# Chapter 1

# The Central Parsec Over The Past Decade

The aim of this chapter is to familiarise the reader with the past decade of the observational results from the Galactic Centre with emphasis on issues important for this work. We do not intend to give the overall current state-of-art review.

## 1.1 Where is the Galactic Centre?

The innermost part of our Galaxy is situated on the southern celestial hemisphere in the direction of the constellation of Sagittarius. In this work the Galactic Centre (GC) represents the region with radius !!!1 pc !!! of the dynamical centre of the Galaxy. The current GC observations show there is a super-massive black hole (SMBH) located at the dynamical centre of our Galaxy. This SMBHs environment can be observed in radio and infra-red (IR) wavelengths.

The first determination of the distance from the Sun to the dynamical centre of the Galaxy, $R_0$, published by Shapley (1918) based on Cepheid magnitude-period relation was estimated as $R_0 \approx 13$ kpc. According to the review by Reid (1993) the best estimate results from $H_2O$ maser proper motions: $R_0 = (8.0 \pm 0.5)$ kpc.

The most recent value of $R_0 = (7.62 \pm 0.32)$ kpc by Eisenhauer et al. (2005). This estimate was obtained by solving Keplerian orbits (the corresponding central mass estimate is $M_\bullet = (3.61 \pm 0.32) \times 10^6 M_\odot$) of the innermost individual stars from radial velocity and proper-motions measurements.

## 1.2 What is the Sgr A$^\star$ ?

The compact radio-source nowadays referred to as the Sgr A$^\star$ was first observed by Becklin & Neugebauer (1967). Since then there were several ideas what kind of astrophysical object the Sgr A$^\star$ should be according to the current mass-density estimates determined from IR observations: from very dense cluster, through fermion ball, cluster of neutron stars, white dwarfs and stellar black holes – see Fig. 12 in Schödel et al. (2003).

The recent measurements resulted in agreement that Sgr A$^\star$ is a supermassive black hole (SMBH), residing in the dynamical centre of the Galaxy, the SMBH mass-estimate varies in range $M_\bullet = 3 - 4 \times 10^6 M_\odot$. The celestial position of Sgr A$^\star$ is RA=17$^{\rm h}$45$^{\rm m}$40.0409$^{\rm s}$ and DE=-29°00′ 28.118″ (J2000.0), see Reid & Brunthaler (2004).

## 1.3 Stellar populations in the Galactic Centre

The SMBH in the centre of our Galaxy is surrounded by the nuclear stellar cluster, gas and dust. The Galactic Centre (GC) region is mostly observed in near-infrared (NIR) wavelengths, the most often used bands are K-band (2.2 $\mu$m), L-band (3.5 $\mu$m) and H-band (1.65 $\mu$m).

The central pc contents different stellar populations. Genzel et al. (2003) summarise that the radial distribution of stars follows the power-law distribution with power-law index $\alpha \sim 1.3 - 1.4$. The stellar population in the GC can distinct three groups of stars: galactic bulge-like, cusp within 1.5″ and the innermost cusp.

The outer part of the central pc contains the same stellar population as the galactic bulge: synthesis of an old, metal rich stellar population, contributed by young, early- and late-type stars. The central pc is dominated by old (1-10 Gyr) red giants with K $\geq$ 13 mag.

There are $\sim$ 12 luminous blue super-giants ($K \sim 9 - 12$ mag) which suggest the recent star formation (age of 2-7 Myr). The next stellar component are bright asymptotic giant branch (AGB) stars with intermediate-mass and intermediate-age $\geq$ 100 Myr, $K \sim 10 - 12$ mag. The next component of the central pc are dust-embedded stars associated with gaseous mini-spiral.

The hot topic of the GC region research are the young stars in the inner 0.15 pc. In the innermost part of the GC, in the central 0.01 pc is a group of young stars to which we reffer as to the S-stars. Most of the massive early-type stars in distance 0.05-0.15 pc formed two disk-like structures, referred to as clockwise (CWS) and counter-clockwise (CCWS) disks.

### 1.3.1 S-stars

### 1.3.2 Disk-like Structures in the Galactic Centre

## 1.4 Engaged Instrumentation

# Bibliography


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