Young, Massive Star Candidates Detected throughout the Nuclear Star Cluster of the Milky Way

NISHIYAMA, Shogo
(NAOJ)

SCHÖDEL, Rainer
(Instituto de Astrofsica de Andaluca)

Nuclear star clusters (NSCs) are ubiquitous in galaxies and appear as compact clusters at the dynamical centers of their host galaxies [1]. They show mixed stellar populations and their spectra indicate recent events of star formation. However, it is impossible to resolve external NSCs in order to examine the relevant processes. The Milky Way NSC, on the other hand, is close enough to be resolved into its individual stars and presents therefore a unique template for NSCs in general.

Young, massive stars have been found by AO assisted, systematic spectroscopic studies at projected distances $R < 0.5$ pc from the supermassive black hole Sgr A* (e.g., [2]). In recent years, increasing evidence has been found for the presence of young, massive stars also at $R > 0.5$ pc (e.g., [3]). Our goal is a systematic search for young, massive star candidates throughout the entire region within $R \sim 2.5$ pc of the black hole.

We present the results of a systematic search for young, massive stars within $R \approx 2.5$ pc of Sgr A* via nearinfrared (NIR) imaging observations with VLT/ISAAC [4]. Our method is a narrow-band seeing-limited imaging, using the CO-band absorption of late-type stars to distinguish between young, massive, early-type stars and late-type giants in the central $\sim 6 \times 6$ pc. Recurrence to seeing-limited observations allow us to probe a significantly larger FoV than what would be possible in comparable time with AO imaging.

We have found 63 early-type star candidates at $R < 2.5$ pc, with an estimated erroneous identification rate of only about 20 %. Considering their K-band magnitudes and interstellar extinction, they are candidates for Wolf-Rayet stars, supergiants, or early O-type stars. Of these, 31 stars are so far unknown young, massive star candidates, all of which lie at $R > 0.5$ pc. The surface number density profile of the young, massive star candidates can be well fit by a single power-law ($\propto R^{-\Gamma}$), with $\Gamma = 1.6 \pm 0.17$ at $R < 2.5$ pc, which is significantly steeper than that of the late-type giants that make up the bulk of the observable stars in the NSC. Intriguingly, this power-law is consistent with the power-law that describes the surface density of young, massive stars in the same brightness range at $R < 0.5$ pc.

The finding of a significant number of newly identified early-type star candidates at the Galactic center suggests that young, massive stars can be found throughout the entire cluster which may require us to modify existing theories for star formation at the Galactic center. Follow-up studies are needed to improve the existing data and lay the foundations for a unified theory of star formation in the Milky Way's NSC.

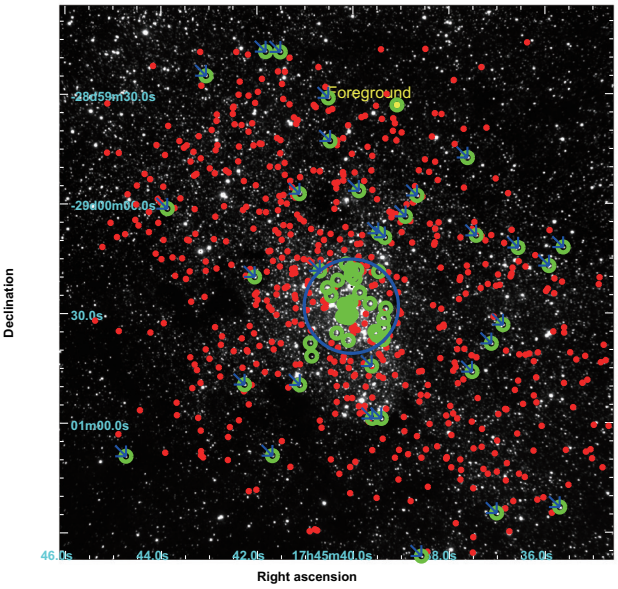

Figure 1: Spatial distribution of the early-type star candidates (green circles). The candidates which have been unknown so far are indicated by blue arrows. Red giants identified by our analysis are marked by red circles. The large blue circle delimits a region within 0.5 pc (12.″9) in projection from Sgr A*. We have identified about 30 new candidates outside the 0.5 pc region.

References

[1] Böker, T., et al.: 2010, *IAU Symp.*, **226**, 58.
[2] Do, T., et al.: 2009, *ApJ*, **703**, 1323.
[3] Mauerhan, J. C., et al.: 2010, *ApJ*, **710**, 706.
[4] Nishiyama, S., et al.: 2013, *A&A*, **549**, A57.