Case of the deadly strangelets

When the *Sunday Times* reported last July that a new accelerator at the Brookhaven National Laboratory could create "strangelets" that might destroy the planet, the story spread like wildfire around the globe. One year on, **Robert P Crease** looks at the lessons to be learned from the episode

One year ago, on 18 July 1999, the *Sunday Times* of London carried an alarming article: "Big Bang machine could destroy Earth". The culprit was the Relativistic Heavy Ion Collider (RHIC), which was then nearing completion at the Brookhaven National Laboratory in the US. Particle collisions inside the accelerator, said the *Sunday Times*, might create black holes or new forms of matter called "strangelets", which would either blow up the planet or suck it into oblivion. A caption to the story asked: "The final experiment?"

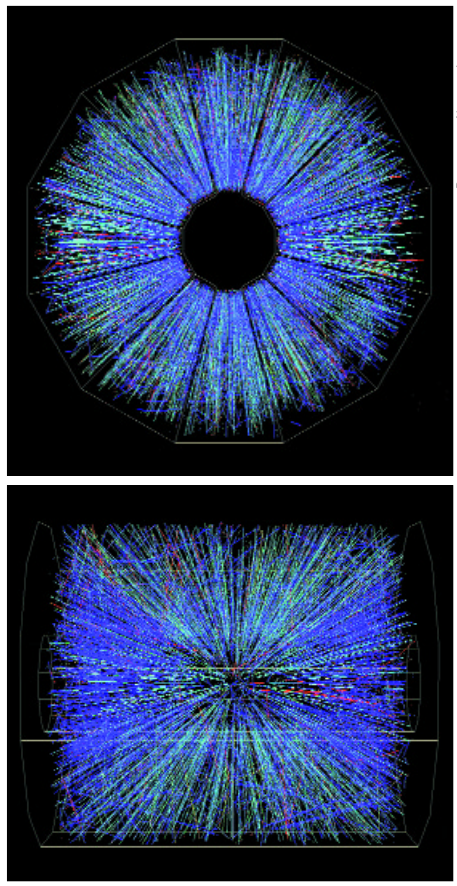
Frightening. The word that the Brookhaven lab was risking planetary destruction in the name of science spread around the globe. A technology reporter with ABC News labelled the collider "the Doomsday machine", condemned the lab for "playing at God" and said that a physicist had told him that RHIC's completion was "the most dangerous event in human history".

This story spread the alarm even further. "I am literally crying as I write this letter," a terrified sixth-grader from New York's fashionably elite Dalton school wrote in protest to the lab. Another (presumably elder) correspondent wrote that the Cuban missile crisis, the USSR and China had failed to frighten him as much as the "insane" and "genocidal" Brookhaven machine. One news organization even telephoned the lab's public relations department (sheepishly) to check the rumour that a black hole created at Brookhaven had swallowed up John F Kennedy Jr's plane. A lawsuit (still in court) was filed to stop the machine.

Scientists generally were incredulous or bemused. "That connection would not, ah, have occurred to me," said one Brookhaven physicist on learning of the alleged mechanism for JFK Jr's death.

Story of the strangelets

The trouble began a few months earlier, when *Scientific American* ran an article about RHIC (March 1999 pp65–70). Its title, "A little big bang", referred to the machine's ambition to study forms of matter that existed in the very early universe. Walter Wagner, the founder of a botanical garden in Hawaii, wrote a letter in response to that article. Citing Stephen Hawking's hypothesis that miniature black holes would have existed moments after the big bang, Wagner asked whether scientists knew "for certain"



BROOKHAVEN NATIONAL LABORATORY

Still here to tell the tale – the first collisions from the Relativistic Heavy Ion Collider, which were produced last month without any signs of planetary destruction

that RHIC would not create a black hole.

Scientific American printed Wagner's letter in its July issue, along with a response from Frank Wilczek of the Institute for Advanced Study in Princeton. Physicists hesitate to use the word "impossible", usually reserving it for things that violate relativity or quantum mechanics, and Wilczek called RHIC's ability to create black holes and other such Doomsday ideas "incredible scenarios". Amazingly, however, he then went on to mention another Doomsday scenario that was more likely than black holes. It involved the possibility that RHIC would create a "strangelet" that could swallow ordinary matter. But not to worry, Wilczek concluded, this scenario was "not plausible".

It was the July 1999 issue of *Scientific American* containing the Wagner–Wilczek exchange that then inspired the *Sunday Times* article in mid-July. This was followed by much more press coverage, and the filing of a lawsuit, by Wagner himself, to stop the machine from operating.

Shortly before the July issue of *Scientific American* was published, Brookhaven's director John Marburger learned of the letters, and appointed a committee of eminent physicists (including Wilczek) to evaluate the possibility that RHIC could cause a Doomsday scenario. After the *Sunday Times* article appeared, CERN's director-general Luciano Maiani – fearing a similar reaction to the Large Hadron Collider that was then in the planning stages – did likewise.

Scientists versus the public

The report eventually produced by Marburger's committee was so dry and technical that some felt it would do little to reassure those who were in fear of the collider. Therefore, when it was eventually put up on Brookhaven's Web page, Marburger wrote a summary in non-technical language as well (www.bnl.gov/bnlweb/rhicreport.html). Marburger's committee concluded that black holes were easy to dispose of and produced two arguments against strangelets. One was an extended argument against RHIC's ability to create them in the first place. The other hypothesized that strangelets might exist with certain properties and then analysed the experimental evidence for them – resulting in an infinitesimal (but non-zero) probability that these objects do exist.

As explained to me, the difference between the two lines of reasoning is like arguing against the existence of the Loch Ness monster on the basis of biological first principles in the first case, while in the second assuming that the monster has a certain size and behaviour and calculating the infinitesimal (but non-zero) probability that seekers missed it. Scientists tend to find the first type of argument more convincing; non-scientists the second. The second involves inventing a fiction to compare with experimental evidence. Stated in crude terms: if something like strangelets could exist, they would already have been created in cosmic rays.

The contrast between the near-unanimous confidence of the scientists and the fearful reaction of some of the public makes it tempting to view the episode as an illustration of the difference in knowledge that sociologists of science call the "expert–lay

divide". The scientists are confident because they possess technical knowledge, while those who lack that expertise rely on value-laden thinking that leaves them vulnerable to misunderstanding situations with technical dimensions. What is needed to bridge the gap is the right translation between the two different styles of reasoning.

However, things are not that simple. The physics arguments involved long chains of reasoning using detailed models of nuclear matter, which non-nuclear physicists cannot follow and which most nuclear physicists themselves would find too difficult and time-consuming to work through. Such an argument could never be "translated" into a piece of evidence that, standing alone, would convince a non-scientist – or even a jury. When the Brookhaven and CERN committees began arguing about each other's arguments (in some quarters, the dispute is still raging), it unsettled some outsiders, who saw it as a mark of uncertainty – that the scientists did not know the answer. However, the quarrelling generally reinforced confidence among scientists, who saw that it was a dispute about details and reflected a fundamental agreement about how nature behaved.

No trace here of the traditional expert–lay divide. The confidence of the experts was an intuition acquired through different styles of reasoning: the physicists did not all follow the same chain of arguments and did not use the same methods of probability assessment. Similarly, members of the general public also interpreted what they had heard in many different ways, giving rise to a spectrum of reactions. Even the most extreme of the public's reactions can hardly be called "irrational", if the word is literally taken to mean "wholly without reasons".

Just over half a century ago, a surprised public leaned that scientists had discovered an unsuspected source of energy, of world-destroying proportions, locked up inside the unbelievably small nuclei of atoms. If scientists could do that once, why not again? An imaginative scientist can produce numerous terrifying scenarios that could happen if nature were just a little different than we think, which it sometimes is.

Many of the letters protesting against the machine criticized the Brookhaven scientists for "playing God". But doesn't this phrase merely represent the flip-side of the religious imagery sometimes invoked by scientists themselves, such as Hawking and Feynman, who say that doing physics is trying to know God's thinking?

The critical point

"Strangelets", or their equivalents, have menaced accelerators in the past as well. In the 1970s the Russian scientist Yakov Zel'dovich expressed worries (which he eventually decided were groundless) that CERN's latest accelerator, the Super Proton Synchrotron, could create a catastrophe. Later, in 1995, Fermilab was attacked by Paul Dixon, a psychologist from the University of Hawaii. His supporters picketed the lab with signs claiming that its Tevatron was "home of the next supernova".

Do we know what motivates such Doomsday stories and why different people respond differently? Do we understand the process by which experts communicate with each other and the public? Do we understand how confidence and credibility are generated and perpetuated both inside and outside the scientific community? Philosophers and sociologists of science have, in fact, examined these sorts of question. Strangelet science would seem to be a case of what the philosophers of science Silvio Funtowicz and Jerome Ravetz call "post-normal science", which involves extremely high perceived risks or uncertainty. "When environmental issues are involved," they write, "the stakes can become the survival of civilization as we know it or even of life on the planet." In post-normal science, they point out, "issues of quality are crucial, and traditional mechanisms of quality assurance are patently inadequate".

Will this kind of work be incorporated into the management of large scientific projects or will quality assurance on issues like strangelets still be treated as public relations or merely academic questions? If the latter, then strangelets – more dangerous ones, inspiring stronger lawsuits even harder to dismiss – are sure to return to menace the building and operation of future accelerators. If so, strangelets are still dangerous and may yet cause a scientific catastrophe.

"What motivates Doomsday scenarios and why do people react differently?"

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