IRIS, the process introduced by the Trump administration has not been peer reviewed, and yet it would allow agency officials to circumvent IRIS evaluations. Under former president Barack Obama, the EPA would have used IRIS to perform these reviews when considering regulations under TSCA.

The IRIS programme dates back to 1985, but under the Obama administration, the EPA modernized and standardized its chemical-evaluation procedures to improve transparency and confidence in its health assessments. Woodruff says that the IRIS process is solid and that bypassing it would be a mistake.

"The TSCA office is deciding to ditch all of the experts and empirical methods that have been developed over the last 30 years for a method that appears to be based on their whim and personal opinion," she says.

But the EPA insists that the review process used in these chemical evaluations is intended to "comprehensively capture all available science".

Politicians in the US House of Representatives have also hammered IRIS, holding hearings questioning the quality and validity of the programme's assessments. The political manoeuvring parallels efforts from industry to bypass scientific reviews of certain chemicals.

One plant in LaPlace, Louisiana, makes the chemical chloroprene for the Tokyo-based company Denka. Chloroprene is used to make neoprene, a synthetic rubber integral to products such as wetsuits. A 2010 IRIS evaluation and subsequent government studies suggested that chloroprene exposure levels in LaPlace were high enough to increase cancer risk in some areas of the city. Denka challenged that ruling last year, arguing that the assessment was incorrect. The company lost its challenge in January but has since appealed against that ruling. A panel appointed by the EPA leadership will now consider the appeal.

Denka has argued to its political allies that reducing chloroprene emissions would be too expensive, says Karl Brooks, a former EPA official who last year served as a consultant in a lawsuit filed by LaPlace residents against Denka. That's a potentially dangerous development, he says, because IRIS assessments are meant to focus on the health effects of chemicals — not the economic challenges that a company might face as a result of the core science.

Researchers fear that the chloroprene case represents yet another strategy for companies seeking relief from the burdens of regulations: challenge the science and, when that fails, appeal to friendly politicians and political appointees. ■

WILLIAM WIDMER/REDUX/EYEVINE

A chemical produced in a US-based plant is part of a challenge to a government safety programme.

PARTICLE PHYSICS

LHC teams turn to brute-force hunt

World's most-powerful particle collider is using a fresh approach to find evidence of 'new' physics.

BY DAVIDE CASTELVECCHI

A once-controversial approach to particle physics could soon have an increased role at the Large Hadron Collider (LHC). The LHC's major ATLAS experiment has officially thrown its weight behind the method — an alternative way to hunt through the reams of data created by the machine — as the collider's best hope for detecting behaviour that goes beyond the standard model of particle physics, because conventional techniques have so far come up empty-handed.

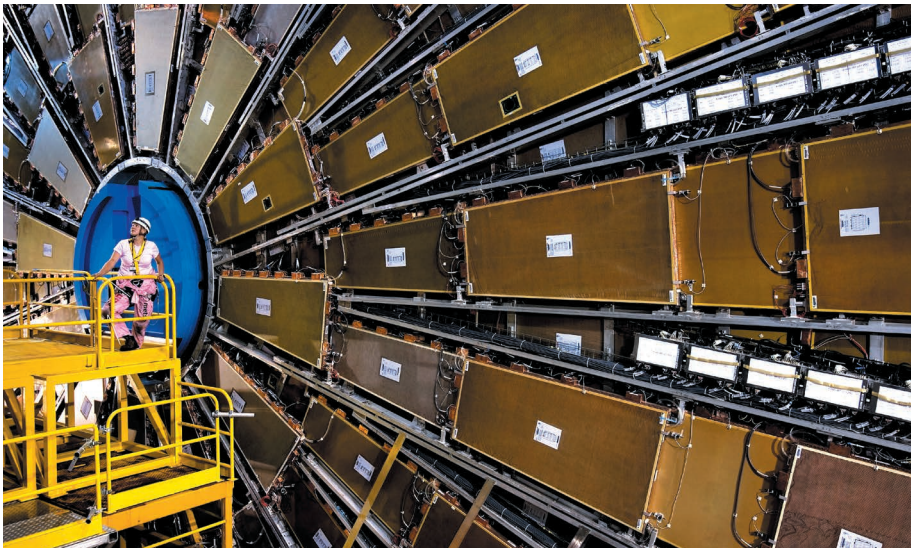
So far, almost all studies at the LHC — at CERN, Europe's particle-physics laboratory near Geneva, Switzerland — have involved 'targeted searches' for signatures of favoured theories. The ATLAS collaboration now describes its first all-out 'general' search of the detector's data — a kind of brute-force approach — in a preprint posted last month and submitted to *European Physics Journal C* (ATLAS Collaboration. Preprint at https://arxiv.org/abs/1807.07447v1; 2018). Another major LHC experiment, CMS, is working on a similar project.

"My goal is to try to come up with a really new way to look for new physics" — one driven by the data rather than theory, says Sascha Caron of Radboud University Nijmegen in the Netherlands, who has led the push for the approach at ATLAS. General searches are to the targeted ones what spell-checking an entire text is to searching for a particular word. These broad searches could realize their full potential soon, when combined with increasingly sophisticated artificial-intelligence (AI) methods.

LHC researchers hope that the methods will lead them to their next big discovery — something that hasn't happened since the detection of the Higgs boson in 2012, which put in place the final piece of the standard model. The model describes all known subatomic particles, but physicists suspect that there is more to the story — the theory doesn't account for dark matter, for instance. But big experiments such as the LHC have yet to find evidence for this behaviour. That means it's important to try new things, including general searches, says Gian Giudice, who heads CERN's theory department and is not involved in any of the experiments. "This is the right approach, at this point."

COLLISION COURSE

The LHC smashes together millions of protons per second at colossal energies to produce a profusion of decay particles, which are recorded by detectors such as ATLAS and CMS. Many different types of particle interaction can produce the same debris. For example, the decay of ▶



STEFANO DAL POZZOLO/CONTRASTO/EYEVINE

The ATLAS detector at the Large Hadron Collider near Geneva, Switzerland.

a Higgs might produce a pair of photons, but so do other processes. So, to search for the Higgs, physicists first ran simulations to predict how many of those 'impostor' pairs to expect. They then counted all photon pairs recorded in the detector and compared them to their simulations. The difference — a slight excess of photon pairs within a narrow range of energies — was evidence that the Higgs existed.

ATLAS and CMS have run hundreds of these targeted searches to look for particles not in the standard model, but the searches have come up empty so far. This leaves open the possibility that there are exotic particles that produce signatures no one has thought of — something that general searches have a better chance of finding.

Whereas targeted searches typically look at only a handful of the many types of decay product, the latest study looked at more than 700 types at once. The study analysed data collected in 2015, the first year after an LHC upgrade raised the energy of proton collisions in the collider from 8 teraelectronvolts (TeV) to 13 TeV. At CMS, Meyer and a few collaborators have conducted a proof-of-principle study, which hasn't been published, on a smaller set of data from the 8 TeV run. Neither experiment has found significant deviations so far. This was not surprising, the teams say, because the data sets were relatively small. Both ATLAS and CMS are now searching a larger trove of data.

The approach "has clear advantages, but also clear shortcomings", says Markus Klute, a physicist at the Massachusetts Institute of Technology in Cambridge who is part of CMS and has worked on general searches for previous experiments. One limitation is statistical power. If a targeted search finds a positive result, there are standard procedures for calculating its significance; when casting a wide net, however, some false positives are bound to arise, one reason that general searches had not been favoured in the past. But the teams say they have put a lot of work into making their methods more solid.

Proponents of this approach hope to use machine learning to find patterns in the data without any theoretical bias. "We want to reverse the strategy — let the data tell us where to look next," Caron says. ■