AN Hα SURVEY OF THE GALACTIC PLANE

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1. Introduction

We describe a major new Anglo-Australian proposal for a U.K. Schmidt Telescope (UKST) Hα survey of the Southern Galactic plane, Magellanic clouds and selected regions. The agreed survey will use a new 12×12 inch monolithic Hα interference filter of very high specification in combination with Tech Pan film. Tech Pan offers significant advantages for this work due to an inherent sensitivity at Hα and its extremely fine grain, high resolution, exceptional DQE, excellent imaging and low noise (*e.g.*, Parker *et al.* 1994). The combination of Tech Pan and a narrow band Hα filter will provide a survey of unprecendented area coverage, depth and resolution, superior to any previous optical survey of ionized gas in the galaxy. It should to lead to exciting new discoveries and avenues of research.

2. The Need for the Survey

Considering the great importance of variable star formation within and between galaxies it is surprising how little survey work has been done. Gunn made a systematic Hα survey in the 1950's using a 6inch telescope and coarse grained emulsion whilst other work has mainly concentrated on relatively small areas of interest for specific study (*e.g.*, Russeil, this volume, p. 186) or else is of low resolution (*e.g.*, Dennison *et al.*, this volume, p. 182). The only existing UKST wide area Hα survey work dates from the late 1970's (Davis, Elliot & Meaburn 1976). It was mainly carried out by coarse grained (though fast) 098 emulsion and a far from optimum Hα filter. Many parts of the plane remain to be covered, particularly the outer extensions beyond a few degrees from the Galactic equator. The northern Milky Way above Dec $= -20°$ has not been surveyed at all at good resolution. Progress in other wavebands highlights the paucity of the

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optical counterpart for the study of Galactic gas. A clear need for a high resolution optical survey to complement the studies at other wavebands is seen.

3. The Scientific Aims of the Survey

Hα emission lines from HII regions are one of the most direct optical tracers of current star formation. These lines also trace ionized gas in the ISM revealing, for example, stellar outflows in regions masked by strong reflection nebulae, shocks from high velocity galactic HI clouds, optical couterparts of supernova remnants, emission nebulosity close to young stellar sources and stellar wind-blown bubbles, sheets, filaments, *etc.* The spatial extent and detailed morphology of HII regions, OB associations and the wide variety of structures (shells, holes, bubbles, filaments and arcs) over a range of scales from a few arcseconds to tens of degrees can be particularly well studied by Hα imaging.

The nearest star forming complexes may lie as close as 100pc with physical sizes of tens of parsecs. Such structures often present large angular sizes (a degree or more) yet can exhibit fine detail at the arc-second level. If we wish to study the interaction of ionized structures with their large scale environment we clearly need surveys of considerable extent and at good resolution. CCDs cannot yet match the wide-area coverage, uniformity and resolution of the UKST/Tech Pan combination to which a wide angle, yet deep Hα survey of the Galactic plane is well suited. The high resolution of Tech Pan Hα imaging should enhance our ability to resolve out point sources from more extended emission (*e.g.*, detection of more distant planetary nebulae in the Magellanic clouds). Furthermore we should provide better definition of the sharp shock fronts seen around ionized gas clouds and be able to investigate the morphology and environment of Herbig-Haro objects and find more distant or less extended examples. We expect to determine accurate surface brightness and its variations in extended regions across the entire survey via independent CCD calibration.

Of particular interest on the large scale will be comparisons between Hα emission and other indicators of interstellar gas and/or star formation activity. These include Giant molecular clouds and the general molecular ISM traced by CO observations, radio continuum emission, γ-rays, HI, dust clouds or IRAS far infra-red flux. This survey should complement the radio maps being obtained by the ATNF, MOST, the new Parkes HI multibeam survey as well as those from mm wave telescopes.

4. Filter Specification

Barr associates was commissioned to supply a very high specification large monolithic Hα filter. Stringent optical requirements were necessary as the filter is to be used in a converging f/2.48 beam and the excellent imaging of Tech Pan must not to be seriously compromised. A 3-cavity design was adopted with ion-assisted deposition of refractory oxide on both sides of a SCHOTT RG630 R-band filter. The filter will have a clear aperture of 280mm minimum with thickness: 5.5 ± 0.5mm so as to fit inside existing UKST plateholders. The bandpass FWHM should be 70 ± 10Å with CWL of $\sim$ 6590Å and 0.01% of peak out of band transmission. The transmitted wavefront should be $\lambda/4$ per 25mm or better with peak transmission $\geq$ 75% across CA with 5% max variations.

5. Survey Size, Timescale and Availability

The survey is timely in respect of telescope loading as most competing photographic surveys are drawing to an end and there are few UKST non-survey projects when the Galactic plane is well placed. The narrow-band nature of the Hα filter means that the survey can proceed in grey/bright time when the sky is too bright for normal observations. The survey should commence towards the end of 1996 and will initially include 160 standard UKST fields. This will then be extended to the Galactic plane's outer regions and to declinations from +0 to +15 degrees. Exposures will be of the order of 3 hours. The survey will take 3–4 years to complete and represents the largest and most important new UKST photographic survey.

The survey will be made available to the astronomical community as quickly as possible though the consortium which involves groups in the U.K. (Bristol, Cardiff and ROE) and Australia (Sydney, Wollongong and AAO) will have some initial scientific exploitation rights. Original films will be scanned on the SuperCOSMOS machine at 10μm resolution to produce pixel maps of each field. Data will be disseminated on CD-ROM (1.8GB per scanned film). A small number of survey film copies may be made according to demand. The survey's photometric integrity will be assessed via independent narrow band photometry with CCDs on other telescopes and with reference to previously studied objects over a range of UKST fields.

References

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