STOPPING the COLLISION

The Fight Over the Large Hadron Collider

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It's a product liability case to the *n*th degree. An eminent scientist goes to court to stop other equally eminent practitioners from releasing its "product" on the grounds that the design is defective and the possible consequences to the public could be catastrophic. The plaintiff's lawyer might well feel that not only the fate of his or her client at stake, but also that of the free world if the verdict is not returned in his or her favor.

In the case of *Sancho v. Department of Energy*, this was exactly the case—with the plaintiff arguing that a new scientific experiment would result in the end of the world, and the defendants claiming that it was completely safe and merely imitating the natural actions of the physical universe. The case presents a prime example of the difficulties of litigation centered around science. How does a lawyer explain cutting-edge science to a judge and other lawyers who may have no particular scientific expertise? What standard of proof is appropriate where one side honestly believes the consequences could be as dire as extinction of the earth?

The Large Hadron Collider Project

At the center of the *Sancho* case is the largest scientific experiment in history: the Large Hadron Collider project, designed (it is hoped) to prove the Standard Model of particle physics and replicate the moments after the Big Bang to find the Higgs boson, or "God particle." Located 350 feet underground beneath the border between Switzerland and France outside Geneva, the Large Hadron Collider project began as an idea in the early 1980s as physicists began to look to the future of particle physics. The largest supercollider ever built, the Large Hadron Collider project aims to recreate the conditions that existed shortly after the Big Bang. After 14 years of planning and construction, on September 10, 2008, the LHC was switched on and the first beam of protons successfully traveled the 17-mile tunnel of pipes, a cause for celebration among the scientists at the facility.[1]

The LHC project seeks to answer a number of questions about the nature of physics and ultimately the universe, most importantly whether the Standard Model of particle physics is correct. The Standard Model sets out that the universe is made of matter that is made up of 12 fundamental particles that are governed by four forces.[2] The two basic types of particles are quarks and leptons, each of which consists of pairs called "generations" that are determined by the weight and stability of the particles, so that the first generation features the lightest and most stable particles while the heavier and less stable particles make up the second and third generations.[3]

The generations of quarks are arranged such that the first generation is made up of the "up quark" and "down quark," the second generation of the "charm quark" and "strange quark," and the third generation of the "top quark" and "bottom quark."[4] In the case of the leptons, the first generation is made up of the "electron" and "electron-neutrino," the second of the "muon" and "muon-neutrino," and the third of the "tau" and the "tau-neutrino," with the former of each of the pairs having an electrical charge and mass while the neutrinos are neutral with little mass.[5] The four forces at work in the universe according to the Standard Model are the strong force, the weak force, the electromagnetic force, and the gravitational force.[6] The forces differ in terms of the ranges over which and the strength with which they work. Gravity is the weakest force, but has infinite range, while the electromagnetic force has the same range but is far stronger than gravity.[7]

In contrast, the weak and strong forces only work at very short ranges, and are dominant only at the level of subatomic particles. Central to this inquiry is whether the Higgs boson, or "God particle," can be found among the particles after the collisions. The Higgs boson is seen as being key to the origin of particle mass, and to the explanation of what gives mass to particles in the universe.[8] The quest to find the Higgs, as well as gain the deepest understanding yet of what makes up the universe, is what has driven and continues to drive scientists to bring the LHC

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into fruition and get into the business of smashing particles.

In order to explore these questions, the LHC was designed to send two streams of protons around the supercooled 17-mile tunnel in opposite directions at 99.999999 percent the speed of light in an effort to recreate the conditions that are believed to have existed after the Big Bang.[9] The LHC has four detectors that will be used to track the particles that are created by these collisions, the largest of which are ATLAS (A Toroidal LHC ApparatuS) and CMS (Compact Muon Solenoid).[10] The detectors work in layers to detect different types of particles. Both the ATLAS and CMS detectors contain tracking devices that will follow short-lived particles, as well as enormous magnets that bend the paths of the particles so that they can be identified by charge.[11] The layer of tracking devices in between the magnets and trackers are calorimeters, one designed to capture electromagnetic energy, and the other designed to capture energy from particles such as protons, neutrons, and pions.[12] Finally, the outer layer of both measuring apparatuses are designed to detect muons, or particles that cannot be stopped by the inner layers of the detectors.[13] The detectors are enormous, with ATLAS measuring 151 feet long and 82 feet high, and CMS taking up less space but weighing twice as much, due in part to the fact that CMS contains more iron than the Eiffel Tower as a result of its layers of magnets.[14]

In addition to ATLAS and CMS is the ALICE (A Large Ion Collider Experiment) detector. This apparatus will only be used for about a month out of every year to conduct experiments where the collider will be switched from smashing protons to smashing lead ions, which are 100 times heavier than protons.[15] The experiments conducted with ALICE are expected to blast the ions so that they will produce a plasma of free-flying quarks, in addition to gluons, or the particles that usually bind quarks together.[16] Previous experiments have indicated that such a plasma behaved like a liquid, and ALICE scientists are hoping to discover how this plasma will behave at the gas stage, something that has never been seen in science.[17]

The fourth detector at the LHC, LHCb, like ALICE, aims to answer a specific scientific question, that of studying particular types of quarks and antiquarks called B mesons and anti-B mesons to explore why matter seems to edge out antimatter in the universe.[18] LHCb aims to follow up on previous studies that showed particles and antiparticles decayed in different fashions, which challenges the idea that matter and antimatter should act in symmetry.[19] In addition to the above detectors, there are two smaller detectors: the LHCF, which studies cosmic ray-like events near ATLAS; and TOTEM, which measures the effective size of protons near CMS.[20]

As could be expected, the LHC is expected to produce monumental amounts of data as a result of its design that allows the collider to produce up to 600 proton collisions per second.[21] In recognition of the fact that the LHC will generate enough data each year to fill 1.7 million dual layer DVDs, CERN is collaborating with 33 countries to develop and operate the Large Hadron Computer Grid.[22] The grid will operate by distributing primary backup tapes of data to 11 primary computer centers that will then assign data to second level centers for specific data analysis tasks.[23]

Although the LHC has generated great interest on the part of the public and the scientific community, it has also created quite a bit of controversy among dissenting scientists. The most notable objectors to the project are former nuclear safety official Walter Wagner and Spanish science writer Luis Sancho, the plaintiffs who filed suit seeking an injunction to stop the LHC from being turned on until further study could be done to determine the project's safety. The suit has come to be known as the "doomsday lawsuit," in large part because the pleading alleges that the LHC could produce a number of miniature black holes that could eventually swallow and destroy the Earth. This lawsuit has been perhaps the best source of indavertent publicity for the project, and providing CERN with a great opportunity to disseminate information about the LHC to the public. Another inadvertent source of publicity for the LHC has been the "Large Hadron Collider Rap" written and performed by Michigan graduate student and science writer Kate McAlpine, whose video shot in the tunnels of the LHC has garnered more than two million views on YouTube.[24] CERN has certainly taken advantage of these opportunities to publicize the project and educate the public. These outlets have also been used by both sides to present their respective positions on the safety of the collider while waiting for the startup of the LHC, or the resolution of the lawsuit, to bring the debate to an end.

Litigation

The case of *Sancho v. Department of Energy* was filed in March of 2008 by Luis Sancho and Walter Wagner in U.S. District Court in Hawaii. The suit sought injunctive relief to prevent the LHC from being started until further safety tests and reports can be completed. The plaintiffs brought suit under the National Environmental Policy Act, and claimed that the LHC is in violation of the law as a result of CERN's failure to file safety reports and follow procedures under the act, as well as under European laws.[25]

In response, the United States Department of Energy and CERN have emphasized the safety of the project, and moved for the dismissal of the case based on its procedural posture.[26] Among the procedural issues raised in the Department of Energy response to the suit was that it was filed after the statute of limitations for objections to U.S. involvement with the LHC project, which ended after funds were awarded in 1998 and 1999.[27] In addition, the U.S. emphasized that not only was the country's funding for the project completed, but also that the LHC is completely in the hands of CERN at this point, which was backed up by a letter from CERN stating that "no safety risk exists" in proceeding with the LHC experiments.[28] Further, the government challenged the standing of the plaintiffs as being "overly speculative and not credible," making the potential injuries claimed incapable of being traced back to the U.S. government, and that the plaintiffs lack a connection to the actions of the government sufficient to give them standing.[29] Finally, the Department of Energy argued that even if the injunction is granted to stop U.S. involvement in the project, there is "not effective relief that the court can order."[30]

Ultimately, on September 26 of this year, United States District Judge Helen Gillmor ruled in favor of the government and dismissed the lawsuit on procedural grounds.[31] The judge based her decision in part on the fact that the United States had contributed less than 10 percent of the overall budget of the project, and was given a position on the board of CERN with only observational status rather than voting status.[32] The court also took into account in reaching this decision the fact that after constructing components of the collider, the United States signed over these components fully to CERN and did not retain any rights in them sufficient to give the nation's courts jurisdiction over the project.[33]

Although the suit has been dismissed and brought to an end, it is not clear if the debate over the safety of the LHC has been brought to an end by this action. A flurry of amicus briefs and scientific opinions contained therein were submitted on both sides of this case, demonstrating the intense debate on this issue. The court relied on the "Review of the Safety of LHC Collisions" submitted by Dr. Bruce Strauss, the Program Manager of the Office of High Energy Physics for the United States, particularly the conclusion that "there is no basis for any concerns about the consequences of new particles or forms of matter that could possibly be produced by the LHC."[34]

LHC Status

As this case has wound its way through the courts, the LHC was started up and initial testing of the technology was done until a malfunctioning electrical connection caused two magnets to melt, putting the LHC and some of the debate on hiatus until next year due to the delay running into the facility's scheduled winter break. However, the *Sancho* litigation, as well as the debate surrounding the Large Hadron Collider, continues to illustrate the difficulties that can emerge for lawyers litigating cases involving scientific theories that are controversial or are still being tested or developed. It is clear that if the science is subject to debate, other aspects such as procedure must be sound if the intention is to put science at the center of the case. ◆

Endnotes

1. Alan Boyle, "Biggest 'Big Bang Machine' Switched On," September 10, 2008; CERN LHC site.
2. CERN, "The Standard Model," http://public.web.cern.ch/public/en/Science/StandardModel-en.html.
3. *Id.*
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7. *Id.*
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9. Boyle; "CERN: The LHC Experiments," http://public.web.cern.ch/public/en/LHC/LHCExperiments-en.html.
10. *Id.*
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23. *Id.*
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25. Sancho v. U.S. Department of Energy, et al., Complaint pp. 7–9.
26. Alan Boyle, "Doomsday Lawsuit Dissed," MSNBC.com, June 24, 2008.
27. *Id.*
28. *Id.*
29. *Id.*
30. Sancho v. U.S. Department of Energy, Gov't brief.
31. Sancho, Order of Dismissal.
32. Sancho, Order of Dismissal.
33. *Id.*
34. *Id* at 8; Strauss Decl. 3.