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ESO programme Accretion Discs in Halpha with OmegaCam, Data Release DR1
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Accretion Discs in Halpha with OmegaCam (ADHOC)

Abstract

This document describes the released ADHOC images and source catalogues. This release includes reduced images and single-band source lists of the star forming regions Orion A and Gamma Vel. The scientific goal of the ADHOC project is to study the star formation history of the several star forming regions using homogeneous wide fields multi band data, including u, g, r, i and Hα.

Release Content

We took advantage of the wide-field capabilities (1 square degree) of OmegaCAM to carry out a deep (r=21 ABmag) wide-field study of eight star-forming regions in the Galaxy. In this first release we provide reduced images and single-band sources list of Gamma Vel and Orion A. The observations of additional star forming regions (including e.g. Lupus, Upper-Sco, Haffner 18) will be made available in future data releases.

The observations of the entire survey were distributed over four ESO observing periods for a total of 355 hours using "filler conditions", i.e., exploiting the poorest observing conditions available at the VLT (ESO Programme IDs: 096.C-0730(A), 097.C-0749(A), 098.C-0850(A) and 099.C-0474(A)). Most of the regions were observed with the SDSS ugri broad-band filters (hereafter referred to simply as ugri) and the NB659 (Hα) narrow-band filter. The observations were designed following the same observational strategy adopted by the ESO Public Survey VST Photometric Hα Survey of the Southern Galactic Plane (VPHAS+; Drew et al., 2014): each targeted region was sampled in groups of three overlapping fields, and in each group the fields are contiguous with a footprint close to 3 × 1 square degrees. For each position in the sky we acquired two exposures of 70 seconds in u and g, two exposures of 25 seconds in r and i and three images taken with the Hα filter using 150-second exposures. The entire dataset was fully processed, from the bias, flatfield and linearity correction to the stellar photometry, at the Cambridge Astronomical Survey Unit (CASU). The magnitude for each star was extracted using aperture photometry, adopting an algorithm based on IMCORE and the nightly photometric calibrations were also performed.

Release Notes

This release includes data obtained with the ESO programs 096.C-0730(A) and 097.C-0749(A). Reduced images are one of the two major components of this release. These are presented as native 32-CCD OmegaCam pawprint, each representing a tile

of 1 x 1 sq.deg. These are unstacked. Altogether there are 1860 images and 1860 single band catalgoues extracted by the CASU pipeline from the reduced image data. The number of detected objects in them varies from ~ten thousand up to hundreds of thousands, depending on pointing and filter.

Data Reduction and Calibration

The data pipeline used to process the raw survey data is operated by the Cambridge Astronomical Survey Unit (CASU) and has many features in common with the VISTA Data Flow System. The latter is described at:
http://casu.ast.cam.ac.uk/surveys-projects/vista/technical/data-processing

Specifics relating to VST data are presented at:
http://casu.ast.cam.ac.uk/surveys-projects/vst/technical

In brief, the current method of source detection is aperture photometry, applied to the images after the adaptive removal of 'smooth' background due to both telluric and astronomical sources (nebulosity) using CASU's nebulizer software. The pipeline includes the morphological classification of all detected sources that distinguishes a range of object types, from high-probability point objects (stars) through to clearly extended objects and noise-like features.

The astrometric calibration is achieved by reference to the 2MASS catalogue. The calibration of the extracted source fluxes is improved by making comparisons with APASS stellar photometry. The calibration of the Hα data is tied to that of the r–band data, a practice already used to good effect in the VPHAS+ survey. No reddening corrections are applied.

Data Quality

The astrometric quality as measured in the pipelining is very good, and uniform across the large field –typical mean RMS errors with respect to 2MASS are 70-80 mas. The photometric calibration is provisional and only as good as the comparisons with APASS allow. This means in practice that g, r and i are expected to be relatively secure with external errors comparable to those of APASS (~0.03 magnitudes). In the u band, there is greater uncertainty that at present is hard to quantify. However the early signs are that a good uniformity is being achieved from CCD to CCD across the native 32-CCD OmegaCam pawprint, which may in the long run support the determination of simple photometric offsets per field in achieving a satisfactory final global calibration. In preparing this release, we have computed the median and standard deviation of all single-filter magnitude differences (m1–m2), in the magnitude range 12 to 19 for i and Hα, 13 to 20 for u and r, 14 to 21 for g, to look for unstable observing conditions and other problems that might cause unwanted measured flux variations within tiles and hinder their ultimate calibration. In the vast majority of single-band catalogue pairs, the median difference is below 0.02, with the standard deviation ranging from 0.04 to 0.07.

Figure 1 shows a true-colour image of the Orion Nebula Cluster (ONC) obtained using OmegaCAM data which are part of this release, with a 59.95 × 46.56-arcminute field of view. In the left panel of Figure 2 we instead show the colour-magnitude diagram (CMD) of the entire stellar population sampled with the ADHOC data within a radius of 1.5 deg around the ONC while in the right panel of the same figure we show the stellar population selected at the distance of the ONC (~400pc) using GAIA Dr3 parallaxes. The ONC stellar population is identified with unprecedented accuracy. The CMDs clearly show the photometric accuracy that can be achieved with the ADHOC data.

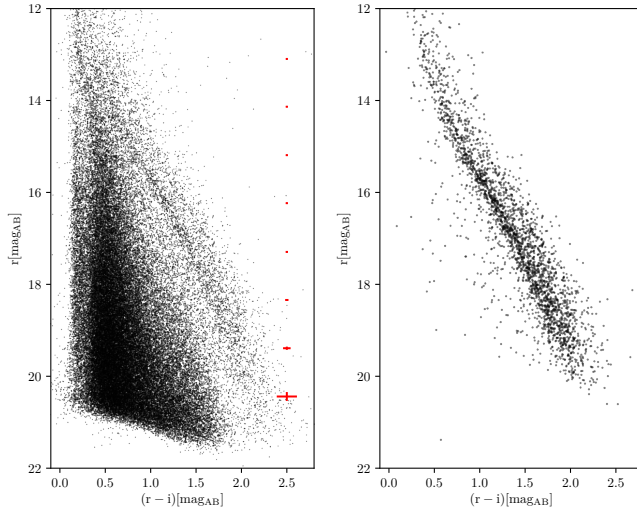*Figure 1: True colour image of the Orion Nebula Cluster obtained using OmegaCAM data.*

Figure 2: Left-panel: CMD of the entire stellar population in the ONC area; Right-panel: stars selected using Gaia DR2 parallaxes around the ONC.

Known issues

When using the data acquired for this survey, users must remember that the data were taken as part of filler programs. This means that the data were taken under "Any weather" conditions. While the restriction on the accepted image quality for the images was fixed to a maximum value of 1.2 arcsec, we had no restriction on the moon conditions. This fact as little if no effect on the limiting magnitude achieved with the Hα narrow-band filter while the effect is more severe for the bluest filters.

Users must be aware that some of the files observed with the ADHOC survey are characterized by a very sparse stellar population. As a consequence some chips of the OMEGACAM CCD mosaic are populated by very few stars (in some cases there are even no stars). As a consequence, the astrometric solution of such chips is inaccurate and it is not possible to provide an estimation of the Full Width-Half Maximum of the PSF. The affected extensions of the fits source tables are flagged with a PSF_FWHM=-1 value, which encodes missing measurements.

Previous Releases
None

Data Format

Files Types
There are two major file types: (i) reduced fits images, (ii) single-band fits catalogues of detected objects. Associated files are also provided. They are named according to a simple unique convention that specifies the date on which the night of observation started, and the run number for the night.
Image naming format: o<yyyymmdd>_<runno>.fits.fz
Catalogue naming format: o<yyyymmdd>_<runno>_cat.fits.fz
Associated files, e.g. confidence maps: <filter>_<conf>_<date>.fits.fz

Also see:

http://casu.ast.cam.ac.uk/surveys-projects/vst/technical/naming-convention

Note that 'pawprint' and 'tile' are synonymous in the VST/VPHAS+ context.

Catalogue Columns

For a specification of the layout see:
http://casu.ast.cam.ac.uk/surveys-projects/vst/technical/catalogue-generation

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"This research has made use of the services of the ESO Science Archive Facility."

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