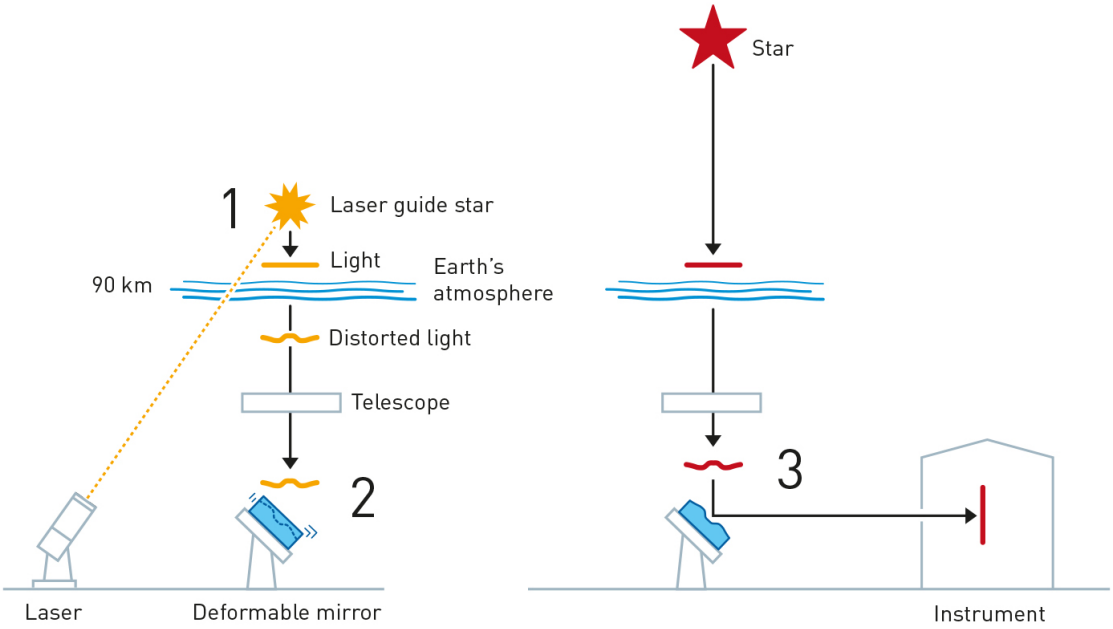

Figure 7. *The principle of adaptive optics. A laser system is used to make artificial guide stars that sense the blurring in the Earth's atmosphere. The images of the bright spots generated by the laser [1] are used in a feedback loop to introduce fast deformations of a secondary mirror [2] that effectively correct for the atmospheric turbulence in the science images [3].*

The discovery of a compact object in the Galactic centre

One of the stars, labelled as S2 by Genzel's group (called S02 by the team led by Ghez), was shown to have a very short orbiting period around Sgr A*, just under 16 years (Schödel et al. 2002, Ghez et al. 2003). For comparison, it takes over 200 million years for the Sun to complete a full orbit around the Galactic centre. This star has a highly elliptical orbit with eccentricity e = 0.88. Its pericentre distance from Sgr A* in the spring of 2002 was a mere 17 light hours, or 1,400 R_S, for a black hole of mass $4 \times 10^6 M_\odot$ (see figure 8). The plane of the orbit has an inclination of about 46° with respect to the plane of the sky.

The agreement between the data from the NTT/VLT and Keck telescopes was excellent. The analysis of the combined data sets showed that the extended mass component (visible stars, stellar remnants and, possibly, dark matter) within the orbit of S2, gave a negligible contribution to the estimation of the central mass (Ghez et al. 2008, Gillessen et al. 2009b). The work of the two teams together established that the Galactic centre contains a highly concentrated mass of ~4 million solar masses within the pericentre of S2, i.e. within 125 AU. This requires a minimum density of $5 \times 10^{15} M_\odot pc^{-3}$. The mass centroid lies within ±2 milliarcseconds of the position of the compact radio source Sgr A*, which itself has an apparent size of <1 AU (Shen et al. 2005, Bower et al. 2006, Doeleman et al. 2008) and lacks detectable proper motion (Reid & Brunthaler, 2004).

A robust interpretation of these observations is that the compact object at the Galactic centre is compatible with being a supermassive black hole. Further support for this conclusion comes from the fact that near-infrared and X-ray flares are observed from the same position, which can be naturally ascribed to variations in the accretion flow towards a massive black hole.