A Wide Field Narrowband Survey for Star Forming Galaxies at Different Epochs

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Disclaimer

I hereby declare that the work of this thesis is that of the candidate alone, except where indicated below or in the text of the thesis.

Chapters 2 and 3 of this thesis have been published as papers. Chapter 4 has been submitted to a journal. A list of authors is given at the beginning of each of these chapters.

Chapter 2: C. Lidman reduced the spectroscopic data presented here. The candidate has independently re-reduced these data subsequently.

Chapter 3: The imaging with WFI on the ESO/MPI 2.2 m and the spectroscopy with VLT/FORS2 were taken by ESO staff in service mode. C. Lidman performed preliminary reductions on the WFI frames to remove instrumental signatures. Remaining processing and all subsequent analysis was done by the candidate.

Chapter 4: Some of the AAOmega spectroscopic data were taken by AAO staff as part of service observations.

Further acknowledgements have been made at the end of each chapter.

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Abstract

Narrowband surveys are a well-established tool for finding star-forming galaxies at different epochs. This thesis presents the Wide Field Imager Lyman Alpha Search (WFILAS), a survey originally designed to find Lyman-α (Lyα) emission-line galaxies at redshift $z \sim 5.7$, and subsequently utilised to find Hydrogen-α (Hα) emitting galaxies at redshift $z \sim 0.24$. The survey covers three 0.25 sq. deg. fields each observed in three narrowband filters, an intermediate band filter (encompassing all narrowband filters), and two broadband filters.

A sample of seven luminous Lyα-emitting galaxies was identified ($L_{\mathrm{Ly}\alpha} \geq 1.8 \times 10^{43}$ ergs), complementing existing surveys by further constraining the bright end of the Lyα luminosity function. Three candidates identified in one of the three fields, the well-studied Chandra Deep Field South, were grouped together, supporting claims of an overdensity at this redshift by other groups.

Two of the seven candidate Lyα emitting galaxies have been confirmed through spectroscopy, one of which is the most luminous at this redshift to date. The spectra of both objects displayed the asymmetric line profiles common in Lyα at these redshifts. Furthermore, tentative evidence of a second Lyα component, redward of the Lyα line was found. Additional high-resolution imaging showed that both objects were unresolved.

Spectroscopic follow-up was used to determine the fraction of Hα-emitting galaxies in two of the fields from a total sample of 707 candidate emission line galaxies. This yielded two independent Hα luminosity functions and star formation densities at $z \sim 0.24$ following corrections for extinction, imaging and spectroscopic incompleteness. These values were found to agree with those of other recent surveys within the limits of uncertainty. A detailed error analysis found that both cosmic variance and differences in selection criteria remain the dominant sources of uncertainty between various Hα luminosity functions at $z \lesssim 0.4$. While the star formation rates were consistent with the typical field galaxy densities probed by the fields, a tentative increase in star formation rate per galaxy with increasing density of star forming galaxies was found. This observation supports galaxy formation scenarios in which galaxy-galaxy interactions are triggers for star formation.

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"Numquam ponenda est pluralitas sine necessitate"
"(It is vain to do with more than which can be done with less)"

or

"Entia non sunt multiplicanda praeter necessitatem"
"(Entities should not be multiplied beyond necessity)"

Occam's Razor