distances and cutting errors down to less than 1%.

Stellar parallax is good, but it can go only so far. It entails measuring a star's apparent position in the sky at different times of the year, as Earth (or a space probe such as Gaia) orbits the Sun. The distance between the two observing points, measured to high accuracy, provides the base of a triangle. The distant star is at the opposite vertex. The smaller the angle at that vertex, the farther away the star is.

But because the size of Earth's orbit is fixed, as the vertex moves farther away the angle becomes smaller and smaller, and ultimately impossible to measure with any accuracy. (The basic unit of measurement of astronomical distance, the parsec, is short for 'parallax of one arcsecond', which refers to the size of that angle. One arcsecond is 1/3,600th of a degree, and in typical parallax measurements the angles are much smaller.)

For objects in more distant galaxies, astronomers have devised steps that build on the parallax method. Each step is a 'rung' on what they call the cosmic distance ladder. For example, the distance from Earth of the Andromeda Galaxy, the closest large galaxy to the Milky Way, is estimated by measuring the brightnesses of various types of star in it and comparing them to the brightnesses of similar stars closer to Earth whose parallax is known. Such estimates exploit the fact that similar stars look fainter the farther away they are.

Andromeda is roughly 780 kiloparsecs (2.54 million light years) away. Telescopes cannot resolve individual stars in galaxies that are hundreds of millions of parsecs away — except when those stars happen to blow up as supernovae. Astronomers use some supernovae as signposts of cosmic distances, or 'standard candles', meaning that their measured brightness is an indicator of their distance.

A major complicating factor is that the observed brightness of distant objects can be affected by foreground matter such as dust. Wouldn't it be wonderful to have a more direct and reliable way of measuring distances — one that were as precise as Gaia and worked at scales from the galactic to the cosmic?

Beginning with a paper in this journal 30 years ago (B. F. Schutz *Nature* **323,** 310–311; 1986), physicists have suggested that gravitational waves could provide such a tool. The ripples, predicted by Albert Einstein in 1916 as a consequence of his general theory of relativity, travel across the Universe without being dimmed significantly by dust or gas.

"Stellar parallax is good, but it can go only so far."

The gravitational waves that struck Earth in September and were recorded by the Advanced Laser Interferometer Gravitational-Wave Observatory (LIGO) carried information that revealed their strength at the source. In theory, this information can be used to work out the source's distance.

In the next few years, other interferometers are scheduled to join LIGO to form a global network of gravitational-wave observatories. Together, these instruments could calculate the positions and distances of merger events. Neutron-star mergers are especially interesting to cosmologists because they should also produce bursts of short, high-energy γ-rays, which would help to pinpoint their galaxies of origin.

Researchers hope that they will be able to use information from mergers as a way to calculate the distances of known galaxies. Because gravitational waves are more similar to sound than they are to light, physicists have dubbed these potential signposts 'standard sirens'.

One of the main uses of supernova standard candles has been to measure the current rate of cosmic expansion. Standard sirens could provide an independent way to do this. And, if space-based interferometers are added to the network, they could be used to track dark energy. Hear the call. ■

Power of the pen

Scientists must unite to stop Turkey from removing the right to freedom of expression.

When he labelled outspoken academics as terrorists, Turkey's increasingly authoritarian President Recep Tayyip Erdoğan was probably not thinking of Voltaire's eighteenth-century philosophical maxim: "To hold a pen is to be at war".

Erdoğan sent shivers down the spines of those who care about human rights by declaring on 14 March that those who support terrorists are as guilty as those "who pull the trigger", and that Turkish law should be changed to reflect this. "The fact that an individual is a deputy, an academic, an author, a journalist or the director of an NGO does not change the fact that that person is a terrorist," he said.

One the same day, three academics from universities in Istanbul were hauled into police custody and then refused bail while prosecutors considered charges of making propaganda for a terrorist organization.

Their crime? In January, they had signed a petition that called for an end to violence in the southeast of the country, where government forces have been fighting Kurdish separatists. The petition was signed by 1,128 academics, mostly from Turkish universities, when it was publicly launched on 11 January. It immediately sparked Erdoğan's rage. Many politically appointed university rectors leapt into line, launching disciplinary investigations into members of their staff who had signed — more than 500 so far. Dozens of signatories were brought in for police questioning. The harsh response attracted a shocked solidarity. Another 1,000 people signed the petition, including a large number of Western scientists, before it was closed on 20 January.

An atmosphere of uncertainty and fear prevails. None of the signatories knows whether they, too, will be arrested, and several have had death threats. Some have actively sought sabbaticals abroad; those working outside the country are afraid to return even to visit family.

Meanwhile, Turkey is playing a major part on the world political stage, in a role that is overshadowing the fate of the academics.

Turkey is a geopolitical fulcrum. On one side it borders war-torn Middle East, on the other, strife-ridden Europe that is struggling to cope with the refugee crisis. When the country reached a historic agreement with the European Union last week to take back migrants who were crossing into Europe illegally, many in the EU complained bitterly about making a deal with Erdoğan because of his worrying human-rights record.

Terrorist attacks in Turkey are intensifying, some carried out by Kurdish separatists, others by the Islamist group ISIS. Erdoğan's controversial announcement followed on the heels of a deadly attack in Ankara, and on 19 March, a suicide bomber killed four in Istanbul. Kurdish separatist terrorism had abated during a two-year ceasefire, but that broke down last July. Erdoğan argues that the peace petition, by focusing only on government military attacks on Kurdish militants, which have killed many innocent civilians, and ignoring terrorist attacks and other serious human-rights abuses carried out by the separatists, actively supports terrorism.

While appreciating the urgency of a call to peace, many scientists and academics themselves have reservations about the petition, seeing it as unhelpfully confrontational and even intellectually dishonest. But many have still bravely spoken up for the freedom of expression of the signatories.

Turkey's recently formed Science Academy published a strongly supportive statement in January. "The right to express one's opinions — even if these might be annoying or minority views — is an essential freedom of every citizen and every academic," it said. The academy should know — it was created by those who resigned en masse from the Turkish Academy of Sciences when Erdoğan took it over by decree in 2011. Scientists everywhere should use their pens and send their support. ■

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