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The extended mass distribution in the Galactic center

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Since 2017, the GRAVITY interferometer at ESO's Very Large Telescope has allowed us to obtain astrometric data with unprecedented accuracy of the S-stars orbiting around Sagittarius A*, turning them into a powerful tool to investigate the gravitational potential around the supermassive black hole at the center of our Galaxy. In particular, for the star S2, we have been able to detect the in-plane, prograde Schwarzschild precession of the orbit's pericenter angle, as predicted by General Relativity.

In this talk, I will discuss the effect of an extended distribution of mass around Sagittarius A*, which is expected to be composed mainly of a dynamically relaxed cusp of old stars and stellar remnants.
Assuming the distribution follows a smooth, spherically symmetric density profile, it would add a retrograde precession of the stellar orbits, counteracting the prograde relativistic precession. I will present the upper limits that we obtain with S-stars data on the amount of extended mass that could lie within the orbit of S2, roughly in the central 10 milliparsecs of our Galaxy, and I will show that it is in slight tension with the theoretical predictions.

Then I will discuss the effect of the granularity of this mass distribution, which is actually composed of a finite number of bodies. This can cause deviations in the orbital motion of stars compared to a smooth density distribution, due to the breaking of spherical symmetry and the presence of scattering events. Most notably, it leads to a precession of the orbital plane. The question I aim to answer through numerical simulations is whether these deviations could be observable with the current astrometric accuracy of GRAVITY and whether they could perturb our measurement of the Schwarzschild precession of S2 and, potentially, of the spin and quadrupole moment of Sagittarius A*.

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