The Multi-Messenger Astrophysics of the Galactic Centre
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The Fingerprint of a Galactic Nucleus

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Abstract. Because of the unique observational challenges -extreme crowding and extinction- any existing large-scale near-infrared (NIR) imaging data on the Galactic Center (GC) are limited by either one, or a combination, of the following: saturation, lack of sensitivity, too low angular resolution, or lack of multi-wavelength coverage. To overcome this situation, we are currently carrying out a sensitive, 0.2" resolution JHK imaging survey of the Galactic Centre with HAWK-I/VLT. Thanks to holographic imaging, we achieve a similar resolution than with HST/WFC, but can cover also the long NIR, beyond 2 micrometers, which is essential to deal with extinction. Our survey is supported by an ESO Large Programme and will provide photometrically accurate (few percent uncertainty for H<18 stars), high-angular resolution, NIR data for an area of several 1000 pc^2, a more than ten-fold increase compared to the current state of affairs. Here we present an overview and first results.

Keywords. Galaxy: center, instrumentation: high angular resolution, techniques: image processing, stars: Population II.

1. Introduction

The centre of the Milky Way is the only galaxy nucleus in which we can resolve the Nuclear Stellar Cluster (NSC) observationally and examine its properties and dynamics down to milli-parsec scales. However, only on the order of 1% of the projected area of the Galactic Centre (GC) has been observed with sufficient angular and wavelength resolution to allow an in-depth study of its stellar population. Therefore, we have initiated a new high resolution survey to remedy this situation and increase by more than 10-fold the extension of the well-studied area. We aim to constrain the structures of and the relationships between the nuclear cluster and the nuclear disk to obtain a comprehensive picture of star formation within 40 pc of SgrA* in the past ($\sim$ 100 Myr), to analyze the stellar populations, and to study the extinction curve.

2. Overview

The region that we are observing has been selected taking into account previous observations from HST (Dong *et al.* 1997). In this way, we will be able to complement this survey with our data. Besides, we have selected some regions in nearby bulge regions to compare the stellar population with the one in the GC (see Fig. 1).

The observations are being obtained with the wide field near infrared imager HAWK-I located at ESO VLT UT 4. Its large field of view and the possibility of using the fast photometry mode, make this instrument ideal for our survey. We use the broad band filters J, H and Ks. One of the key points of the project is the use of the speckle holography technique (Schoedel *et al.* 2013) to achieve high angular resolution ($\sim$ 0.2"). Thus, we are able to obtain data with a quality comparable to the one obtained by the Hubble Space Telescope.

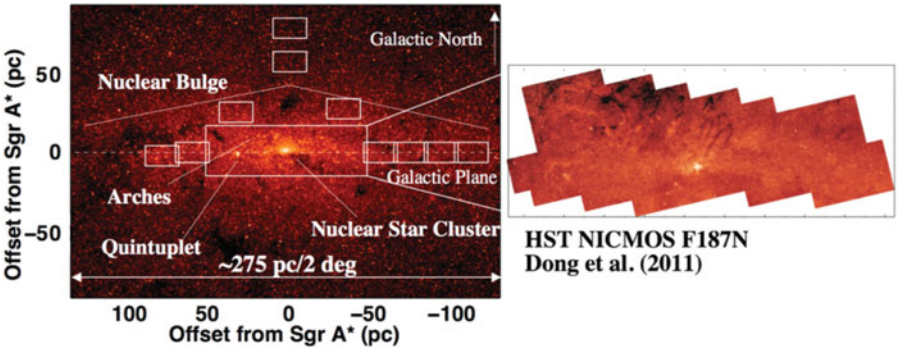

Figure 1. Left panel: Galactic Centre (Spitzer). Regions being observed in the project in white. Right panel: HST NICMOS F187N.

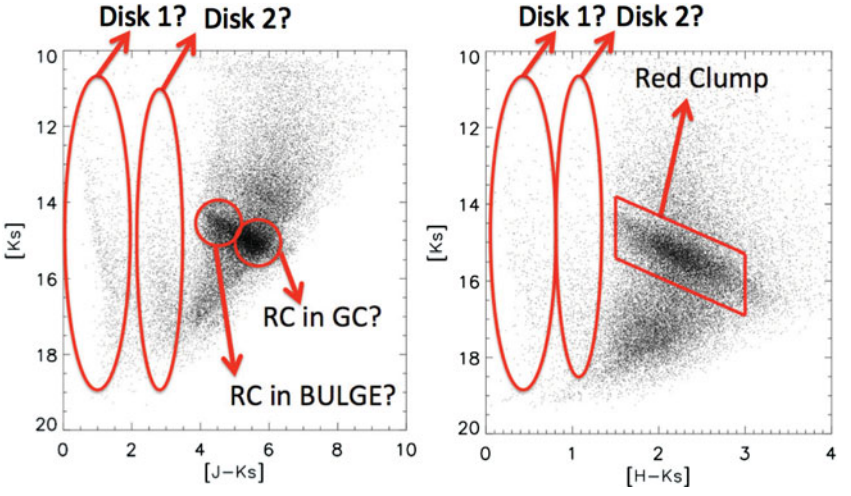

Figure 2. CMD from central field photometry.

3. Implications

Here we present the preliminary results from the first analysis of the data corresponding to a region of 8.2' × 2.8' centered on Sgr A*. PSF-photometry has been obtained by means of STARFINDER (Diolaiti *et al.* 1999).

Color-Magnitude diagrams (CMDs)

Analyzing the CMD, we distinguish different stellar populations as it is shown in Fig. 2.

Infrared extinction curve

Using RC as standards we find that the extinction can be described well by a single power law with an exponent $\alpha = 2.25 \pm 0.31$ which is consistent with the value obtained by Schoedel *et al.* 2010.

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