



Universiteit
Leiden
The Netherlands

Probing the darkness : the link between baryons and dark matter

Velliscig, M.

Citation

Velliscig, M. (2015, November 11). *Probing the darkness : the link between baryons and dark matter*. Retrieved from <https://hdl.handle.net/1887/36109>

Version: Not Applicable (or Unknown)

License: [Leiden University Non-exclusive license](#)

Downloaded from: <https://hdl.handle.net/1887/36109>

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

Cover Page



Universiteit Leiden



The handle <http://hdl.handle.net/1887/36109> holds various files of this Leiden University dissertation

Author: Velliscig, Marco

Title: Probing the darkness : the link between baryons and dark matter

Issue Date: 2015-11-11

Probing the darkness:
The link between baryons and dark matter

ISBN: 978-94-6233-116-7

Probing the darkness: The link between baryons and dark matter

Proefschrift

ter verkrijging van
de graad van Doctor aan de Universiteit Leiden,
op gezag van Rector Magnificus prof.mr. C.J.J.M. Stolker,
volgens besluit van het College voor Promoties
te verdedigen op woensdag 11 november 2015
klokke 10.00 uur

door

Marco Velliscig

geboren te Udine, Italië
in 1985

Promotiecommissie

Promotor: Prof. dr. Joop Schaye
Co-promotor: Dr. Marcello Cacciato

Overige leden: Prof. dr. Koen Kuijken University of Leiden
Prof. dr. Sarah Bridle University of Manchester
Dr. Henk Hoekstra University of Leiden
Dr. Benjamin Joachimi University College London

*Alla mia famiglia
senza la quale non sarei niente*

Contents

1	Introduction	1
1.1	Numerical simulations in astrophysics	1
1.1.1	Dark matter-only simulations	1
1.1.2	Hydrodynamical simulations	1
1.2	Gravitational lensing	3
1.2.1	Single lens	5
1.2.2	Statistical weak lensing	6
1.3	This Thesis	8
2	Impact of galaxy formation on halo properties	11
2.1	Introduction	12
2.2	Simulations	15
2.2.1	Finding and matching haloes between simulations	17
2.3	How baryons alter the masses of haloes	18
2.3.1	Change in total mass between different realisations of the same halo	18
2.3.2	Change in baryon mass and back-reaction on dark matter	22
2.3.3	Baryon fractions	24
2.3.4	Enclosed mass profiles	24
2.3.5	Evolution with redshift	25
2.3.6	Effect of cosmology	28
2.4	Analytic fitting formula for the change in halo mass	28
2.5	Effects of baryons on the halo mass function	29
2.5.1	Analytic fitting formula for the halo mass function	32
2.5.2	Implications for cluster number counts	33
2.6	Comparison with previous studies	36
2.7	Summary and Conclusions	39
2.A	Resolution test	43
3	Galaxy-halo misalignment	47
3.1	Introduction	48
3.2	Simulations and Technical Definitions	50
3.2.1	Simulations	50
3.2.2	Halo and subhalo definition	52
3.2.3	Shape parameter definitions	52
3.2.4	Axes and misalignment angle definition	53
3.3	The effect of galaxy formation efficiency	54
3.4	Shape of the different components of haloes	58
3.4.1	The shape of haloes	58
3.4.2	Shape of the stellar component of haloes	58
3.4.3	Shape of the hot gas component of haloes	62
3.5	Misalignment of Galaxies with their own host haloes	63
3.5.1	Misalignment of stars with their host haloes	64
3.5.2	Misalignment of hot gas with its host halo	70
3.6	Summary and Conclusions	71
3.A	Caveats in shape parameter estimation	75

3.A.1	The choice of inertia tensor	75
3.A.2	The effect of sampling	76
3.B	Analytic fits for the misalignment angle distributions	78
3.C	Resolution test	79
4	Intrinsic Alignments in EAGLE and COSMO-OWLS	81
4.1	Introduction	82
4.2	Simulations and Technical Definitions	84
4.2.1	Simulations	84
4.2.2	Halo and subhalo definition	85
4.2.3	Shape parameter definitions	87
4.3	Orientation-direction alignment	87
4.3.1	Dependence on subhalo mass and separation	87
4.3.2	Dependence on the choice of matter component	90
4.3.3	Dependence on galaxy morphology	91
4.3.4	Alignment of satellite and central galaxies	92
4.4	Towards observations of orientation-direction galaxy alignment	95
4.5	Orientation-orientation alignment	98
4.6	Conclusions	99
5	Galaxy-Galaxy lensing in EAGLE	105
5.1	Introduction	106
5.2	Methods	107
5.2.1	KiDSxGAMA	107
5.2.2	Simulations	110
5.3	Results	111
5.3.1	The galaxy-galaxy lensing signal around central galaxies	113
5.3.2	The galaxy-galaxy lensing signal around satellite galaxies	115
5.3.3	The galaxy-galaxy lensing signal around all galaxies	117
5.4	Discussion	123
5.5	Conclusions	124
5.A	Convergence tests	128
6	Nederlandse Samenvatting	131
6.1	Dit Proefschrift	131
	Publications	135
	Curriculum Vitae	137
	Acknowledgments	139