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## Focal-plane wavefront sensors for direct exoplanet imaging: theory, simulations and on-sky demonstrations

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# Focal-plane wavefront sensors for direct exoplanet imaging

Theory, simulations and on-sky demonstrations

## Proefschrift

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	Dr. Rebecca Oppenheimer	American Museum of Natural History
	Dr. Sandrine Thomas	Vera C. Rubin Observatory

*Voor mijn ouders  
&  
Voor Charlotte*



## **Don't quit**

*"When things go wrong as they sometimes will,  
when the road you're trudging seems all up hill,  
when the funds are low and the debts are high  
and you want to smile, but you have to sigh,  
when care is pressing you down a bit,  
rest if you must, but don't you quit.  
Life is strange with its twists and turns  
as every one of us sometimes learns  
and many a failure comes about  
when he might have won had he stuck it out;  
don't give up though the pace seems slow—  
you may succeed with another blow.  
Success is failure turned inside out—  
the silver tint of the clouds of doubt,  
and you never can tell just how close you are,  
it may be near when it seems so far;  
so stick to the fight when you're hardest hit—  
it's when things seem worst that you must not quit."*

—John Greenleaf Whittier

Cover design: Artistic representations of the metaphorical mountains that I have climbed during my academic career and would climb if I had chosen to stay. On top of these mountains are the telescopes that I (would) have observed with during the different phases in my career. Also shown are two of the (in my opinion) most impressive objects and phenomena in astronomy: the Andromeda galaxy and a solar eclipse.

Back cover: The mountain on the left represents my Bachelor's and has the Isaac Newton Telescope (La Palma) on top. Also placed on this mountain is my personal Meade ETX-125 telescope pointed at the Andromeda galaxy. The mountain on the right represents my Master's with the William Herschel Telescope telescope (La Palma). Shown in the upper left is a solar eclipse with the Minnaert and Van de Hulst neutral points denoted as white points. In the lower right I placed the Leiden Eclipse Imaging Polarimeter, which is the instrument we used to observe these neutral points in polarized light. In the upper right is the Andromeda galaxy, which is the most distant object that can be observed with the naked eye.

Front cover: The mountain on the left represents my PhD. The telescopes placed on top are the Subaru telescope (Hawaii) and the Keck telescopes (Hawaii). Also shown on the top of this mountain is a group of people observing the Andromeda galaxy. The mountain on the right represents the career in astronomy that I would have had if I decided to stay in astronomy. The Extremely Large Telescope (Chile), currently under construction, is placed on top.

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# Contents

<b>1</b>	<b>Introduction</b>	<b>1</b>
1.1	Detecting exoplanets . . . . .	1
1.2	Direct imaging of exoplanets . . . . .	4
1.2.1	Wavefront aberrations . . . . .	6
1.2.2	Adaptive optics . . . . .	8
1.2.3	Coronagraphy . . . . .	10
1.2.4	Observing strategies and post processing . . . . .	12
1.2.5	Detecting exoplanet variability . . . . .	13
1.3	Focal-plane wavefront sensing . . . . .	14
1.3.1	Theory . . . . .	14
1.3.2	Family of focal-plane wavefront sensors . . . . .	19
1.4	This thesis . . . . .	24
<b>2</b>	<b>Focal-plane wavefront sensing with the vector-Apodizing Phase Plate</b>	<b>33</b>
2.1	Introduction . . . . .	34
2.2	Theory . . . . .	37
2.2.1	Phase retrieval . . . . .	37
2.2.2	vAPP design for phase retrieval . . . . .	41
2.3	Aberration estimation algorithm . . . . .	44
2.3.1	Maximum a posteriori estimation . . . . .	44
2.3.2	Coronagraph model . . . . .	45
2.4	Simulations . . . . .	47
2.4.1	Photon and read noise sensitivity . . . . .	49
2.4.2	Mode photon noise sensitivity . . . . .	50
2.4.3	Dynamic range algorithm . . . . .	52
2.5	Demonstration at SCExAO . . . . .	53
2.5.1	SCExAO . . . . .	53
2.5.2	Algorithm implementation in SCExAO . . . . .	53
2.5.3	Internal source demonstration . . . . .	55
2.5.4	On-sky demonstration . . . . .	58
2.6	Discussion and conclusion . . . . .	58
2.7	Appendix . . . . .	66
2.7.1	Phase retrieval examples . . . . .	66
2.7.2	Implications for spatial LDFFC . . . . .	67
2.7.3	Derivatives objective function . . . . .	68
<b>3</b>	<b>Linear Dark Field Control at Subaru/SCExAO</b>	<b>73</b>
3.1	Introduction . . . . .	75
3.2	Combining spatial LDFFC with an APvAPP . . . . .	78
3.2.1	Spatial LDFFC . . . . .	78
3.2.2	FPWFS with the APvAPP . . . . .	81
3.3	Deploying LDFFC on SCExAO . . . . .	81
3.3.1	Instrument parameters . . . . .	82
3.3.2	Deriving the reference PSF . . . . .	82

3.3.3	Bright pixel selection . . . . .	83
3.3.4	Modal basis set and control matrix . . . . .	84
3.3.5	LDFC closed-loop operation . . . . .	88
3.3.6	Noise analysis for LDFC with the SCExAO APvAPP . . . . .	90
3.4	Results . . . . .	91
3.5	Discussion and Conclusions . . . . .	96
<b>4</b>	<b>On-sky demonstration of Linear Dark Field Control</b>	<b>101</b>
4.1	Introduction . . . . .	102
4.2	LDFC at SCExAO . . . . .	104
4.2.1	Principle . . . . .	104
4.2.2	SCExAO . . . . .	105
4.2.3	Static wavefront error calibration . . . . .	106
4.2.4	Reference image and bright pixel selection . . . . .	106
4.2.5	Response and control matrix . . . . .	111
4.3	On-sky demonstration . . . . .	115
4.3.1	Static eigenmode aberration . . . . .	115
4.3.2	On-sky atmospheric residuals . . . . .	118
4.4	Discussion and conclusion . . . . .	122
<b>5</b>	<b>The polarization-encoded self-coherent camera</b>	<b>129</b>
5.1	Introduction . . . . .	130
5.2	Theory . . . . .	133
5.2.1	Polarization-encoded self-coherent camera . . . . .	135
5.2.2	Reference hole diameter . . . . .	137
5.2.3	Reference hole distance . . . . .	137
5.2.4	Focal-plane sampling constraints . . . . .	138
5.2.5	Spectral bandwidth limitations . . . . .	139
5.2.6	Instrumental polarization . . . . .	141
5.2.7	Polarization leakage . . . . .	143
5.2.8	Coherent differential imaging . . . . .	144
5.3	Simulations . . . . .	145
5.3.1	Wavefront sensing . . . . .	146
5.3.2	Wavefront sensing & control . . . . .	154
5.3.3	Coherence differential imaging . . . . .	164
5.4	Discussion and conclusions . . . . .	164
<b>6</b>	<b>On-sky verification of Fast and Furious focal-plane wavefront sensing</b>	<b>175</b>
6.1	Introduction . . . . .	177
6.2	Fast and Furious algorithm . . . . .	180
6.3	Demonstration at Subaru/SCExAO . . . . .	182
6.3.1	SCExAO and algorithm implementation . . . . .	182
6.3.2	Quantifying PSF quality . . . . .	185
6.3.3	Internal source demonstration . . . . .	186
6.3.4	On-sky demonstration . . . . .	192

6.4	Discussion and conclusion . . . . .	198
<b>7</b>	<b>The Vector Speckle Grid</b>	<b>205</b>
7.1	Introduction . . . . .	206
7.2	Theory . . . . .	207
7.2.1	Vector phase speckle grid . . . . .	207
7.2.2	Vector amplitude speckle grid . . . . .	210
7.3	Simulations . . . . .	211
7.3.1	Performance quantification . . . . .	211
7.3.2	Degree of polarization effects . . . . .	218
7.4	Implementation of vector speckle grid . . . . .	220
7.5	Discussion and conclusion . . . . .	220
<b>8</b>	<b>Outlook</b>	<b>225</b>
<b>Nederlandstalige samenvatting</b>		<b>229</b>
<b>Publication list</b>		<b>239</b>
<b>Curriculum Vitae</b>		<b>245</b>
<b>Acknowledgements</b>		<b>247</b>

