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Image Digitisation of Outflows and the AAO/UKST Hα Survey

W. J. Zealey and S. L. Mader

Department of Physics, University of Wollongong, Northfields Avenue, Wollongong, NSW 2522, Australia
b.zealey@uow.edu.au, slm06@uow.edu.au

Abstract: The Hα emission-line survey of the Southern Sky to be carried out by the AAO/UKST will provide deep, high resolution images of Galactic Plane sources allowing the detection of new and existing filamentary sources such as Herbig–Haro objects. Used in conjunction with the existing ESO/SERC Southern Sky Survey Plates, the Hα plates will provide us with the opportunity to study the morphology and environment of new and existing star forming regions.

Keywords: techniques: image processing — surveys

1 Introduction

The process of star formation is a highly disruptive event where both infall and outflow of material occur simultaneously in the production of a protostellar core. The outflow phase is characterised by the impact of high velocity winds with the surrounding interstellar medium, creating bipolar molecular outflows, masers, Herbig–Haro (HH) objects and jets. Multi-wavelength observations have shown HH objects and jets to be regions of shock-excited gas emitting Hα (λ 6563), [OI] ($\lambda\lambda$ 6300, 6363) and [SII] ($\lambda\lambda$ 6716, 6731) in the visible and H_2 ($2{\cdot}12$ μm) in the infrared.

The new AAO/UKST Hα survey of the Galactic Plane will be beneficial to star formation studies as it provides us with a tool for surveying large regions near and around dark clouds for signs of outflow activity from young stellar objects (YSOs) which span a wide range in evolution from highly embedded sources to optically visible T Tauri stars. In this poster paper, we outline an application of digital methods to the study of outflows from YSOs using the AAO/UKST Hα survey of the Galactic Plane in conjunction with existing ESO/SERC Schmidt Plates. These allow us to identify shock-excited emission regions and distinguish between reflection and emission nebulosity. The image digitisation process has been discussed elsewhere (Zealey et al. 1994; Zealey & Mader 1997). This paper will be devoted to showing examples of the digitised images and the information we can obtain from them.

2 HH 49/50

Figure 1 shows IIIaJ, IIIaF and IVN images of the region near the visible reflection nebula Ced 110 and objects HH 49/50. First discovered by Schwartz (1977) these objects are located in a high extinction region of the Cha I cloud at a distance of 140 pc. Cohen & Schwartz (1987) suggested IRAS 11054–7706C as a candidate energy source for HH 49/50, but Prusti et al. (1991) showed this source to be multiple and argued for the central component (hereafter IRS4) as the driving source. IRS4 also drives a molecular outflow in line with the axis defined by IRS4 and the HH objects (Mattila, Liljeström & Toriseva 1989).

The nebulosity associated with Ced 110 is clearly seen in the IIIaJ, IIIaF and IVN images. HH 49/50 are seen in the IIIaF image, but not in the IVN image thus indicating they are dominated by line emission. As IRS4 is highly obscured, we do not see any reddened sources at its location in the IVN image. The IIIaJ/IIIaF images show a reflection nebulosity located slightly north-east of IRS4 which could be associated with the embedded source and not Ced 110.

By comparing Hα survey plates with existing ESO/SERC material, we do not have to resort to CCD cameras with small fields of view to study morphological properties of new and existing outflow features, although follow-up observations are vital for deeper studies. The direct comparison of the Hα and ESO/SERC plates will also determine if nebulosities are dominated by line emission seen in shocked regions of HH objects and supernova remnants. The scale of outflows from low-mass YSOs is only now being realised with the discovery of parsec-scale HH flows using wide field of view (up to 1°) CCD cameras (Bally & Devine 1994). The 6° fields of the Hα survey and ESO/SERC material will provide new insights into these giant HH flows and their smaller ($<$ 1 pc) counterparts.

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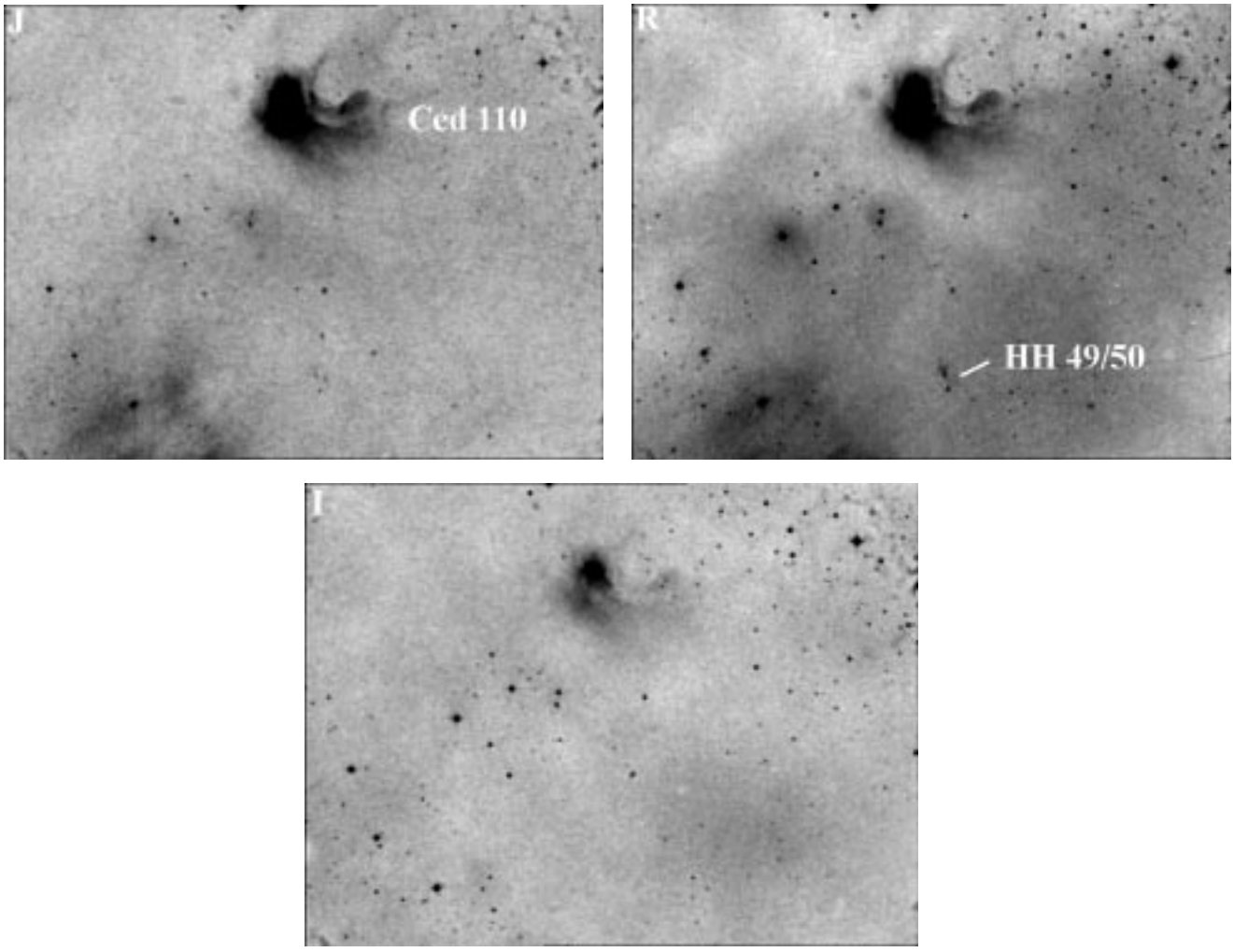

Figure 1—IIIaJ [J], IIIaF [R] and IVN [I] images of the region near Ced 110 and HH 49/50.

3 Conclusions and Future Directions

We have shown how the use of low cost digital imaging systems will enable detection of new and existing Galactic Plane sources in (almost) real time. As part of the proposal to fund the Hα survey filter, we have included funding to provide a 12-bit digitising system at the UKST. The improved image resolution and sensitivity of the Kodak Tech-Pan emulsion coupled with this system and archival material will allow the discovery and cataloging of new emission-line sources in the Galactic Plane.

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Bally, J., & Devine, D. 1994, ApJ Lett., 428, L65
Cohen, M., & Schwartz, R. D. 1987, ApJ, 316, 311
Mattila, K., Liljeström, T., & Toriseva, M. 1989, in Low Mass Star Formation and Pre-main Sequence Objects, Proc. ESO Conference and Workshop, ed. B. Reipurth, Vol. 33 (Garching: ESO), p. 153
Prusti, T., Clark, F. O., Whittet, D. C. B., Laurejis, R. J., & Zang, C. Y. 1991, MNRAS, 251, 303
Schwartz, R. D. 1977, ApJS, 35, 161
Zealey, W. J., & Mader, S. L. 1997, PASA, 14, 200
Zealey, W. J., Moore, G. K. G., Ihnat, P., & Suters, M. G. 1994, in Working Group on Wide-field Imaging, IAU Commision 9, Newsletter 6