The mass distribution in the galactic centre

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Infrared observations of the star cluster at the heart of our galaxy revealed the existence of a massive compact object (putative black hole) of 4.2 million solar masses in coincident location with the radio source Sagittarius A*. The enormous efforts to confirm this have been recognised by the 2020 Nobel prize in Physics. The corresponding results demonstrate the utility of the galactic centre as a unique laboratory for relativistic astrophysics and testing relativity. In particular, the precise astrometric and spectroscopic tracking of the orbit of the star S2 allowed the observation of two prominent relativistic effects. The relativistic redshift could be observed during the last pericentre passage in 2018. The relativistic (Schwarzschild) precession of the stellar orbit could be measured in 2020. The same study also improved the 1σ upper bound on a possibly present dark continuous extended mass distribution (e.g. faint stars, stellar remnants or Dark Matter) within the orbit of S2 to ~ 4000 solar masses.

In my talk I will present the latest observational constraints on both, the Schwarzschild precession as well as on an eventually present extended mass around Sagittarius A*, thanks to a refined data analysis and more data gathered in 2021 with VLTI/GRAVITY—not only for S2, but also for three further S-stars in close approximation to the black hole. I will also complement these observational results by theoretical considerations, e.g. regarding future expectations to further sharpen these and related constraints.