NEWS IN FOCUS

IVAN ROMANO/GETTY

Luigi Di Maio leads the populist Five Star Movement, which is tipped to receive the highest number of votes in Italy's March election.

ITALY'S ELECTION

Italian science out in the cold

Election campaign gives researchers little hope for future of the nation's science system.

BY ALISON ABBOTT

As campaigning ahead of Italy's national election enters its final weeks, researchers in the country fear that budget cuts and declining interest in science will only continue — whatever the outcome of the vote on 4 March.

A complex coalition government is likely to emerge. The country's traditional centre-left and centre-right parties have splintered, and myriad small parties make up the ballot sheet, as well as the populist Five Star Movement. Topics such as immigration, the refugee influx and eurozone membership have dominated mainstream debates.

But, apart from a battle over the nation's compulsory vaccination programme, which was introduced last year, science has featured little in the campaigning — even as economists warn that Italy's research system is in a precarious state. "We are on the verge of collapse," says Mario Pianta, an economist at the University of Rome Tre, who helps to prepare Italy's statistics on research and development (R&D) for the European Commission.

Italy has hotspots of scientific excellence, such as in particle physics and biomedicine. But, unlike many other European countries, it has failed to modernize its science system in the past few decades. Budgets have constantly been low. Academic hiring practices can be complicated, and bureaucracy crippling, many scientists say. Research organizations have had little power politically, and have been unable to stem the rising influence of those who have demonized vaccinations and promoted charlatan cure-alls.

The gap in scientific achievement and investment between the country's affluent north and poorer south is widening, helping to fuel regionalist and populist politics, says Raffaella Rumiati, vice-president of Italy's national research-evaluation agency, ANVUR. In January, the agency announced the results of its first competition to reward the best-performing university departments, and northern institutions received an overwhelmingly greater share of the funds.

The outgoing centre-left coalition government, led by Paolo Gentiloni of the Democratic Party, has introduced some research initiatives, including a €1.5-billion (US$1.9-billion) research centre in Milan focused on genomics and personalized medicine, called the Human Technopole. The Democratic Party has some science-related policies in its manifesto that promise more money, research positions and institutional competition.

Pianta says that further reforms to the research system must be supported by increased budgets. But since the 2008 economic crisis, Italy's already low R&D spending has declined by 20% in real terms — equivalent to a hefty €1.2 billion. In 2016, it stood at €8.7 billion. The university budget has shrunk by about one-fifth — to €7 billion — as has the number of professors nationwide. Funding for public research institutes is no higher than it was in 2008, representing a 9% drop in real terms. And Italy's substantial deficit means the situation is unlikely to improve soon.

Even worse, more scientists have left the country since 2008 than have entered it, according to statistics from the Organisation for Economic Co-operation and Development. "It is not just that scientists are going to countries with strong bases in science," says Pianta. "There is also a net loss of scientists from Italy to countries like Spain."

Paradoxically, science is performing well overall. Since 2005, Italy has increased its contribution to the top 10% of the world's most cited scientific documents. And it produces more publications per unit of R&D expenditure than any other European Union country except the United Kingdom. "The happy paradox cannot sustain," says Pianta. "We are heading towards mediocrity."

The next government will have its work cut out. Polls suggest that the Five Star Movement, founded by comedian Beppe Grillo and led by Luigi Di Maio, will receive the highest number of votes. Di Maio has actively wooed academics, bringing some on board as advisers. But most researchers regard the movement with alarm. Some of its members have vociferously supported anti-science campaigns, including that against vaccination.

The movement is unlikely to take part in any governing coalition. So the most likely government to emerge will be a mix of centre-right parties led by Silvio Berlusconi's Forza Italia and including the regionalist League, which is expected to receive the second highest number of votes. But whatever the content of the next government, says Mattia Butta, an Italian engineer at the Czech Technical University in Prague, it is unlikely to fundamentally change the scientific culture. ■

NUCLEAR PHYSICS

Physicists plan first antimatter road trip

Elusive material will be used to probe radioactive nuclei.

BY ELIZABETH GIBNEY

Antimatter is notoriously volatile, but physicists have learned to control it so well that they are now starting to harness it as a tool for the first time. In a project that began last month, researchers will transport antimatter by truck and then use it to study the strange behaviour of rare radioactive nuclei. The work aims to provide a better understanding of fundamental processes inside atomic nuclei, and to help astrophysicists learn about the interiors of neutron stars, which contain the densest form of matter in the Universe.

"Antimatter has long been studied for itself, but now it is mastered well enough that people can start to use it as a probe for matter," says Alexandre Obertelli, a physicist at the Technical University of Darmstadt in Germany, who leads the project, known as PUMA (antiProton Unstable Matter Annihilation), which will take place at CERN, Europe's particle-physics laboratory near Geneva, Switzerland.

CERN's antimatter factory makes antiprotons — the rare mirror image of protons — by slamming a proton beam into a metal target, and then dramatically slowing the emerging antiparticles so that they can be used in experiments. Obertelli and his colleagues plan to use magnetic and electric fields to trap a cloud of antiprotons in a vacuum. They will then load this trap into a van and drive it a few hundred metres to the site of a neighbouring experiment, known as ISOLDE, which produces rare, radioactive atomic nuclei that decay too quickly to be transported anywhere themselves. "It's almost science fiction to be driving around antimatter in a truck," says Charles Horowitz, a theoretical nuclear physicist at Indiana University Bloomington. "It's a wonderful idea."

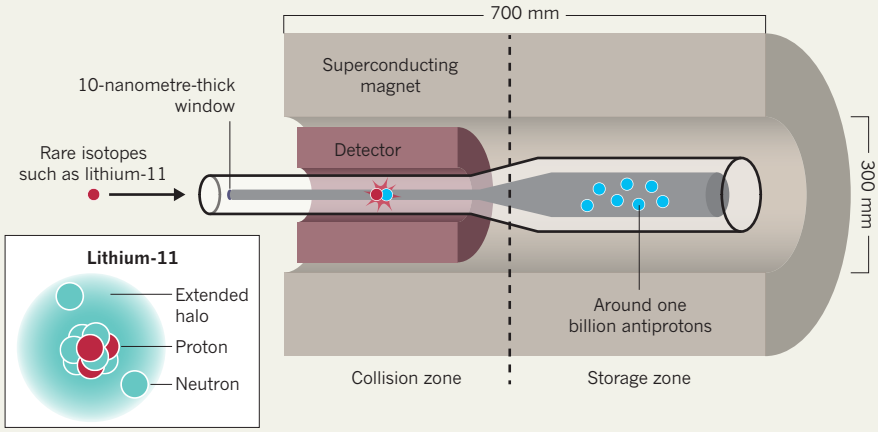
UNIQUE PROBE

Because antiprotons annihilate so readily, both with protons and with neutrons, they present a unique way to study the unusual configurations of radioactive nuclei. Whereas everyday atomic hearts host protons and neutrons in roughly equal measure, radioactive isotopes are stuffed with extra neutrons. This imbalance can give rise to exotic characteristics, including a surface 'skin' that is richer in neutrons than protons, or an extended halo in which neutrons orbit alone, as in lithium-11 (see 'Antimatter to go'). By observing how often antiprotons annihilate with a proton versus a neutron, the team will be able to understand the relative densities of these particles at the very edge of the nucleus. "It's a kind of test we haven't been able to do before on these new, more exotic nuclei, which may have very interesting structures," says Horowitz.

Radioactive nuclei act as microcosms for learning about neutron stars, objects that squash more mass than is contained in the Sun into the size of a city, and which are key to understanding how the Universe's heavy elements form. The cores of these

ANTIMATTER TO GO

To reveal the surface structure of atomic nuclei, physicists send ions of rare isotopes into a bottle 700 millimetres long — where they annihilate with antiprotons stored in the trap.



SOURCE: PUMA

CORRECTION

In saying that everyday atomic hearts have equal protons and neutrons, the News story 'Physicists plan first antimatter road trip' (*Nature* **554,** 412–413; 2018) didn't take account of the fact that some elements, such as hydrogen and lithium, have uneven numbers of protons in their most abundant form.