GENERAL RELATIVITY

Supermassive confirmation for Einstein

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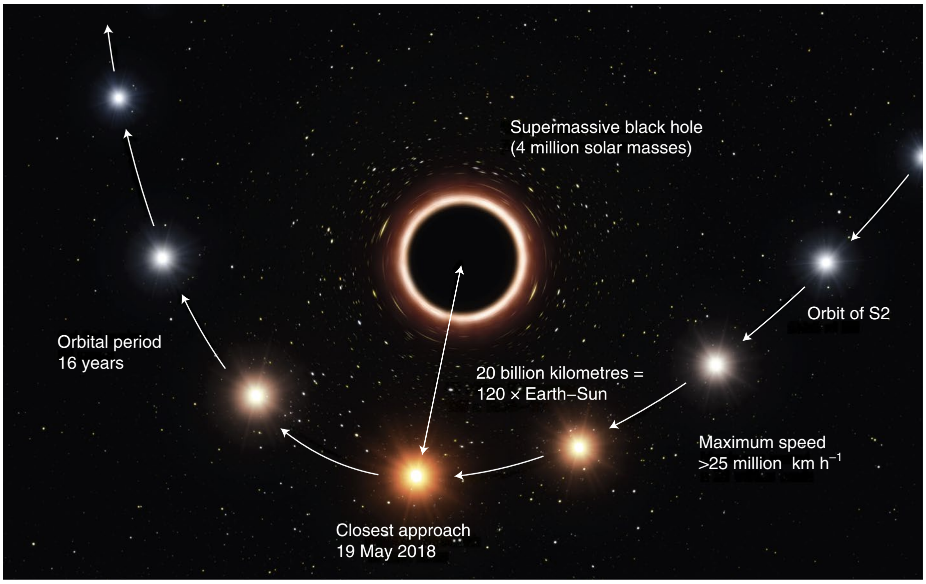

Credit: ESO/M. Kornmesser

The star S2 orbits Sgr A*, the supermassive black hole at the centre of the Milky Way, reaching such an orbital speed (7,650 km s^{-1}) that first-order relativistic effects come into play — Newtonian dynamics are not sufficient for explaining the star's orbit. This result, a first for a main sequence star, has been recently asserted by the GRAVITY collaboration led by Reinhard Genzel using the instrument of the same name, attached to the Very Large Telescope (VLT).

GRAVITY, an interferometric astrometry imager, detected S2 and Sgr A* thirty times over the period of a year (2017–2018), when S2 was approaching and receding from its pericentre (see artist's representation). Combining these data with measurements from SHARP at the New Technology Telescope and NACO at the VLT, S2's entire 16-year elliptical orbit could be traced out. Since GRAVITY's astrometry is sufficiently precise to determine the separation between S2 and Sgr A* to within 30 microarcseconds, the degree of departure from a Keplerian (Newtonian) orbit could be detected at the ~10σ level. Complementary spectroscopic data from the VLT's SINFONI instrument also exhibited evidence of gravitational redshift in S2's spectrum.

S2's highly constrained orbit can be used to infer the properties of the environment close to Sgr A*. For instance, luminous and massive objects between S2 and Sgr A* are unlikely, but massive, non-luminous objects could be present. A subsequent goal of the GRAVITY collaboration will be to determine if faint objects on even closer orbits than S2's give any indication of whether the Galaxy's supermassive black hole is rotating.

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