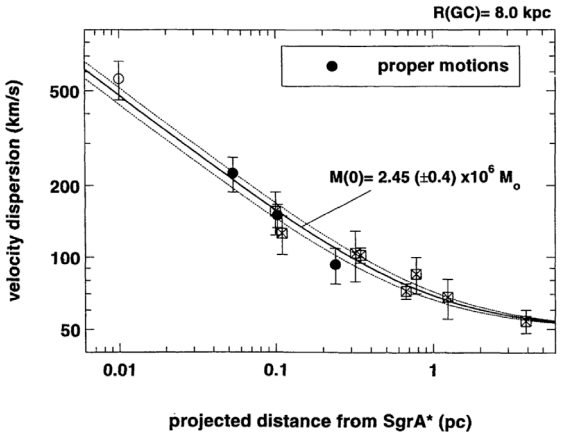

Figure 6. *Projected stellar velocity dispersion as a function of projected distance from Sgr A* from a set of measurements, culminating with the innermost points within 0.2 parsec (circles) obtained from measurements with the SHARP camera on the ESO 3.5-m NTT. The curves indicate the expectations from a supermassive black hole with ~2.5 million solar masses. Adding more recent data from VLT and Keck the mass estimate increased to over 4 million solar masses. From Eckart & Genzel (1997).*

The era of adaptive optics: tracing individual star orbits

The short exposure times involved in speckle imaging limited the monitoring to only the brightest stars, and lengthy surveys were required to extract a robust determination of the projected velocity. These limitations were overcome when adaptive optics, first envisioned by Babcock (1953), became available to Ghez's team at the Keck Observatory (Wizinowich et al 2000) and Genzel's team at the Very Large Telescope (VLT) operated by ESO (Rousset et al 2003).

As shown in figure 7, the adaptive optics technique uses a bright reference object next to the observation target, either a bright star or even an artificial 'star' created by laser excitation of Sodium atoms in the upper atmosphere. A deformable secondary mirror changes shape to compensate for aberrations to the known reference object. The compensation is performed in real time with a feedback loop, thus enabling long exposure time and the creation of much sharper and deeper images, down to the diffraction limit. This technological revolution also allowed for the use of a spectrograph to study the stars, adding two important features: the composition of the stars could be studied and, crucial to the project, radial velocities could be measured in addition to the projected velocities.

At ESO, Genzel's group started a program at the 8-m VLT using adaptive optics imaging with the NACO instrument and spectroscopy with SINFONI. Not only statistical measurements of the stellar motions were made with the new technique, but most importantly, individual stars could be accurately monitored in a manageable time scale.