hurdle to exploiting the data in the future.

Such neglect would be a mistake, says Cristinel Diaconu of the Centre for Particle Physics in Marseilles, France, who leads the H1 experiment at the Hadron–Electron Ring Accelerator (HERA) in Hamburg, Germany, which closed in 2007. “We always have new ideas that can be used to reanalyse data,” he says. Diaconu, who is chair of an international study group on data preservation and long-term analysis in high-energy physics, estimates that good data preservation can increase the scientific potential of an experiment by 10% for less than a 1% increase in cost.

At BaBar, an experiment that produced B mesons at the Stanford Linear Accelerator Center in Palo Alto, California, until 2008, physicists have begun building a US\$500,000 archival system that will save the raw data and software, and are also setting up virtual interfaces to run the older software on modern machines. “We have decided to save everything at least to 2018,” says Tina Cartaro, BaBar’s computing coordinator.

Other experiments are adopting cost-saving compromises. Collaborators on the HERA H1 experiment have decided that it is not necessary to keep all their seven attempts at reconstructing particle events from the raw data. “Our initial thinking was to keep everything, but we now think we will keep three iterations,” says David South, computing coordinator for H1 at the Technical University of Dortmund in Germany.

The Tevatron can learn from those examples, says Roser. But Li says it’s a tougher job than it would have been if data preservation had been planned for from the beginning. In addition, over the next five years, thousands of tapes’ worth of data will somehow have to be migrated to newer, higher-density storage and a suitable retrieval system to go with it.

The situation at the LHC is strikingly different. Computing specialists there are already working towards permanent archiving of the data, says Elizabeth Sexton-Kennedy of Fermilab, who works on computing systems for the CMS, one of the LHC experiments. In its short lifetime, the LHC has collected five times as much data as the Tevatron. All the raw data are being kept, although the CMS is saving space by deleting old attempts at reconstruction when they are surpassed by newer ones. “When we know things much better, we delete older knowledge,” says Sexton-Kennedy. “It’s the tension between the old and the new.”

Particle physicist Siegfried Bethke of the Max Planck Institute for Physics in Munich, Germany, who spent two years reconstructing data that hadn’t been maintained from PETRA, a positron–electron collider that ran from 1979 to 1986 at the DESY accelerator in Hamburg, told the data-preservation workshop that his experience indicates that better planning is really vital. “These data have cost a lot of money to the taxpayer and not conserving them would be a crime,” he said. ■

EDUCATION

Furore erupts over Turkish test cipher

University entrance-exam fiasco hits election campaign.

BY ALISON ABBOTT

Imagine sitting your university entrance examinations, only to learn the next day that the correct answers to many of the multiple-choice questions were signalled by a secret code in the exam paper itself.

For 1.7 million Turkish high-school students competing for a place at university, the bizarre scenario came true in March. Newspaper accounts of the cipher, and rumours that a privileged few had been told how to decode it, sparked student demonstrations across the country. Although the cipher may have been an accident of the test’s design rather than a conspiracy, outrage has persisted and the debacle has become an issue in the run-up to the country’s general election on 12 June.

Last week, prime minister Recep Tayyip Erdoğan accused a journalist investigating the case of campaigning to discredit the government. “He will pay a heavy price, not now but in the future,” said Erdoğan. This is no empty threat — several investigative journalists were arrested in March as part of an inquiry into an alleged plot to overthrow the government.

Ankara’s Chief Public Prosecutor’s Office declared on 11 May that the cipher indisputably exists. It said it had found no evidence of cheating, but requested permission to investigate Ali Demir, head of the Student Selection and Placement Center (ÖSYM), the Council of Higher Education office responsible for the examinations. On 25 May, the council’s president Yusuf Ziya Özcan said that it would probably not consider the investigation request until after the election.

In a country where corruption is rife, some educators see benefit in multiple-choice examinations because they can be graded by computer. In previous years, up to ten different versions of the exam paper had been printed with the same questions in a different order, to reduce the possibility of copying. Crucially, the easiest questions had

always appeared first. This year, however, ÖSYM decided to create a unique version for each student by changing the orders of both questions and answers, commissioning an external company to create an algorithm for the task.

According to some academic experts, that algorithm may have inadvertently generated the cipher that eventually emerged for those questions with numerical answers. If the answers were rearranged in ascending order and placed next to the original list, the correct answer occupied the same position in each list. Enough questions followed the pattern that students could have passed the

exam by relying entirely on this decryption method.

“It’s not possible to tell” whether the cipher was accidental or deliberate, says Ersan Akyıldız, a cryptologist at the Middle East Technical University in Ankara. Either way, he is critical of the test design, noting that the reshuffling of questions put students who encountered more daunting questions at the beginning of the exam at

a disadvantage. The ÖSYM team should have consulted academic experts in education and cryptography before trying such an ambitious experiment, Akyıldız says.

Many Turkish academics also complain that multiple-choice exams do not test reasoning skills well enough to be suitable for selecting university students. “We need to have real university entrance exams in Turkey, like the [international] baccalaureate,” says chemical engineer Kemal Gürüz, a former president of the Higher Education Council, at Middle East Technical University.

The stakes are high. Turkey has a policy of widening access to higher education but has only 600,000 university places available this year. As a consequence, profitable cram schools have flourished — and have lobbied against change. ■

Turkish premier Recep Tayyip Erdoğan threatened a journalist over an exam row.

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