Neutral star population near the Galactic center

The Galactic center region is a very complex region, which hosts the supermassive black hole of ~4x10^6 M☉, which is associated with the compact source Sgr A*. Infra-red observations revealed a very dense nuclear star cluster (NSC) that consists of both late-type and early-type stellar populations (Hatchell et al., 2003), see Fig. 1. Long-slit observations extending from red to blue L-band up to the radio domain disentwined the structure of the gaseous-dust multiphase medium, which consists of both ionized (Sgr A East) and thermal components (Sgr A West – the mini-spiral). Since the thermal streaming of the mini-spiral and the NSC occupy the innermost parsec, the rate of conversion between the gaseous density and stars is expected to be non-negligible. The geometry of the mini-spiral is highly non-spherical, thus the geometrical distribution of encounters is expected to produce the net polarization of the total signal, see Fig. 2.

The presence of suprathermic objects may be revealed by the presence of bow shocks. The end-products of the stellar evolution that are still observationally unexplored in the Galactic center region – in particular neutron stars – could be revealed via bow shocks, see Fig. 3 for illustration. The method of searching for neutron star bow shocks in particular in the X-ray and radio domains could thus be complementary to standard radio pulse searches, which have yielded a low number of detections in the Galactic center despite sufficient sensitivity (Fig. 4).

Distribution of interaction modes of neutron stars

Using the properties of the ambient medium and the distribution of neutron stars in terms of the magnetic dipole intensity and their rotational period, we assess the distribution of the interaction modes (accelerator, propeller, and ejector) in the innermost parsecs of the Galactic center (Zajacek et al., 2013). We consider two types of the spatial power-law distribution of neutron stars, see Figs. 5 and 6, which affect mainly the rate of the interaction with the mini-spiral in the range 1–10%. The ejector regime is prevalent for both the inner and the mini-spiral region, see Figs. 7 and 8. However, it is even more prevalent for the circumstellar region due to lower ambient pressure. The distribution of the interaction modes in the periodic magnetic intensity plane is depicted in Fig. 9 for both the interarm and the mini-spiral region. A shift is apparent between the interarm and the mini-spiral region for the high value of the period, the propeller and the accelerator regimes occur for larger magnetic intensities in the mini-spiral region.

Observability of bow-shock nebulae

The observability of bow-shock structures is given by the angular scale and the flux density that is above the sensitivity threshold of given wavelength. The bow-shock angular scale is given by the standard angular distance $\theta_{\text{shock}} = \frac{\text{rad} \times (\text{flux} \times \text{distance})}{\text{weight}}$, where $\text{flux}$ is the flux density. In the Figure below, we plot simulated size distribution of bow-shock nebulae for the spatial distribution (b).

References