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OUT THERE

Dancing With a Black Hole

Astronomers described the strange orbit of a star that loops the monster in the Milky Way, offering more evidence for one of Einstein's ideas.

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For decades, astronomers have had their earthly eyes on the adventures of a star known as S2 that tickles the edges of oblivion.

Every 16 years, the star's orbit takes it within a cosmic whisker's breadth — 11 billion miles — of the lip of what is believed to be the supermassive black hole Sagittarius A*, the pothole in eternity at the center of the Milky Way galaxy. That black hole has consumed mass equivalent to four million suns. During its fraught passages, the S2 star experiences the full strangeness of the universe, according to Einstein.

One result of this strangeness, now determined after 27 years of high-precision observations with the European Southern Observatory's Very Large Telescope in Chile is that the star's egg-shaped orbit does not stay fixed in space. Reinhard Genzel, an astronomer at the Max Planck Institute for Extraterrestrial Physics, and his colleagues described the star's unusual journey around the black hole on Thursday in the journal Astronomy and Astrophysics.

As shown in the animated video above, the orbit itself rotates around the black hole. The star's closest point to the black hole, known as perihelion, advances around in a circle by about a fifth of a degree — 12 arc minutes. At this rate the orbit will do a complete loop in only 28,800 years, a mere cosmic eyeblink.

It's another score for Albert Einstein and his general theory of relativity, which ascribes the phenomenon we call gravity to a warping of the geometry of space and time. Black holes, objects so dense that space has sagged around them, swallowing even light, are one consequence of his theory. Another is that orbits around particularly dense objects won't stay still. They will do a pirouette around the object of their attraction.

In our own solar system, astronomers had long known that the planet Mercury behaves like this;but they could not account for one microscopic bit of its advancing perihelion that amounts to 43 seconds of its arc in a century. That was general relativity in action. In November 1915, Einstein tried out his new theory on Mercury's motion, and his calculation came out right on the money with no fudging or fussing. He said he had heart palpitations.

If he could see this result applied to the monster in the Milky Way's middle, he would probably have them again. Comparing S2's wandering to Mercury's trip around the sun, Dr. Genzel said in a statement that more than a century after Einstein's calculations, "we have now detected the same effect in the motion of a star orbiting the compact radio source Sagittarius A* at the center of the Milky Way."

The observation, he said, strengthened the case that Sagittarius A* is a black hole, and augurs well for future efforts to use the star S2 as a probe to find out more about the black hole — how it is spinning, for example — and its close environment.