

A star known as S2 orbits the black hole at the center of the Milky Way. Along with other stars, it has been monitored since the mid-1990s by two groups of scientists led by Andrea Ghez and Reinhard Genzel, who were awarded the 2020 Nobel Prize in Physics for their work.

The angular diameter of the semi-major axis of S2's orbit is
 $\Theta = 0.125 \text{ arc-seconds} = 6.25 \times 10^{-7} \text{ radians}$

The period of its orbit is 16 years.

For this problem, it is convenient to use AU as the unit of length.

The distance to the Galactic center is approximately $D = 1.6 \times 10^9 \text{ AU}$ (1.6 billion AU)

1. Using $\Theta = L / D$, what is the length L of the semi-major axis of the orbit of S2, in AU?
2. Using $(M/M_{\text{sun}}) = (r / 1 \text{ AU})^3 \times (1 \text{ yr} / P)^2$, what mass do you infer for the black hole, in solar masses?