12th Hel.A.S Conference
Thessaloniki, 28 June-02 July, 2015
CONTRIBUTED LECTURE

The Manchester-Athens Wide-Field Camera (MAWFC): A new 30deg diameter narrow-band optical camera

P. Boumis[1], *J. Meaburn*[2], *C. Dickinson*[2], *N. Nanouris*[1], *A. Chiotellis*[1], *A. Liakos*[1], *J. Font*[1,3], *V. Loizos*[1], *A. Galtress*[2], *C. Drakos*[1]
[1]IAASARS, National Observatory of Athens, I. Metaxa & V. Pavlou, Penteli 15236, Greece
[2]Jodrell Bank Centre for Astrophysics, University of Manchester, UK
[3]Instituto de Astrofisica de Canarias, La Laguna, Tenerife, Spain

Abstract:
The Manchester-Athens Wide-Field (Narrow-Band) Camera (MAWFC) is the first scientific instrument for astronomy that constructed and tested completely in Greece. The instrument is ready and after the first light tests, it started to conduct a large-area sky survey that will provide maps at 1 arcmin resolution, in order to investigate the very extensive, but faint, line emission regions over the whole sky. Deep observations of the northern sky in the optical emission lines of Hα, [O III], and Hβ are started to be taken and it is expected the results to have significant impact on topical astronomical areas of research e.g. subtracting the foreground for the cosmic microwave background, investigating the giant, high latitude, radio filaments from the Galactic centre or very close objects in the Galactic plane of extreme angular extent etc. The instrument and its first results are presented here.

1 Introduction

The sky at high galactic latitudes is host to a wide range of extensive phenomena that emit faintly in optical lines over a range of excitations. These features remain largely unexplored for the overwhelming majority of the observing programmes of the Worlds largest telescopes which have been concentrated on achieving high angular resolution over small fields. The MAWFC project is to design and construct a state-of-the-art, wide-field (~30 degree diameter), narrow-band, optical filter camera The Manchester-Athens Wide Field Camera (MAWFC). The standalone camera is the first scientific instrument for astronomy that was constructed and was tested completely in Greece and will conduct a large-area sky survey that will provide maps at less than 1 arcmin resolution, in order to investigate the very extensive, but faint, line emission regions over the whole sky. We will make deep observations of the northern sky in the optical emission lines of Hα, [O III] and Hβ, from astronomical sites. The successful outcome will have a significant impact on topical astronomical areas of research e.g. subtracting the foreground for the cosmic microwave background; estimating the electron temperature of the warm ionized gas by comparison with radio data; investigating the giant, high latitude, radio filaments from the Galactic center or very close objects in the Galactic plane of extreme angular extent, etc.

Note that this new camera is a 10 times more sensitive upgrade of a number of previous versions (Fig.1), it is an enhanced version of the one used very successfully several years ago (MWFC; Johnson et al. 1978, Boumis et al. 2001, Dickinson 2002).

2 MAWFC Survey

Over a period of ~7 to 8 months, using dark time to minimize background contributions (2 weeks/month), we will make deep observations of the northern-sky. With a FOV of ~30-degree diameter, we can cover the northern hemisphere with ~75 individual pointings, with adequate overlap between fields for calibration of baselines. For each pointing, we will require at least 20 min exposures to provide deep ($\geq$3

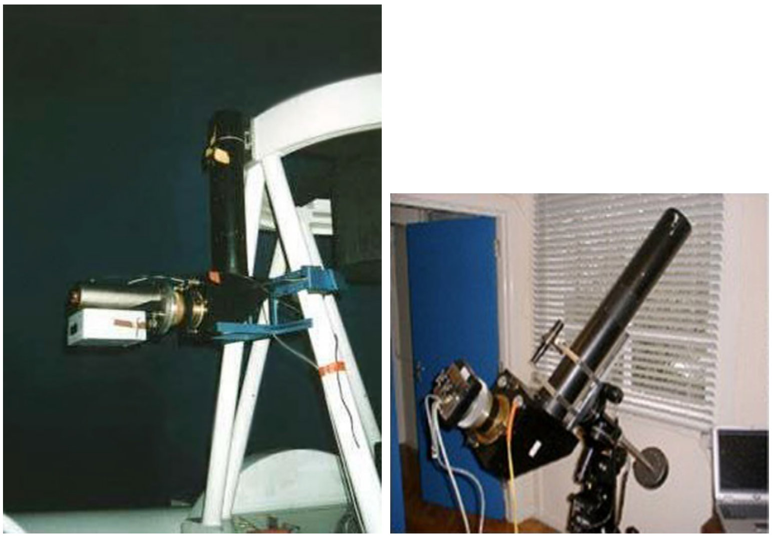

Figure 1: The left image illustrates successful use of the 2nd version where the faint but extremely extensive Eridanus nebulosity has been imaged in the light of Hα (Boumis et al. 2001), the right image is the 3rd version while was tested int he lab (Dickinson 2002).

hour) observations using narrow-band Hα, Hβ and [O III] filters, and shorter observations in continuum bands ($\sim$100 $\AA$ wide) to remove stellar contamination. The total integration time required is $\sim$700 hours, which should be readily achieved on a timescale of $\sim$7 to 8 months. We will use the ratio of Hα and Hβ brightnesses to estimate the dust extinction at Hα (see e.g. Casassus et al. 2004) and also the possible contribution from dust-scattered Hα light, which may be significant at high latitudes (Adolf Witt, priv. comm.). Absolute calibration will be achieved using standard nebular sources (e.g. the California nebula) or via the publically available Wisconsin H-Alpha Mapper (WHAM) Fabry-Perot data on large angular scales (Haffner et al. 2003). The images will then be combined, with appropriate background corrections, to make a large mosaic map. Combining this with other surveys (WHAM and SHASSA) will allow an accurate full-sky map of Hα, with an angular resolution of $\sim$1 arcmin. This will be complementary to high-resolution Galactic plane surveys in Hα such as the IPHASS/VPHAS surveys, and will become a Legacy Survey to be used for many years to come for studying diffuse Galactic emission (e.g. Dobler, Draine & Finkbeiner, 2009). The calibrated sky maps will be made publically available. A possible future extension to the survey would be to map other lines (e.g. [S II] etc.) or to map the Southern sky with particular emphasis on the environment of the Magellanic Clouds. A pipeline code for the MAWFC will also be available for the data reduction procedure (see Nanouris et al. 2015).

3 Instrumentation and First light results

The instrument (Fig. 2) was designed (optically and mechanically) and constructed in a very short period ($\sim$ a year), then tested in the mechanical (MYEDPP - University of Patras) and optical (IAASARS optical lab) labs (Fig. 3) before we have the first light tests. The latter were performed in April 2015 (Fig. 4) and after a number of small modifications and adjustments, it was moved to the Kryoneri Observatory (June 2015) for first light on dark sky tests (Fig. 5). It is now under final adjustments before starting the survey observations. More information can be found at http://mawfc.astro.noa.gr/.

Acknowledgements: The project MAWFC is implemented under the ARISTEIA II action of the Operational Programme Education and Lifelong Learning and is co-funded by the European Social Fund (ESF) and National Resources.

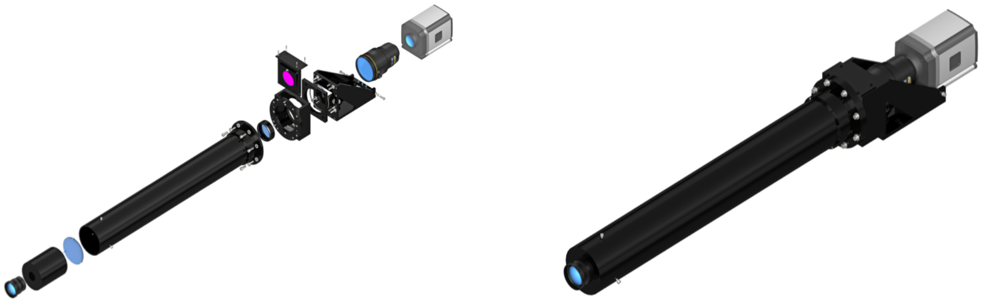

Figure 2: 3D mechanical layout of MAWFC

Figure 3: Tests of MAWFC at the mechanical (left) and optical (right) laboratories.

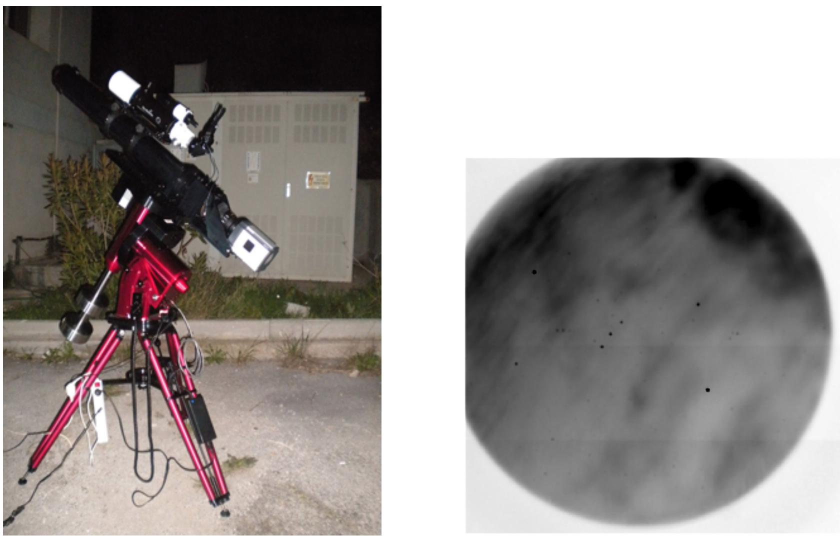

Figure 4: First light tests of MAWFC at the IAASARS Headquarters in Penteli hill. The instrument setup can be seen on the left image while on the right is the first light image of the Orion (without using any filter).

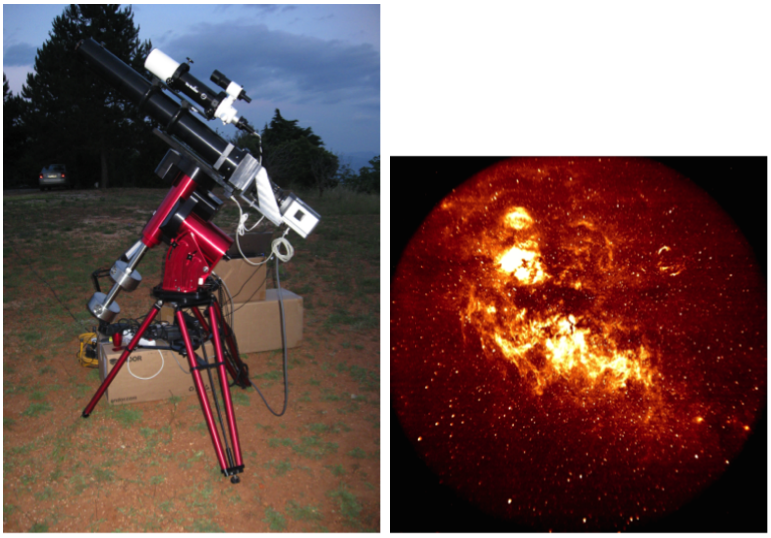

Figure 5: First light tests of MAWFC at the IAASARS Kryoneri Observatory. The instrument setup can be seen on the left image while on the right is the first light Hα image (20min exposure) in Cygnus.

References

[1] Boumis P., Dickinson C., Meaburn J., et al. 2001, MNRAS, 320, 61

[2] Casassus S., Readhead A.C.S., Pearson T.J., et al. 2004, ApJ, 603, 599

[3] Dickinson C., 2002, PhD thesis, University of Manchester, UK

[4] Dobler G., Draine B., Finkbeiner D.P., 2009, ApJ, 699, 1374

[5] Haffner L.M., Reynolds R.J., Tufte S.L., et al., 2003, ApJS, 149, 405

[6] Johnson P.G., Kaye A.L., Meaburn J., 1978, Applied Optics, 17, 442

[7] Nanouris N., Boumis P., Chiotellis A., Dickinson C., Font J., 2015, 12th Helaset proc., in press