



Universiteit
Leiden
The Netherlands

Studying dark matter haloes with weak lensing

Velander, M.B.M.

Citation

Velander, M. B. M. (2012, June 20). *Studying dark matter haloes with weak lensing*. Retrieved from <https://hdl.handle.net/1887/19107>

Version: Corrected Publisher's Version

License: [Licence agreement concerning inclusion of doctoral thesis in the Institutional Repository of the University of Leiden](#)

Downloaded from: <https://hdl.handle.net/1887/19107>

Note: To cite this publication please use the final published version (if applicable).

Cover Page



Universiteit Leiden



The handle <http://hdl.handle.net/1887/19107> holds various files of this Leiden University dissertation.

Author: Velandar, Malin Barbro Margareta

Title: Studying dark matter haloes with weak lensing

Issue Date: 2012-06-20

Publications

1. *CFHTLenS: improving the quality of photometric redshifts with precision photometry*
Hildebrandt, Erben, Kuijken, van Waerbeke, Heymans, Coupon, Benjamin, Bonnett, Fu, Hoekstra, Kitching, Mellier, Miller, Velander, Hudson, Rowe, Schrabback, Semboloni, & Benítez 2012
MNRAS, 421, 2355-2367
This publication is publicly available at <http://arxiv.org/abs/1111.4434>
2. *Galaxy-galaxy lensing constraints on the relation between baryons and dark matter in galaxies in the Red Sequence Cluster Survey 2*
van Uitert, Hoekstra, Velander, Gilbank, Gladders, & Yee 2011
A&A, 534, A14+
This publication is publicly available at <http://arxiv.org/abs/1107.4093>
3. *Probing galaxy dark matter haloes in COSMOS with weak lensing flexion*
Velandar, Kuijken, & Schrabback 2011
MNRAS, 412, 2665-2677 (Chapter 3, page 64)
This publication is publicly available at <http://arxiv.org/abs/1011.3041>
4. *Gravitational Lensing Accuracy Testing 2010 (GREAT10) Challenge Handbook*
Kitching, Balan, Bernstein, Bethge, Bridle, Courbin, Gentile, Heavens, Hirsch, Hosseini, Kiessling, Amara, Kirk, Kuijken, Mandelbaum, Moghadam, Nurbaeva, Paulin-Henriksson, Rassat, Rhodes, Schölkopf, Shawe-Taylor, Gill, Shmakova, Taylor, Velandar, van Waerbeke, Witherick, Wittman, Harmeling, Heymans, Massey, Rowe, Schrabback, & Voigt 2010
preprint (astro-ph/1009.0779)
This publication is publicly available at <http://arxiv.org/abs/1009.0779>

5. *Results of the GREAT08 Challenge: an image analysis competition for cosmological lensing*
Bridle, Balan, Bethge, Gentile, Harmeling, Heymans, Hirsch, Hosseini, Jarvis, Kirk, Kitching, Kuijken, Lewis, Paulin-Henriksson, Schölkopf, Velander, Voigt, Witherick, Amara, Bernstein, Courbin, Gill, Heavens, Mandelbaum, Massey, Moghaddam, Rassat, Réfrégier, Rhodes, Schrabback, Shawe-Taylor, Shmakova, van Waerbeke, & Wittman 2010
MNRAS, 405, 2044-2061
This publication is publicly available at <http://arxiv.org/abs/0908.0945>

6. *Evidence of the accelerated expansion of the Universe from weak lensing tomography with COSMOS*
Schrabback, Hartlap, Joachimi, Kilbinger, Simon, Benabed, Bradač, Eifler, Erben, Fassnacht, High, Hilbert, Hildebrandt, Hoekstra, Kuijken, Marshall, Mellier, Morganson, Schneider, Semboloni, van Waerbeke, & Velander 2010
A&A, 516, A63+
This publication is publicly available at <http://arxiv.org/abs/0911.0053>

Curriculum Vitæ

Born in 1983 in Lund of southern Sweden, I grew up in a small village about a Swedish mile (10 km) from the city, surrounded by sweeping fields of green, yellow and blue. It was when I started seventh grade, in 1996 at the age of thirteen, that I first came in contact with science. I had always been curious and always asked the big questions about how the world worked, and now suddenly I was being taught the answers. My teacher at that time was a warm and inspiring person who encouraged me to use my own approach to internalise the material, such as creating a website about our Solar System. I thoroughly enjoyed making the computer show what I wanted it to display using the secret language of HTML, and the subject of my work — astronomy — caught my attention as well.

Once I had finished ninth grade in 1999 I got accepted to the International Baccalaureate (IB) in Malmö, the Big City. From then on my life changed dramatically as I was now amongst others who asked as many questions as I did. All subjects were taught in English, which is why I do not have an established science vocabulary in Swedish. After the introductory year I was allowed to deepen my knowledge in a few subjects of my choice, and apart from languages and maths I also chose physics and economics. Both subjects held the sublime promise of explaining the workings of the world, but in the end physics appealed to me more. Therefore I chose *What mass does the Hydra 1 cluster of galaxies (Abell 1060) contain?* as the subject of my Extended Essay for which I carried out the research with the help of Lund University. This project constituted my first encounter with the mysterious dark matter, a taunting enigma which has fascinated me ever since.

I had decided early on during the IB that I wanted to attend university in the UK, partly because of the language barrier I would otherwise face in my own country, and partly because of the adventure it entailed. As I scrolled down the UCAS list of subjects aiming for physics, a subject at the top of the list once again caught my attention: astronomy & astrophysics. Going through the directory of institutions offering such a specialised programme, I knew straight away that Edinburgh University had to be my highest priority choice, though since I had never been my main reason for this decision was having seen *Braveheart*. To my great joy I was accepted and in 2002 my parents and I took the ferry across the North Sea to the wonderful city of Edinburgh which still holds a special place in my heart. As an interesting aside, the second person I spoke to in this city was my beloved future husband though I did not

yet know it.

In my fifth year at Edinburgh University, it was time to chose my master's research project. My fascination with dark matter had only grown during my time there, and amongst the choice of about thirty project titles only one seemed appropriate to me: *Probing dark matter and baryonic sub-structure with gravitational lensing* with Andy Taylor. I did not rest until I had secured that project, and I thoroughly enjoyed the research the rest of that year and received my Master of Physics degree in 2007. The project gave me a taste of what weak lensing could do, and as a result I limited my PhD applications to institutes where I knew I would be able to research further using this technique. The only non-UK institute I applied to was Leiden, at the recommendation of Andy, as there was an opportunity to become an Early Stage Researcher within the European Marie Curie network *the Dark Universe with Extragalactic Lensing* (DUEL) with Konrad Kuijken. When I went for a visit I instantly liked the atmosphere at the department and the fact that I would be able to design large parts of my PhD research myself. Once again I therefore took the ferry across the North Sea, this time together with my then fiancé and our cat Trouble, and with the Netherlands as destination.

Five years on I know I made the right decision as the Sterrewacht at Leiden University has been a truly fantastic place to conduct my research. I have been in charge of the direction to take and have at the same time received great support from my supervisors and brilliant colleagues. The department also gave me the chance to act as a teaching assistant on the master's course *Astrophysical Accretion* where I created solutions to problem sheets and corrected the students' work. The plethora of international conferences and meetings I have been able, and encouraged, to attend have also given me a broad knowledge of topical cosmology and a large number of friends both within the weak lensing clique and in the greater astrophysical community. My travels have also given me the opportunity to present my work in settings as awe-inspiring as OZ Lens 2008 or the winter AAS meeting in 2012. On a more personal level, I have through these conferences also had the honour to meet and talk to many of my heroes. Most notable of these is Vera Rubin who fifty years ago helped change the world of cosmology forever even though she, as a woman, had to face and overcome obstacles every step of the way. Although I do not face the same obstacles, as women in science now enjoy much the same opportunities as men, I find her story highly inspirational.

My husband and I have now taken the ferry back across the North Sea and I am currently a post-doctoral Beecroft Fellow at Oxford University, working with Lance Miller. Already I have tutored *Optics* at Oriel College as I am a fellow there. Though I did act as a teaching assistant in Leiden, here my responsibilities towards the students are greater and include being in charge of tutorials and revision sessions, and setting and correcting collections papers. I have also quickly gotten involved in the one thing I was unable to do in Leiden due to my own lack of Dutch skills: outreach activities. Connecting with the public, and interacting with school children who are as inquisitive as I was, truly inspires me and provides me with the motivational sustenance that makes doing research so fulfilling. I do hope I will have the opportunity to do both for many years to come.

Afterword

The Sterrewacht at Leiden University has been a truly outstanding environment in which to conduct the research for this Thesis. The international focus of the Sterrewacht is, I believe, one of the main reasons why this department attracts so many great scientists and why it is so successful. And not only is the academic staff both encouraging and highly skilled, but so is the IT support. Were there any computer related issues, something which did not happen often, they were soon sorted thanks to the considerable efforts of Eric, David, Aart and Tycho. For this I am eternally grateful. Other support staff also helped make things run smoothly, and amongst them I would particularly like to thank Jan, Jeanne and Evelijn.

The lensing group consisted of an incredible collection of people. Soon after I arrived, several inspiring individuals were recruited to the group, creating a very stimulating environment for a green PhD-student like myself. Amongst them was Tim who became both a friend and a mentor to me. Tim, I am not sure if you are aware of how much you actually taught me. You sped up my learning significantly and equipped me with all the tools I needed to finish this research. You also made certain that I was not completely absorbed with work through games' nights and the occasional all-night Lord of the Rings (though not as often as you would have liked). I cannot even begin to tell you how much I appreciate your support and friendship. In fact, I consider everyone in the lensing group a friend above all else. Edo, your path to a PhD degree ran parallel to mine for more than four years, with you just pipping me to the post. Though I am not entirely happy about this, I do know that you fully deserve it. Working with you was a true pleasure; your intelligence always shone through and you were never afraid to argue your (often correct) point. You also became a close friend of mine, and I thoroughly enjoy the gossip sessions we both still indulge in. Once Stefania and Elisabetta joined us the group felt complete, although the noise level in my corridor certainly increased. Stefania, you are great fun and I wish I had gotten the chance to know you better. And Elisabetta, oh Elisabetta. With your arrival the Sterrewacht improved a hundredfold, thanks to your special take on life. You always make me see things in a different (and often better) light, both in science and otherwise. You are a fun and loud person and completely my opposite, which is probably why I find your company so refreshing. Finally, I would like to thank the lensing group as a whole and any sporadic add-ons as well, including Freeke, Berenice, Merijn, Remco and Hendrik, for being such a sociable bunch and for making coffee breaks and evenings that much more

enjoyable.

Actually Hendrik, you were part of another side to my life in Leiden as well: AA-Awesome. This band truly lived up to its name, arguably not in talent but definitely in terms of band members. You were all awesome Rik, Hendrik, Rob and Craig and I had an awesome time while it lasted. But Craig, you were probably the awesomest of them all. Your harsh sarcasm coupled with your strange politeness made me feel right back in Britain, and I often indulged in taking the mickey out of you. I think you did intensify my own sarcasm though, which means that I now frequently accidentally offend my own family. This is to your credit.

I would also like to take this opportunity to thank the two extended groups I have been a part of: the DUEL network, and the CFHTLenS collaboration. Through frequent DUEL meetings I was continuously spurred on to do my research, and I made many social connections with other young researchers in the field. CFHTLenS has also been very good to me and provided me with a great network that now spans the globe. Catherine, you in particular have been very encouraging. Thank you for believing in me; it has without doubt helped build my confidence as a scientist. You have also always been there to lend advice on a more personal level, something I greatly appreciate.

Of course, my family has also always been there for me and have always managed to muster the proper amount of awe at each one of my achievements. Thank you, Mum and Dad, for never pressuring me unnecessarily but nudging me in the right direction when appropriate. Mum, you always read through all my essays for school and university to make sure that the language was correct and fluent. As a thank you for that, I will *not* make you read my Thesis. Dad, thank you for coaxing me into doing things I would never have dared do otherwise, from joining that class at högstadiet which allowed me to be taught by Arne who got me interested in science in the first place, to contacting Lund University for guidance on my Extended Essay. These and many other choices have had a long-lasting positive effect on my life and career. Kattis, and lately also Ivar, thank you for always treating me without respect whenever I come home to Sweden and that way making me feel like I never left. Jonas, you and Ann have also supported me through this simply by making home still seem like home. I do sometimes wonder who the real big sister is though, since you and Kattis have turned into such sensible adults in my absence. Richelle, though you are not officially my sister, I do consider you one and I am grateful that you have remained my close friend even though I have been somewhat unavailable over the past year.

My wonderful family-in-law has also helped see me through. In particular, thank you Ellen for your kind-heartedness, thank you Gabrian for adding a sense of art to my Thesis, and thank you Josha for keeping my motivation high by being so fascinated by what I do that you decided to try it out for yourself. Special thanks also to all of my cousins who have always been great friends, and in particular to Tove with whom I have always been close. Furthermore, I am grateful to Johanna for taking the time to read and correct my Swedish summary. For this reason I also thank Fredrik who has been a friend ever since I recognised him as a fellow Swede in Edinburgh because of his Loka bottle.

AFTERWORD

Last, but most certainly not least, I would like to thank my own budding family. Marcus, without your tireless efforts to keep our home tidy and me fed, without your continuous and unfailing support, and without your endless love I would never have been able to do this. And little one, still dwelling within me, without your encouraging kicks to keep me motivated and focused towards the end, this would be work in progress even now.