



Universiteit
Leiden
The Netherlands

Stars and planets at high spatial and spectral resolution

Albrecht, S.

Citation

Albrecht, S. (2008, December 17). *Stars and planets at high spatial and spectral resolution*. Retrieved from <https://hdl.handle.net/1887/13359>

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/1887/13359>

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

Stars and planets
at high
spatial and spectral resolution

Stars and planets
at high
spatial and spectral resolution

Proefschrift

ter verkrijging van
de graad van Doctor aan de Universiteit Leiden,
op gezag van de Rector Magnificus prof. mr. P.F. van der Heijden,
volgens besluit van het College voor Promoties
te verdedigen op woensdag 17 december 2008
klokke 15.00 uur

door

Simon Albrecht

geboren te Osnabrück

Promotiecommissie

Promotor: Prof. dr. A. Quirrenbach

Co-promotor: Dr. I. A. G. Snellen

Referent: Dr. M. Fridlund (European Space Agency, ESTEC, Noordwijk)

Overige leden: Dr. M. Hogerheijde
Prof. dr. K. H. Kuijken
Dr. J. Lub
Prof.dr. E. F. van Dishoeck

Für meine Mutter

Sunset as seen by NASA's Mars Rover Spirit on May 19th, 2005. The floor of the Gusev crater is visible in the distance, and the Sun is setting behind its wall some 80 km away. One can see the scatter of sunlight by dust particles in the Martian atmosphere (NASA JPL). Thanks to the rover team for building these wonderful spacecrafts and making the photos publically available. Cover made by Sebastian Heimann.

Contents

	Page
Chapter 1. Introduction	1
1.1 The formation of stars and planets in a nutshell	2
1.1.1 Formation of high-mass stars	2
1.1.2 Stellar binaries	3
1.1.3 Planets	5
1.2 This thesis	6
1.3 Summary and outlook	8
Chapter 2. Combination of optical interferometers and high-resolution spectro-	
graphs	11
2.1 Introduction	12
2.2 Scientific case	13
2.2.1 Stellar diameters and limb-darkening	13
2.2.2 Interferometric Doppler Imaging	14
2.2.3 Pulsations and asteroseismology	14
2.2.4 Interpretation of radial-velocity variations	15
2.2.5 Cepheids and distance ladder	15
2.2.6 Orientation of stellar rotation axes	15
2.2.7 Differential stellar rotation	16
2.2.8 Circumstellar matter	16
2.3 Instrument and infrastructure	17
2.3.1 Telescopes	17
2.3.2 Longitudinal dispersion compensation	17
2.3.3 Fringe tracker	21
2.3.4 Beam Combiner	21
2.3.5 Connection to the spectrograph	23
2.4 An illustrative example: UVES-I	23
2.4.1 VLTI Auxiliary Telescopes	24
2.4.2 Fringe tracking with PRIMA	24
2.4.3 Dispersion compensation for UVES-I	27
2.4.4 Beam combiner for UVES-I	28
2.4.5 UVES instrument on UT-2	29
2.4.6 Performance	30
2.5 Other interferometer-spectrograph pairings	31
2.6 Conclusion	32
Chapter 3. MWC 349A	37
3.1 Introduction MWC 349A	38

3.2	MIDI Observations	39
3.3	Results	44
3.3.1	The circumstellar disk	44
3.3.2	Hydrogen lines	51
3.3.3	Forbidden lines	54
3.4	Discussion	55
3.5	Summary and future work	57
Chapter 4.	Spin axes in V1143 Cyg	61
4.1	Introduction	62
4.2	Observations	64
4.3	Analysis and results	64
4.3.1	Method 1: The BF's center	67
4.3.2	Method 2: Variation of the BF profile	69
4.4	Discussion	70
4.4.1	Orbital parameters	70
4.4.2	Stellar parameters	72
4.4.3	Orientation of the rotation axes	74
4.5	Conclusions	76
4.6	Data	78
Chapter 5.	Misaligned spin axes in the DI Herculis system	81
5.1	Introduction	82
5.2	Data	83
5.3	Results	84
5.4	Discussion	93
5.4.1	Robustness of the results	93
5.4.2	Implications of the misaligned rotation axes	95
5.5	Conclusion	96
Chapter 6.	The atmosphere of HD 209458b	99
6.1	Introduction	100
6.2	UVES VLT observations	100
6.3	Transmission spectroscopy	101
6.3.1	Sodium	103
6.3.2	Sodium results	109
6.3.3	Potassium	110
6.4	Discussion	112
6.5	Conclusions	115
	Nederlandse samenvatting	117
	Curriculum vitae	123
	Nawoord	125