the Art Basel fair in Switzerland. Viewers will be able to walk inside the ten-metre wide vertical cylinder so they are surrounded by the projection.

"It's more accessible than just graphs and histograms and reading scientific papers," says Mark Sutton, a CERN particle physicist who worked with Semiconductor to turn the raw data from the LHC into a usable form. The challenge, he says, was knowing which data could be thrown away. Every second, 40 million proton bunch collisions take place within the LHC's ATLAS detector. If it were all retained, it would generate so much data it would exceed the world's storage capacity in just a few days.

To solve this, the ATLAS detector has triggers that limit the data captured to 1,000 bunch collisions per second. Usually, these triggers are programmed to capture only those collisions that are more likely to produce rarely seen particles such as the Higgs boson, which was discovered at CERN in July 2012. But for the dataset used in *Halo*, the triggers were set to record collisions at random. *Halo* recreates 60 bunch collisions in total, captured during the LHC's first run between 2009 and 2013.

"We've worked with the data in its rawest form, which basically ends up as white points in space," says Jarman. On the screen, tens of thousands of points of light – representations of the quarks, electrons, pions and muons formed in the aftermath of a proton collision – rain down, mimicking the way subatomic particles radiate out of the detector after a collision. "Each of these points of light – of data – is then translated into MIDI information so it also plays the strings in the space," Jarman says.

The ATLAS detector itself partly inspired the Brighton-based pair's cylindrical design for *Halo*. Inside the detector, the movement of particles is detected by 370,000 tubes filled with xenon gas, with a thin tungsten wire running through the length of each tube. When a particle released from a collision passes through one of these tubes, it ionises the xenon and sends a pulse down the corresponding wire. By comparing pulses from different tubes, physicists can reconstruct the path a particle takes in the millionth of a second before it leaves the detector.

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"We're recreating on a micro scale the conditions of that short amount of time after the Big Bang," says Sutton. At CERN, work has started on an upgrade to the LHC, to be completed by 2026, which will increase the number of proton collisions by between five and ten times. This means more opportunities to study particles such as the Higgs boson; in its early runs, the LHC produced around 1.2 million Higgs boson particles a year. By 2016 it should be 15 million.

But for Jarman, every proton collision is a work of art. "You don't need to know what the science experiment is," she says. "We make the work so that it transcends the data and becomes a phenomenon in its own right. You're experiencing nature, and that does become a quite humbling experience." **MR**

PHOTOGRAPHY: DAVID YARNTON-R

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Hoop
Planning a family weekend? Hoop tells you everything going on in your location that fits the ages of your kids – and your budget. *iOS & Android, free hoop.co.uk*

Let's stack AR!
Developed by ten-year-old whizz-kid Yuma Soerianto, this lets you pile up virtual blocks among real-world buildings around you. *iOS, £0.99 madebyyuma.com*

CastBox
This podcast app is home to thousands of podcast series – all searchable using words and phrases within the audio. *iOS & Android, free castbox.fm*

Silly Walks (weird)
Tap to provide help to "Piney", a cute pineapple-shaped cup, fight off household items such the evil Blender. *iOS, free parttimemonkey.com* **EP**