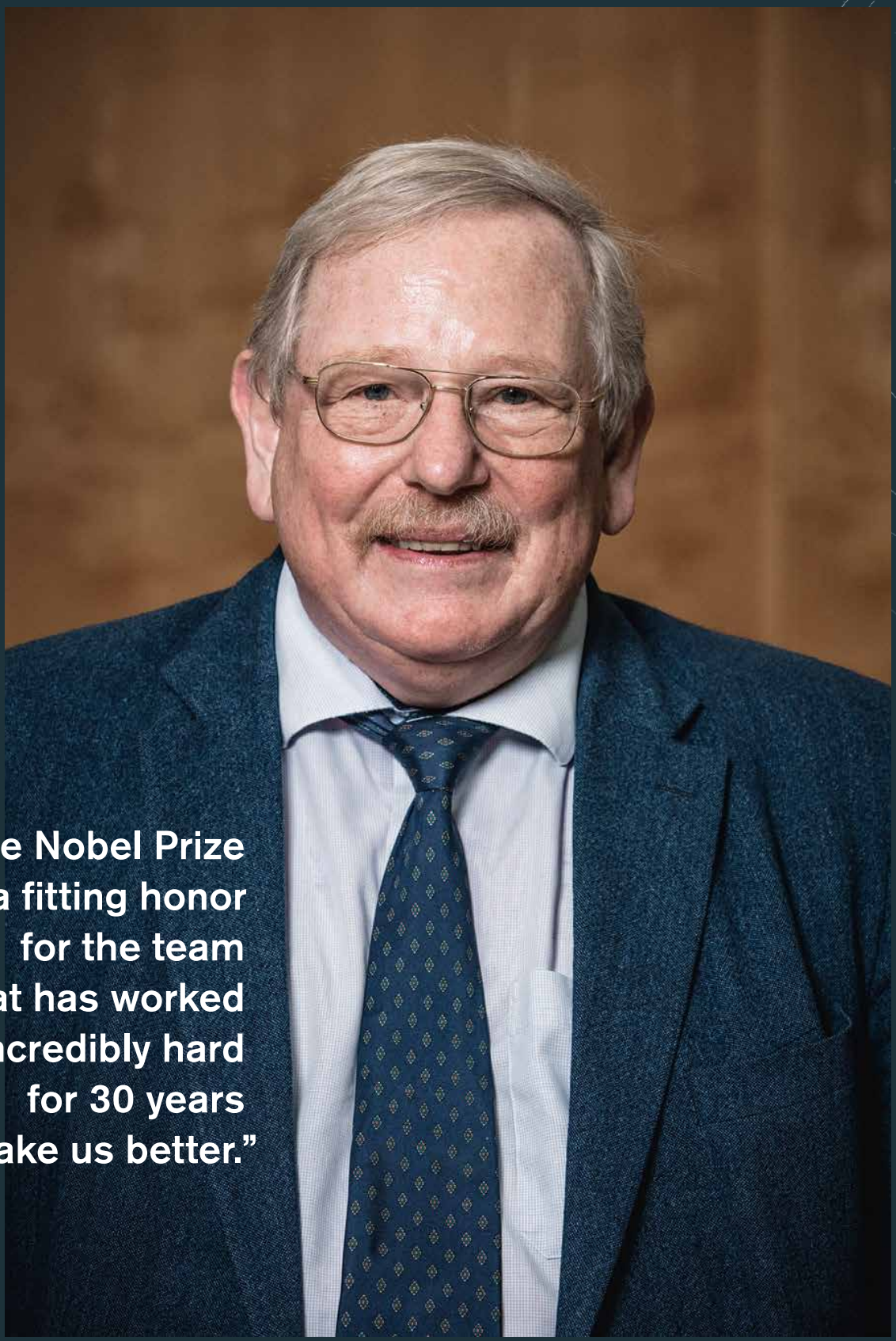

“The Nobel Prize is a fitting honor for the team that has worked incredibly hard for 30 years to make us better.”

PHOTO: DEREK HENTHORN FOR MPG; ILLUSTRATION: HENNING BRUER

NOBEL PRIZE IN PHYSICS

REINHARD GENZEL

Cosmic swarm: the black hole at the heart of the Milky Way reveals itself by the pull it exerts on nearby objects. This image shows the paths of stars as they orbit the gravitational monster at varying degrees of proximity. Reinhard Genzel and his team have worked relentlessly for many years to track the stars' movements, thereby gaining valuable astrophysical insights.

Deep in the heart of the Milky Way lurks a massive black hole. At a distance of 26,000 light-years from Earth, this behemoth is hidden behind dense curtains of gas and dust. Nevertheless, the phantom has been exposed by astronomers, chief among whom are Reinhard Genzel, Director at the Max Planck Institute for Extraterrestrial Physics in Garching, Germany, and the American researcher Andrea Ghez from the University of California. In recognition of their work, the two scientists are sharing one half of the 2020 Nobel Prize in Physics. The other half of the prize has been awarded to the British theorist Roger Penrose for his detailed mathematical description of black holes as a consequence of the general theory of relativity.

Reinhard Genzel and his group have achieved a number of groundbreaking results. For over three decades, the researchers have been using infrared instruments to study the center of our galaxy. There, they follow the movement of stars swirling around the invisible object like moths around a light. Based on these observations, the astronomers have determined the gravitational giant's mass – with a very high degree of accuracy – to be around 4.3 million solar masses. Because this mass is concentrated within a small space, the researchers believe that a black hole is the most plausible explanation.

Further studies by the team have revealed, for example, that stars in the center of the galaxy exhibit an unusual mass spectrum. Moreover, the scientists have discovered infrared flares that are thought to arise from gas close to the inner accretion disc of the black hole. Genzel's group has also found that gas is swirling around the black hole at a speed equal to 30 percent of the speed of light.

In 2018, the researchers succeeded in verifying the so-called "gravitational redshift" of a star for the first time. The light from S2, as the star is known, is stretched to longer wavelengths by the very strong gravitational field of the black hole and therefore appears with a reddish color. This change in wavelength is exactly in line with the prediction made by Einstein's general theory of relativity. In the spring of this year, Reinhard Genzel and his colleagues published their results from another series of observations: the orbit of the star S2 does not remain stationary in space, but instead moves slowly forward – so that multiple orbits of S2 create the shape of a rosette. This is another effect that was predicted by Einstein's theory.

The astronomers made their observations using sensitive instruments such as Gravity, Sinfoni and Naco, all of which are operated at the Very Large Telescope (VLT) of the European Southern Observatory. The instruments were built under the direction of the Max Planck Institute for Extraterrestrial Physics and scan the sky in the infrared region. By combining the light from the four eight-meter mirrors within an underground laboratory, the researchers create what is known as an interferometer. This virtual telescope has a diameter of 130 meters, and its detail resolution is so precise that you could discern a one-euro coin on the moon.