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

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A thesis submitted for the degree of

Doctor of Philosophy

of The Australian National University

Research School of Astronomy & Astrophysics

May 2007
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.

Eduard Westra
May 2007
Acknowledgements

There are several people who I would like to thank for their assistance during the course of my thesis. First of all, my principal supervisor Heath Jones, for making me part of the survey on which this thesis is built upon. He has always helped me along the way, which is much appreciated. My local supervisor Frank Briggs, for taking over the Stromlo supervisory tasks when Heath was in Sydney. Also Chris Lidman, a close collaborator, for all his help with and suggestions to proposals, data reduction and the survey itself.

I am indebted to my friend Anna Frebel. Her honesty, support, laughs, company and so much more have meant a lot to me. I can not thank you enough for that.

Furthermore, I am extremely grateful to my parents and sister for their ongoing and loving support. It is really a pity that it has been at this large distance. Hopefully this will change in the (near) future.

What would Stromlo be without its students? I have had a lot of fun with them. Thanks for all the great parties, drinks at the pub and all other stuff we did. Also, I have enjoyed playing Stromlo Sunday Social Soccer. It has been good fun, guys!

Also, I would like to thank Mike Pracy, Philip Lah, Brian Schmidt and Frank Briggs for the discussions during our star formation lunches. I appreciate the efforts of Bill Roberts, Kim Sebo, the sysmen/syswomen and all the other members of the computer section. Also, they taught me much about computers and networks.

Thanks to all the academic and general staff members for answering all my questions about life, the universe and everything. I really benefited from the suggestion from Penny Sackett of doing a PhD at Stromlo. If it were not for her, I would have never been here.

I acknowledge the Anglo-Australian Observatory in Sydney for their hospitality and financial support.

Thank you all very very much!
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-\(\alpha\) (Ly\(\alpha\)) emission-line galaxies at redshift \(z \sim 5.7\), and subsequently utilised to find Hydrogen-\(\alpha\) (H\(\alpha\)) 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 Ly\(\alpha\)-emitting galaxies was identified (\(L_{\text{Ly}\alpha} \geq 1.8 \times 10^{43}\) ergs), complementing existing surveys by further constraining the bright end of the Ly\(\alpha\) 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 Ly\(\alpha\) 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 Ly\(\alpha\) at these redshifts. Furthermore, tentative evidence of a second Ly\(\alpha\) component, redward of the Ly\(\alpha\) line was found. Additional high-resolution imaging showed that both objects were unresolved.

Spectroscopic follow-up was used to determine the fraction of H\(\alpha\)-emitting galaxies in two of the fields from a total sample of 707 candidate emission line galaxies. This yielded two independent H\(\alpha\) 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 H\(\alpha\) 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