PhD

FCUP
2018

U.PORTO

U.PORTO
FACULDADE DE CIÊNCIAS
UNIVERSIDADE DO PORTO

Towards the near-infrared detection of exoplanets

Jason James Neal

Tese de doutoramento apresentada à
Faculdade de Ciências da Universidade do Porto
Astronomia

2018

PhD

U.PORTO
FACULDADE DE CIÊNCIAS
UNIVERSIDADE DO PORTO

PhD

Towards the nIR detection of exoplanets

by

Jason James Neal

A thesis submitted in conformity with the requirements
for the degree of Doctor of Philosophy
Graduate Department of Departamento de Física e Astronomia
University of Porto

© Copyright 2018 by Jason James Neal

To my wife Jessica,
children Timothy and Amelia;
For always supporting me.

Acknowledgements

this work could not have been competed without the Phd fellowship.

J.J.N. acknowledges support from FCT though the PhD::Space fellowship PD/BD/52700/2014.

This work was financed by FEDER - Fundo Europeu de Desenvolvimento Regional funds through the COMPETE 2020 - Programa Operacional Competitividade e Internacionalização (POCI), and by Portuguese funds through FCT - Fundação para a Ciência e a Tecnologia in the framework of the project POCI-01-0145-FEDER-028953 and POCI-01-0145-FEDER-032113."

This work was also supported by Fundação para a Ciência e a Tecnologia (FCT) (Portugal) research grants through national funds and from FEDER through COMPETE2020 by the following grants: UID/FIS/04434/2013 & POCI–01–0145-FEDER–007672, PTDC/FIS-AST/1526/2014 & POCI–01–0145-FEDER–016886, and PTDC/FIS-AST/7073/2014 & POCI-01-0145-FEDER-016880.

Abstract

The contents of this work focus on detecting exoplanets in the nIR.

It starts of with reduction of nir spectra from CRIRES.

In chapters 4 we approach a differential subtraction technique to separate the spectra from the faint companion. Contrasting the result to other recent detections. In chapter 4 a second technique is developed in which the BD companions are attempted to be recovered from the $\nearrow$-infrared spectra by fitting to a complex model of two synthetic stellar spectra. Finding the technique unsuitable for the data on hand.

Focusing on BD as they should have a stronger flux ratio than planets.

In chapter 6 we change focus towards RV precision of M-dwarf starts. Calculating th theoretical precision of stellar spectra t. Useful for the next-generation of near-infrared spectrographs to detect planets around M-dwarf stars.

Some thought on future are also provided.

Resumo

Thesis abstract in Portuguese

Todo list

Contents

List of Tables

List of Figures

Precision table needs fixed up

Appendix A

RV Precision Tables

The updated relative RV precision results attainable from nIR spectra are presented in the following tables. Table A.1 shows the precision results for the same M-dwarfs analysed in (Figueira et al., 2016). That is stellar temperatures 3900, 3500, 2800, 2600K corresponding to spectral types M0, M3, M6, M9 respectively. logg=4.5 and [Fe/H]=0.0. The rotation applied are $v \sin i$=1, 5, 10 km s^{-1} and instrumental profiles with R = 60k, 80k, 100k.

Columns 2-4 contain the RV precision calculated using PHOENIX-ACES spectra, as done in Figueira et al. (2016). These values differ from two effects. There is small difference in Conditions 1 and 3 from the change in numerical differentiation implemented (see Section 6.6). The values for Condition 2 however, are completely different due to the implementation error in the telluric masking discovered (see Section ??).

In columns 5-7 are the same RV precision calculation but using the BT-Settl spectral library instead (with same spectral parameters), a recent addition in *eniric*.

These can be created with *eniric* with the following shell incantation (after installation and configuration).

```
phoenix_precision.py -t 3900 3500 2800 2600 \    # Temperature
                     -l 4.5 -m 0.5 \             # Logg and Metalicity
                     -r 60000 80000 100000 \     # Resolutions
                     -v 1.0 5.0 10.0 \           # Rotational velocities
                     -b Z Y J H K \              # Wavelength bands
                     --snr 100 \                 # Relative SNR
                     --ref_band J                # SNR reference band
```

eniric was also used to calculate RV precision for the NIRPS and SPIRou.

For SPIRou the requested precisions were provided with the SNR relative to the centre of each individual band. The values are provided in Table A.3 and can be generated with the following code, note the change in.

This has the effect of Z Y band precisions being **lower** and H and K band precisions being **higher**. compared to Table ??

check direction and magnitude in table

```
phoenix_precision.py -t 3900 3500 2800 2600 -l 4.5, -m 0.5 \
    -r 60000 80000 100000 -v 1.0 5.0 10.0 -b Z Y J H K      \
```

```
--snr 100 --ref_band self
```

For NIRPS RV precisions with an instrumental resolution of 75 000 was requested to match the NIRPS instrument, and provided relative to the J and H-bands. The results for the NIRPS precision relative to the J-band are given in Table **??**, and can be reproduced with the following code.

```
phoenix_precision.py -t 3900 3500 2800 2600 -l 4.5, -m 0.5 \
    -r 60000 75000 80000 100000 -v 1.0 5.0 10.0 \
    -b Z Y J H K --snr 100 --ref_band H \
```

Table A.1: RV precisions from the PHOENIX-ACES and BT-Settl synthetic spectral libraries. The PHOENIX-ACES values are the updated values from Table A.1 of Figueira et al. (2016).

	PHOENIX-ACES			BT-SETTL		
Simulation	Cond. 1	Cond. 2	Cond. 3	Cond. 1	Cond. 2	Cond. 3
(SpTp - Band - $v.sini$ - R)	σ_{RV} [m/s]	σ_{RV} [m/s]	σ_{RV} [m/s]	σ_{RV} [m/s]	σ_{RV} [m/s]	σ_{RV} [m/s]
3900-Z-1.0-60k	9.7	15.5	10.0	9.4	15.3	9.7
3900-Z-1.0-80k	6.4	10.4	6.6	6.6	10.7	6.8
3900-Z-1.0-100k	4.7	7.8	4.9	5.2	8.5	5.3
3900-Z-5.0-60k	14.2	22.6	14.6	13.0	21.0	13.4
3900-Z-5.0-80k	10.9	17.6	11.3	10.1	16.4	10.5
3900-Z-5.0-100k	9.2	14.8	9.5	8.6	13.9	8.9
3900-Z-10.0-60k	24.5	38.6	25.3	21.8	35.1	22.4
3900-Z-10.0-80k	20.3	32.2	21.0	18.1	29.2	18.7
3900-Z-10.0-100k	17.8	28.2	18.3	15.9	25.6	16.3
3900-Y-1.0-60k	9.6	11.5	9.8	12.5	15.0	12.7
3900-Y-1.0-80k	6.0	7.1	6.0	8.3	10.0	8.4
3900-Y-1.0-100k	4.2	5.1	4.3	6.3	7.5	6.3
3900-Y-5.0-60k	15.5	18.4	15.7	18.6	22.3	18.9
3900-Y-5.0-80k	11.6	13.8	11.8	14.3	17.0	14.4
3900-Y-5.0-100k	9.7	11.5	9.8	11.9	14.3	12.1
3900-Y-10.0-60k	30.8	36.8	31.2	34.8	41.6	35.2
3900-Y-10.0-80k	25.2	30.1	25.5	28.6	34.3	29.0
3900-Y-10.0-100k	21.8	26.0	22.1	24.9	29.9	25.2
3900-J-1.0-60k	15.7	41.7	16.6	16.2	45.6	17.1
3900-J-1.0-80k	10.5	26.9	11.0	11.5	31.4	12.2
3900-J-1.0-100k	7.9	19.6	8.3	9.2	24.4	9.7
3900-J-5.0-60k	22.7	63.6	24.0	21.8	65.6	23.1
3900-J-5.0-80k	17.5	48.1	18.5	17.1	50.2	18.2
3900-J-5.0-100k	14.8	40.3	15.6	14.6	42.1	15.4
3900-J-10.0-60k	38.6	122.9	41.0	35.4	122.3	37.7
3900-J-10.0-80k	32.0	100.7	34.0	29.5	100.5	31.4
3900-J-10.0-100k	28.0	87.6	29.8	25.9	87.5	27.6
3900-H-1.0-60k	7.2	11.4	7.4	7.6	11.9	7.8
3900-H-1.0-80k	5.0	8.0	5.1	5.4	8.4	5.5

Table A.1: continued.

	PHOENIX-ACES			BT-SETTL		
Simulation	Cond. 1	Cond. 2	Cond. 3	Cond. 1	Cond. 2	Cond. 3
3900-H-1.0-100k	4.0	6.3	4.0	4.2	6.6	4.3
3900-H-5.0-60k	10.1	15.9	10.3	10.8	16.8	11.0
3900-H-5.0-80k	7.9	12.4	8.0	8.3	13.1	8.5
3900-H-5.0-100k	6.6	10.5	6.8	7.0	11.0	7.2
3900-H-10.0-60k	17.5	27.3	17.9	18.8	29.4	19.2
3900-H-10.0-80k	14.5	22.7	14.9	15.6	24.4	16.0
3900-H-10.0-100k	12.7	19.9	13.0	13.6	21.3	14.0
3900-K-1.0-60k	14.5	63.7	15.5	13.7	63.2	14.6
3900-K-1.0-80k	9.7	43.6	10.4	9.6	45.2	10.3
3900-K-1.0-100k	7.4	33.6	8.0	7.6	36.1	8.1
3900-K-5.0-60k	21.7	90.3	23.2	19.4	85.4	20.8
3900-K-5.0-80k	16.6	70.0	17.7	15.0	67.0	16.1
3900-K-5.0-100k	13.9	59.2	14.8	12.6	56.9	13.5
3900-K-10.0-60k	39.4	155.8	42.1	34.2	142.8	36.6
3900-K-10.0-80k	32.6	128.9	34.9	28.4	118.5	30.4
3900-K-10.0-100k	28.5	112.5	30.5	24.8	104.0	26.6
3500-Z-1.0-60k	8.4	13.9	8.7	8.4	14.0	8.6
3500-Z-1.0-80k	5.2	8.8	5.4	5.6	9.4	5.7
3500-Z-1.0-100k	3.7	6.3	3.8	4.2	7.1	4.3
3500-Z-5.0-60k	13.2	21.3	13.6	12.3	20.1	12.7
3500-Z-5.0-80k	10.0	16.4	10.3	9.4	15.5	9.7
3500-Z-5.0-100k	8.3	13.6	8.6	7.9	13.0	8.2
3500-Z-10.0-60k	24.6	39.1	25.4	21.9	35.1	22.5
3500-Z-10.0-80k	20.3	32.4	20.9	18.1	29.1	18.6
3500-Z-10.0-100k	17.6	28.2	18.2	15.8	25.4	16.3
3500-Y-1.0-60k	8.5	10.1	8.6	11.3	13.3	11.4
3500-Y-1.0-80k	5.2	6.2	5.2	7.4	8.7	7.4
3500-Y-1.0-100k	3.6	4.3	3.7	5.5	6.5	5.5
3500-Y-5.0-60k	13.9	16.5	14.1	17.1	20.2	17.3
3500-Y-5.0-80k	10.4	12.3	10.5	13.0	15.3	13.1
3500-Y-5.0-100k	8.6	10.2	8.7	10.9	12.8	11.0
3500-Y-10.0-60k	28.2	33.5	28.5	32.4	38.4	32.8
3500-Y-10.0-80k	23.0	27.3	23.3	26.7	31.5	27.0
3500-Y-10.0-100k	19.9	23.6	20.1	23.2	27.4	23.5
3500-J-1.0-60k	15.1	38.4	15.9	16.7	47.9	17.8
3500-J-1.0-80k	9.8	24.0	10.3	11.8	32.6	12.5
3500-J-1.0-100k	7.1	17.1	7.5	9.3	25.1	9.9
3500-J-5.0-60k	22.5	60.2	23.8	22.9	69.2	24.4
3500-J-5.0-80k	17.3	45.4	18.3	17.9	52.9	19.0

Table A.1: continued.

	PHOENIX-ACES			BT-SETTL		
Simulation	Cond. 1	Cond. 2	Cond. 3	Cond. 1	Cond. 2	Cond. 3
3500-J-5.0-100k	14.5	37.8	15.3	15.2	44.4	16.2
3500-J-10.0-60k	39.9	117.8	42.4	37.9	129.4	40.5
3500-J-10.0-80k	33.0	96.4	35.1	31.5	106.4	33.7
3500-J-10.0-100k	28.8	83.7	30.6	27.6	92.6	29.5
3500-H-1.0-60k	7.7	12.4	7.9	7.7	12.4	7.9
3500-H-1.0-80k	5.4	8.8	5.6	5.4	8.8	5.5
3500-H-1.0-100k	4.3	6.9	4.4	4.3	6.9	4.4
3500-H-5.0-60k	10.7	17.1	10.9	10.9	17.5	11.2
3500-H-5.0-80k	8.3	13.3	8.5	8.4	13.5	8.6
3500-H-5.0-100k	7.1	11.3	7.2	7.1	11.4	7.3
3500-H-10.0-60k	18.1	28.7	18.5	19.5	31.4	20.0
3500-H-10.0-80k	15.0	23.9	15.4	16.1	26.0	16.6
3500-H-10.0-100k	13.1	20.9	13.5	14.1	22.7	14.5
3500-K-1.0-60k	13.5	49.0	14.4	12.1	43.8	13.0
3500-K-1.0-80k	9.0	32.7	9.6	8.4	30.1	8.9
3500-K-1.0-100k	6.8	24.8	7.3	6.5	23.3	7.0
3500-K-5.0-60k	20.4	71.7	21.7	17.6	62.6	18.8
3500-K-5.0-80k	15.5	55.2	16.5	13.5	48.4	14.4
3500-K-5.0-100k	13.0	46.4	13.9	11.4	40.8	12.1
3500-K-10.0-60k	37.5	126.6	39.9	31.8	109.6	34.0
3500-K-10.0-80k	30.9	104.6	33.0	26.3	90.7	28.1
3500-K-10.0-100k	27.0	91.3	28.8	23.0	79.3	24.6
2800-Z-1.0-60k	4.4	8.4	4.5	4.0	7.6	4.2
2800-Z-1.0-80k	2.6	5.1	2.7	2.6	4.8	2.7
2800-Z-1.0-100k	1.8	3.6	1.9	1.9	3.5	1.9
2800-Z-5.0-60k	7.2	13.7	7.5	6.3	11.7	6.6
2800-Z-5.0-80k	5.4	10.3	5.6	4.8	8.8	4.9
2800-Z-5.0-100k	4.4	8.5	4.6	4.0	7.3	4.1
2800-Z-10.0-60k	14.6	27.3	15.2	12.6	22.8	13.0
2800-Z-10.0-80k	11.9	22.4	12.4	10.3	18.6	10.6
2800-Z-10.0-100k	10.3	19.3	10.7	8.9	16.2	9.2
2800-Y-1.0-60k	5.8	7.4	5.9	11.7	14.0	11.9
2800-Y-1.0-80k	3.7	4.8	3.8	7.6	9.1	7.7
2800-Y-1.0-100k	2.7	3.5	2.7	5.6	6.7	5.7
2800-Y-5.0-60k	8.7	10.7	8.8	17.7	21.3	17.9
2800-Y-5.0-80k	6.7	8.3	6.8	13.5	16.2	13.7
2800-Y-5.0-100k	5.6	7.0	5.7	11.3	13.6	11.4
2800-Y-10.0-60k	14.7	17.5	14.9	32.5	39.0	32.9
2800-Y-10.0-80k	12.2	14.6	12.4	26.8	32.1	27.1

Table A.1: continued.

	PHOENIX-ACES			BT-SETTL		
Simulation	Cond. 1	Cond. 2	Cond. 3	Cond. 1	Cond. 2	Cond. 3
2800-Y-10.0-100k	10.7	12.8	10.8	23.3	28.0	23.6
2800-J-1.0-60k	8.8	23.2	9.3	11.0	31.7	11.8
2800-J-1.0-80k	5.5	14.4	5.8	7.6	21.5	8.1
2800-J-1.0-100k	4.0	10.2	4.2	5.8	16.3	6.2
2800-J-5.0-60k	13.5	35.9	14.3	15.6	45.3	16.7
2800-J-5.0-80k	10.3	27.3	10.9	12.1	35.1	13.0
2800-J-5.0-100k	8.6	22.8	9.1	10.2	29.6	10.9
2800-J-10.0-60k	24.3	63.8	25.7	26.7	78.5	28.5
2800-J-10.0-80k	20.1	52.9	21.2	22.2	65.1	23.7
2800-J-10.0-100k	17.5	46.1	18.5	19.4	57.0	20.7
2800-H-1.0-60k	6.6	12.8	6.9	5.7	11.1	5.9
2800-H-1.0-80k	4.4	8.5	4.6	3.9	7.5	4.0
2800-H-1.0-100k	3.3	6.4	3.5	3.0	5.8	3.1
2800-H-5.0-60k	9.8	18.8	10.2	8.4	16.4	8.7
2800-H-5.0-80k	7.5	14.4	7.8	6.5	12.6	6.7
2800-H-5.0-100k	6.3	12.1	6.5	5.4	10.5	5.6
2800-H-10.0-60k	17.8	34.7	18.4	15.6	31.0	16.2
2800-H-10.0-80k	14.7	28.7	15.2	12.9	25.5	13.3
2800-H-10.0-100k	12.8	25.0	13.3	11.2	22.2	11.6
2800-K-1.0-60k	8.2	27.0	8.7	7.1	22.9	7.5
2800-K-1.0-80k	5.4	17.9	5.7	4.8	15.6	5.1
2800-K-1.0-100k	4.0	13.5	4.3	3.7	12.0	4.0
2800-K-5.0-60k	12.4	39.7	13.2	10.3	33.3	11.0
2800-K-5.0-80k	9.4	30.5	10.0	7.9	25.6	8.4
2800-K-5.0-100k	7.9	25.6	8.4	6.6	21.5	7.1
2800-K-10.0-60k	23.0	70.7	24.6	19.1	59.6	20.4
2800-K-10.0-80k	19.0	58.5	20.3	15.8	49.3	16.8
2800-K-10.0-100k	16.6	51.1	17.7	13.8	43.0	14.7
2600-Z-1.0-60k	3.7	7.7	3.9	3.4	6.5	3.6
2600-Z-1.0-80k	2.2	4.6	2.3	2.2	4.2	2.3
2600-Z-1.0-100k	1.5	3.2	1.6	1.6	3.0	1.7
2600-Z-5.0-60k	6.1	12.5	6.4	5.4	10.0	5.6
2600-Z-5.0-80k	4.6	9.4	4.8	4.0	7.6	4.2
2600-Z-5.0-100k	3.8	7.8	3.9	3.4	6.3	3.5
2600-Z-10.0-60k	12.3	24.9	12.9	10.6	19.6	11.0
2600-Z-10.0-80k	10.1	20.4	10.5	8.7	16.0	9.0
2600-Z-10.0-100k	8.7	17.6	9.1	7.5	13.9	7.8
2600-Y-1.0-60k	4.8	6.3	4.9	7.7	9.2	7.8
2600-Y-1.0-80k	3.0	4.0	3.1	5.0	5.9	5.0

Table A.1: continued.

	PHOENIX-ACES			BT-SETTL		
Simulation	Cond. 1	Cond. 2	Cond. 3	Cond. 1	Cond. 2	Cond. 3
2600-Y-1.0-100k	2.1	2.9	2.2	3.6	4.4	3.7
2600-Y-5.0-60k	7.2	9.1	7.3	11.7	14.2	11.9
2600-Y-5.0-80k	5.6	7.0	5.6	8.9	10.8	9.0
2600-Y-5.0-100k	4.7	5.9	4.7	7.4	9.0	7.5
2600-Y-10.0-60k	12.1	14.6	12.2	22.0	26.3	22.2
2600-Y-10.0-80k	10.1	12.2	10.2	18.0	21.6	18.3
2600-Y-10.0-100k	8.8	10.7	8.9	15.7	18.8	15.9
2600-J-1.0-60k	6.4	17.1	6.8	8.1	24.0	8.6
2600-J-1.0-80k	4.0	10.5	4.2	5.4	16.0	5.8
2600-J-1.0-100k	2.8	7.4	3.0	4.1	12.0	4.4
2600-J-5.0-60k	10.0	26.9	10.6	11.7	35.0	12.5
2600-J-5.0-80k	7.6	20.4	8.0	9.0	26.9	9.6
2600-J-5.0-100k	6.3	17.0	6.7	7.6	22.6	8.1
2600-J-10.0-60k	18.1	47.2	19.1	20.8	60.7	22.2
2600-J-10.0-80k	15.0	39.2	15.8	17.2	50.4	18.3
2600-J-10.0-100k	13.0	34.2	13.8	15.0	44.1	16.0
2600-H-1.0-60k	5.2	10.2	5.4	4.6	9.1	4.8
2600-H-1.0-80k	3.4	6.7	3.5	3.1	6.2	3.2
2600-H-1.0-100k	2.6	5.1	2.7	2.4	4.7	2.5
2600-H-5.0-60k	7.8	15.4	8.0	6.8	13.5	7.0
2600-H-5.0-80k	5.9	11.7	6.2	5.2	10.3	5.4
2600-H-5.0-100k	5.0	9.8	5.2	4.4	8.6	4.5
2600-H-10.0-60k	14.2	28.9	14.7	12.6	25.5	13.0
2600-H-10.0-80k	11.7	23.8	12.1	10.3	21.0	10.7
2600-H-10.0-100k	10.2	20.7	10.6	9.0	18.3	9.4
2600-K-1.0-60k	6.2	20.2	6.6	5.7	18.8	6.1
2600-K-1.0-80k	4.0	13.2	4.3	3.9	12.9	4.2
2600-K-1.0-100k	3.0	9.9	3.2	3.0	9.9	3.2
2600-K-5.0-60k	9.4	30.1	10.0	8.3	27.2	8.9
2600-K-5.0-80k	7.1	23.0	7.6	6.4	20.9	6.8
2600-K-5.0-100k	6.0	19.3	6.4	5.3	17.6	5.7
2600-K-10.0-60k	17.4	54.0	18.6	15.2	48.5	16.2
2600-K-10.0-80k	14.4	44.7	15.3	12.5	40.1	13.4
2600-K-10.0-100k	12.5	39.1	13.4	10.9	35.0	11.7

Table A.2: RV precisions calculated for the NIRPS ETC. Reference band SELF.

Simulation ($T_{\rm eff}$-Band-$v.sini$-R)	σ_{RV} (Cond. 1) [m/s]	σ_{RV} (Cond. 2) [m/s]	σ_{RV} (Cond. 3) [m/s]
4000-Z-1.0-75k	6.9	11.2	7.1
4000-Z-1.0-100k	4.7	7.7	4.9
4000-Z-5.0-75k	11.2	18.2	11.6
4000-Z-5.0-100k	9.0	14.5	9.3
4000-Z-10.0-75k	20.5	32.6	21.1
4000-Z-10.0-100k	17.2	27.4	17.8
4000-Y-1.0-75k	6.8	8.1	6.8
4000-Y-1.0-100k	4.4	5.2	4.4
4000-Y-5.0-75k	12.5	14.9	12.6
4000-Y-5.0-100k	9.8	11.7	9.9
4000-Y-10.0-75k	26.4	31.6	26.8
4000-Y-10.0-100k	21.9	26.2	22.2
4000-J-1.0-75k	11.3	29.3	11.9
4000-J-1.0-100k	7.8	19.7	8.2
4000-J-5.0-75k	18.1	50.1	19.1
4000-J-5.0-100k	14.5	39.7	15.3
4000-J-10.0-75k	32.3	102.4	34.3
4000-J-10.0-100k	27.2	85.5	28.9
4000-H-1.0-75k	5.4	8.5	5.5
4000-H-1.0-100k	3.9	6.2	4.0
4000-H-5.0-75k	8.2	13.0	8.4
4000-H-5.0-100k	6.6	10.4	6.7
4000-H-10.0-75k	15.0	23.5	15.4
4000-H-10.0-100k	12.6	19.7	12.9
4000-K-1.0-75k	10.4	47.3	11.1
4000-K-1.0-100k	7.3	33.7	7.8
4000-K-5.0-75k	17.2	73.5	18.4
4000-K-5.0-100k	13.7	59.0	14.6
4000-K-10.0-75k	33.4	132.8	35.7
4000-K-10.0-100k	28.0	111.8	29.9
3900-Z-1.0-75k	7.0	11.4	7.2
3900-Z-1.0-100k	4.7	7.8	4.9
3900-Z-5.0-75k	11.5	18.6	11.9
3900-Z-5.0-100k	9.2	14.8	9.5
3900-Z-10.0-75k	21.2	33.6	21.8
3900-Z-10.0-100k	17.8	28.2	18.3
3900-Y-1.0-75k	6.6	7.9	6.7
3900-Y-1.0-100k	4.2	5.1	4.3
3900-Y-5.0-75k	12.3	14.7	12.5

Table A.2: continued.

Simulation	σ_{RV} (Cond. 1)	σ_{RV} (Cond. 2)	σ_{RV} (Cond. 3)
3900-Y-5.0-100k	9.7	11.5	9.8
3900-Y-10.0-75k	26.3	31.4	26.6
3900-Y-10.0-100k	21.8	26.0	22.1
3900-J-1.0-75k	11.5	29.5	12.1
3900-J-1.0-100k	7.9	19.6	8.3
3900-J-5.0-75k	18.5	50.9	19.6
3900-J-5.0-100k	14.8	40.3	15.6
3900-J-10.0-75k	33.4	104.9	35.4
3900-J-10.0-100k	28.0	87.6	29.8
3900-H-1.0-75k	5.4	8.6	5.5
3900-H-1.0-100k	4.0	6.3	4.0
3900-H-5.0-75k	8.3	13.0	8.5
3900-H-5.0-100k	6.6	10.5	6.8
3900-H-10.0-75k	15.1	23.6	15.5
3900-H-10.0-100k	12.7	19.9	13.0
3900-K-1.0-75k	10.6	47.3	11.3
3900-K-1.0-100k	7.4	33.6	8.0
3900-K-5.0-75k	17.5	73.8	18.7
3900-K-5.0-100k	13.9	59.2	14.8
3900-K-10.0-75k	34.0	133.7	36.3
3900-K-10.0-100k	28.5	112.5	30.5
3800-Z-1.0-75k	6.9	11.3	7.2
3800-Z-1.0-100k	4.7	7.7	4.8
3800-Z-5.0-75k	11.7	18.7	12.0
3800-Z-5.0-100k	9.3	14.9	9.6
3800-Z-10.0-75k	21.7	34.2	22.4
3800-Z-10.0-100k	18.2	28.7	18.8
3800-Y-1.0-75k	6.5	7.7	6.5
3800-Y-1.0-100k	4.1	4.9	4.2
3800-Y-5.0-75k	12.1	14.4	12.3
3800-Y-5.0-100k	9.5	11.3	9.6
3800-Y-10.0-75k	26.0	31.0	26.3
3800-Y-10.0-100k	21.5	25.7	21.8
3800-J-1.0-75k	11.5	29.3	12.1
3800-J-1.0-100k	7.8	19.4	8.2
3800-J-5.0-75k	18.7	51.2	19.8
3800-J-5.0-100k	14.9	40.5	15.8
3800-J-10.0-75k	34.1	106.2	36.2
3800-J-10.0-100k	28.7	88.6	30.4
3800-H-1.0-75k	5.5	8.8	5.7

Table A.2: continued.

Simulation	σ_{RV} (Cond. 1)	σ_{RV} (Cond. 2)	σ_{RV} (Cond. 3)
3800-H-1.0-100k	4.1	6.4	4.1
3800-H-5.0-75k	8.4	13.2	8.6
3800-H-5.0-100k	6.7	10.6	6.9
3800-H-10.0-75k	15.2	23.7	15.6
3800-H-10.0-100k	12.8	20.0	13.1
3800-K-1.0-75k	10.7	46.0	11.4
3800-K-1.0-100k	7.5	32.5	8.0
3800-K-5.0-75k	17.7	72.6	18.9
3800-K-5.0-100k	14.0	58.2	15.0
3800-K-10.0-75k	34.4	132.6	36.7
3800-K-10.0-100k	28.8	111.5	30.8
3700-Z-1.0-75k	6.8	11.1	7.0
3700-Z-1.0-100k	4.5	7.4	4.6
3700-Z-5.0-75k	11.6	18.7	12.0
3700-Z-5.0-100k	9.2	14.8	9.5
3700-Z-10.0-75k	22.0	34.6	22.7
3700-Z-10.0-100k	18.4	29.1	19.0
3700-Y-1.0-75k	6.3	7.5	6.3
3700-Y-1.0-100k	4.0	4.8	4.0
3700-Y-5.0-75k	11.9	14.1	12.0
3700-Y-5.0-100k	9.3	11.0	9.4
3700-Y-10.0-75k	25.6	30.4	25.9
3700-Y-10.0-100k	21.2	25.2	21.4
3700-J-1.0-75k	11.4	28.8	12.0
3700-J-1.0-100k	7.7	18.9	8.1
3700-J-5.0-75k	18.8	50.9	19.9
3700-J-5.0-100k	15.0	40.2	15.8
3700-J-10.0-75k	34.7	106.0	36.8
3700-J-10.0-100k	29.1	88.4	30.9
3700-H-1.0-75k	5.7	9.0	5.8
3700-H-1.0-100k	4.2	6.6	4.3
3700-H-5.0-75k	8.5	13.4	8.7
3700-H-5.0-100k	6.8	10.8	7.0
3700-H-10.0-75k	15.3	24.0	15.7
3700-H-10.0-100k	12.9	20.2	13.2
3700-K-1.0-75k	10.6	43.7	11.4
3700-K-1.0-100k	7.5	30.7	8.0
3700-K-5.0-75k	17.7	70.1	18.9
3700-K-5.0-100k	14.0	56.0	15.0
3700-K-10.0-75k	34.5	128.8	36.8

Table A.2: continued.

Simulation	σ_{RV} (Cond. 1)	σ_{RV} (Cond. 2)	σ_{RV} (Cond. 3)
3700-K-10.0-100k	28.9	108.3	30.9
3600-Z-1.0-75k	6.3	10.5	6.6
3600-Z-1.0-100k	4.1	6.9	4.3
3600-Z-5.0-75k	11.2	18.2	11.6
3600-Z-5.0-100k	8.9	14.4	9.2
3600-Z-10.0-75k	21.8	34.5	22.5
3600-Z-10.0-100k	18.2	28.9	18.8
3600-Y-1.0-75k	6.0	7.2	6.1
3600-Y-1.0-100k	3.8	4.6	3.9
3600-Y-5.0-75k	11.5	13.6	11.6
3600-Y-5.0-100k	9.0	10.6	9.1
3600-Y-10.0-75k	24.9	29.6	25.2
3600-Y-10.0-100k	20.6	24.5	20.9
3600-J-1.0-75k	11.1	27.9	11.7
3600-J-1.0-100k	7.5	18.1	7.8
3600-J-5.0-75k	18.7	49.8	19.7
3600-J-5.0-100k	14.8	39.3	15.7
3600-J-10.0-75k	34.7	104.0	36.9
3600-J-10.0-100k	29.1	86.7	30.9
3600-H-1.0-75k	5.8	9.2	5.9
3600-H-1.0-100k	4.3	6.8	4.3
3600-H-5.0-75k	8.6	13.7	8.8
3600-H-5.0-100k	6.9	11.0	7.1
3600-H-10.0-75k	15.4	24.3	15.8
3600-H-10.0-100k	13.0	20.5	13.3
3600-K-1.0-75k	10.3	39.8	11.0
3600-K-1.0-100k	7.2	27.8	7.7
3600-K-5.0-75k	17.2	64.7	18.4
3600-K-5.0-100k	13.7	51.6	14.6
3600-K-10.0-75k	33.7	120.0	36.0
3600-K-10.0-100k	28.2	100.8	30.2
3500-Z-1.0-75k	5.8	9.7	6.0
3500-Z-1.0-100k	3.7	6.3	3.8
3500-Z-5.0-75k	10.6	17.3	10.9
3500-Z-5.0-100k	8.3	13.6	8.6
3500-Z-10.0-75k	21.1	33.8	21.8
3500-Z-10.0-100k	17.6	28.2	18.2
3500-Y-1.0-75k	5.8	6.9	5.8
3500-Y-1.0-100k	3.6	4.3	3.7
3500-Y-5.0-75k	11.0	13.1	11.2

Table A.2: continued.

Simulation	σ_{RV} (Cond. 1)	σ_{RV} (Cond. 2)	σ_{RV} (Cond. 3)
3500-Y-5.0-100k	8.6	10.2	8.7
3500-Y-10.0-75k	24.0	28.5	24.3
3500-Y-10.0-100k	19.9	23.6	20.1
3500-J-1.0-75k	10.7	26.6	11.3
3500-J-1.0-100k	7.1	17.1	7.5
3500-J-5.0-75k	18.3	48.1	19.3
3500-J-5.0-100k	14.5	37.8	15.3
3500-J-10.0-75k	34.4	100.5	36.5
3500-J-10.0-100k	28.8	83.7	30.6
3500-H-1.0-75k	5.8	9.4	6.0
3500-H-1.0-100k	4.3	6.9	4.4
3500-H-5.0-75k	8.8	14.0	9.0
3500-H-5.0-100k	7.1	11.3	7.2
3500-H-10.0-75k	15.6	24.8	16.0
3500-H-10.0-100k	13.1	20.9	13.5
3500-K-1.0-75k	9.8	35.7	10.5
3500-K-1.0-100k	6.8	24.8	7.3
3500-K-5.0-75k	16.4	58.2	17.5
3500-K-5.0-100k	13.0	46.4	13.9
3500-K-10.0-75k	32.2	108.7	34.4
3500-K-10.0-100k	27.0	91.3	28.8
3400-Z-1.0-75k	5.3	8.9	5.5
3400-Z-1.0-100k	3.3	5.7	3.5
3400-Z-5.0-75k	9.8	16.3	10.2
3400-Z-5.0-100k	7.7	12.8	8.0
3400-Z-10.0-75k	20.2	32.7	20.8
3400-Z-10.0-100k	16.8	27.2	17.3
3400-Y-1.0-75k	5.5	6.6	5.6
3400-Y-1.0-100k	3.5	4.2	3.5
3400-Y-5.0-75k	10.5	12.4	10.6
3400-Y-5.0-100k	8.2	9.7	8.3
3400-Y-10.0-75k	22.3	26.4	22.5
3400-Y-10.0-100k	18.5	21.9	18.7
3400-J-1.0-75k	10.2	25.0	10.8
3400-J-1.0-100k	6.7	15.9	7.1
3400-J-5.0-75k	17.6	45.6	18.6
3400-J-5.0-100k	14.0	35.9	14.7
3400-J-10.0-75k	33.6	95.5	35.7
3400-J-10.0-100k	28.1	79.4	29.9
3400-H-1.0-75k	5.9	9.7	6.0

Table A.2: continued.

Simulation	σ_{RV} (Cond. 1)	σ_{RV} (Cond. 2)	σ_{RV} (Cond. 3)
3400-H-1.0-100k	4.3	7.1	4.4
3400-H-5.0-75k	8.9	14.5	9.2
3400-H-5.0-100k	7.2	11.7	7.4
3400-H-10.0-75k	16.0	25.8	16.4
3400-H-10.0-100k	13.4	21.7	13.8
3400-K-1.0-75k	9.2	31.8	9.8
3400-K-1.0-100k	6.4	22.2	6.8
3400-K-5.0-75k	15.4	52.0	16.4
3400-K-5.0-100k	12.2	41.4	13.0
3400-K-10.0-75k	30.5	97.5	32.4
3400-K-10.0-100k	25.5	81.8	27.2
3300-Z-1.0-75k	4.8	8.2	5.0
3300-Z-1.0-100k	3.0	5.2	3.1
3300-Z-5.0-75k	9.1	15.3	9.4
3300-Z-5.0-100k	7.1	11.9	7.3
3300-Z-10.0-75k	19.0	31.3	19.7
3300-Z-10.0-100k	15.8	26.0	16.4
3300-Y-1.0-75k	5.8	7.1	5.9
3300-Y-1.0-100k	3.8	4.6	3.8
3300-Y-5.0-75k	10.3	12.2	10.4
3300-Y-5.0-100k	8.1	9.7	8.2
3300-Y-10.0-75k	19.9	23.5	20.1
3300-Y-10.0-100k	16.6	19.6	16.8
3300-J-1.0-75k	9.5	23.0	10.1
3300-J-1.0-100k	6.2	14.6	6.6
3300-J-5.0-75k	16.7	42.5	17.7
3300-J-5.0-100k	13.2	33.3	13.9
3300-J-10.0-75k	32.3	89.0	34.3
3300-J-10.0-100k	27.0	74.0	28.6
3300-H-1.0-75k	5.9	10.0	6.1
3300-H-1.0-100k	4.3	7.2	4.4
3300-H-5.0-75k	9.1	15.2	9.4
3300-H-5.0-100k	7.3	12.2	7.5
3300-H-10.0-75k	16.5	27.3	16.9
3300-H-10.0-100k	13.9	22.9	14.2
3300-K-1.0-75k	8.7	28.9	9.2
3300-K-1.0-100k	6.0	20.2	6.4
3300-K-5.0-75k	14.6	47.2	15.5
3300-K-5.0-100k	11.5	37.6	12.3
3300-K-10.0-75k	28.8	88.8	30.7

Table A.2: continued.

Simulation	σ_{RV} (Cond. 1)	σ_{RV} (Cond. 2)	σ_{RV} (Cond. 3)
3300-K-10.0-100k	24.1	74.6	25.7
3200-Z-1.0-75k	4.3	7.5	4.5
3200-Z-1.0-100k	2.7	4.7	2.8
3200-Z-5.0-75k	8.3	14.2	8.6
3200-Z-5.0-100k	6.5	11.1	6.7
3200-Z-10.0-75k	17.8	29.8	18.4
3200-Z-10.0-100k	14.7	24.7	15.3
3200-Y-1.0-75k	5.5	6.7	5.6
3200-Y-1.0-100k	3.6	4.4	3.6
3200-Y-5.0-75k	9.7	11.6	9.8
3200-Y-5.0-100k	7.6	9.2	7.7
3200-Y-10.0-75k	18.4	21.7	18.6
3200-Y-10.0-100k	15.4	18.2	15.6
3200-J-1.0-75k	8.7	20.6	9.2
3200-J-1.0-100k	5.6	13.0	5.9
3200-J-5.0-75k	15.5	38.5	16.3
3200-J-5.0-100k	12.2	30.2	12.9
3200-J-10.0-75k	30.3	80.8	32.1
3200-J-10.0-100k	25.3	67.2	26.8
3200-H-1.0-75k	5.9	10.3	6.1
3200-H-1.0-100k	4.2	7.4	4.3
3200-H-5.0-75k	9.3	15.9	9.6
3200-H-5.0-100k	7.4	12.7	7.7
3200-H-10.0-75k	17.0	29.0	17.5
3200-H-10.0-100k	14.3	24.4	14.7
3200-K-1.0-75k	8.2	26.9	8.7
3200-K-1.0-100k	5.7	18.8	6.1
3200-K-5.0-75k	13.8	43.9	14.7
3200-K-5.0-100k	10.9	34.9	11.6
3200-K-10.0-75k	27.4	82.7	29.2
3200-K-10.0-100k	22.9	69.4	24.4
3100-Z-1.0-75k	4.0	7.3	4.2
3100-Z-1.0-100k	2.5	4.6	2.6
3100-Z-5.0-75k	7.8	13.8	8.1
3100-Z-5.0-100k	6.1	10.8	6.3
3100-Z-10.0-75k	16.7	29.0	17.3
3100-Z-10.0-100k	13.9	24.1	14.4
3100-Y-1.0-75k	5.5	6.8	5.6
3100-Y-1.0-100k	3.6	4.5	3.7
3100-Y-5.0-75k	9.4	11.3	9.5

Table A.2: continued.

Simulation	σ_{RV} (Cond. 1)	σ_{RV} (Cond. 2)	σ_{RV} (Cond. 3)
3100-Y-5.0-100k	7.5	9.0	7.5
3100-Y-10.0-75k	17.3	20.5	17.5
3100-Y-10.0-100k	14.5	17.2	14.7
3100-J-1.0-75k	7.7	17.9	8.1
3100-J-1.0-100k	5.0	11.2	5.2
3100-J-5.0-75k	13.9	34.0	14.7
3100-J-5.0-100k	11.0	26.6	11.6
3100-J-10.0-75k	27.7	71.5	29.3
3100-J-10.0-100k	23.1	59.4	24.4
3100-H-1.0-75k	5.8	10.4	6.0
3100-H-1.0-100k	4.1	7.4	4.3
3100-H-5.0-75k	9.3	16.4	9.6
3100-H-5.0-100k	7.4	13.1	7.7
3100-H-10.0-75k	17.3	30.6	17.9
3100-H-10.0-100k	14.5	25.6	15.0
3100-K-1.0-75k	7.7	25.2	8.2
3100-K-1.0-100k	5.4	17.6	5.7
3100-K-5.0-75k	13.1	41.3	13.9
3100-K-5.0-100k	10.3	32.8	11.0
3100-K-10.0-75k	26.0	77.9	27.7
3100-K-10.0-100k	21.7	65.4	23.1
3000-Z-1.0-75k	3.6	6.8	3.8
3000-Z-1.0-100k	2.3	4.2	2.4
3000-Z-5.0-75k	7.1	12.9	7.4
3000-Z-5.0-100k	5.5	10.0	5.7
3000-Z-10.0-75k	15.3	27.1	15.9
3000-Z-10.0-100k	12.7	22.5	13.2
3000-Y-1.0-75k	5.0	6.3	5.1
3000-Y-1.0-100k	3.3	4.2	3.4
3000-Y-5.0-75k	8.6	10.4	8.7
3000-Y-5.0-100k	6.8	8.3	6.9
3000-Y-10.0-75k	15.7	18.6	15.9
3000-Y-10.0-100k	13.2	15.7	13.3
3000-J-1.0-75k	7.9	20.4	8.3
3000-J-1.0-100k	5.1	13.1	5.4
3000-J-5.0-75k	13.9	37.0	14.7
3000-J-5.0-100k	11.0	29.1	11.6
3000-J-10.0-75k	26.7	72.6	28.3
3000-J-10.0-100k	22.3	60.8	23.7
3000-H-1.0-75k	5.6	10.3	5.8

Table A.2: continued.

Simulation	σ_{RV} (Cond. 1)	σ_{RV} (Cond. 2)	σ_{RV} (Cond. 3)
3000-H-1.0-100k	3.9	7.3	4.1
3000-H-5.0-75k	9.1	16.5	9.4
3000-H-5.0-100k	7.2	13.2	7.5
3000-H-10.0-75k	17.2	31.4	17.8
3000-H-10.0-100k	14.4	26.3	14.9
3000-K-1.0-75k	7.2	23.5	7.7
3000-K-1.0-100k	5.0	16.4	5.3
3000-K-5.0-75k	12.2	38.6	13.0
3000-K-5.0-100k	9.6	30.7	10.2
3000-K-10.0-75k	24.2	73.0	25.8
3000-K-10.0-100k	20.3	61.2	21.6
2900-Z-1.0-75k	3.3	6.2	3.4
2900-Z-1.0-100k	2.0	3.9	2.1
2900-Z-5.0-75k	6.4	11.8	6.6
2900-Z-5.0-100k	4.9	9.2	5.1
2900-Z-10.0-75k	13.8	25.1	14.4
2900-Z-10.0-100k	11.4	20.8	11.9
2900-Y-1.0-75k	4.6	5.8	4.6
2900-Y-1.0-100k	3.0	3.9	3.0
2900-Y-5.0-75k	7.8	9.6	7.9
2900-Y-5.0-100k	6.2	7.6	6.3
2900-Y-10.0-75k	14.2	16.8	14.3
2900-Y-10.0-100k	11.9	14.2	12.0
2900-J-1.0-75k	7.1	18.6	7.5
2900-J-1.0-100k	4.6	12.0	4.9
2900-J-5.0-75k	12.5	33.5	13.3
2900-J-5.0-100k	9.9	26.4	10.5
2900-J-10.0-75k	24.0	64.3	25.5
2900-J-10.0-100k	20.1	53.9	21.3
2900-H-1.0-75k	5.3	9.9	5.4
2900-H-1.0-100k	3.7	6.9	3.8
2900-H-5.0-75k	8.6	16.1	8.9
2900-H-5.0-100k	6.9	12.8	7.1
2900-H-10.0-75k	16.5	31.2	17.1
2900-H-10.0-100k	13.8	26.1	14.3
2900-K-1.0-75k	6.6	21.6	7.0
2900-K-1.0-100k	4.5	15.0	4.8
2900-K-5.0-75k	11.1	35.5	11.8
2900-K-5.0-100k	8.8	28.3	9.4
2900-K-10.0-75k	22.1	67.3	23.6

Table A.2: continued.

Simulation	σ_{RV} (Cond. 1)	σ_{RV} (Cond. 2)	σ_{RV} (Cond. 3)
2900-K-10.0-100k	18.5	56.5	19.7
2800-Z-1.0-75k	2.9	5.7	3.0
2800-Z-1.0-100k	1.8	3.6	1.9
2800-Z-5.0-75k	5.7	10.9	5.9
2800-Z-5.0-100k	4.4	8.5	4.6
2800-Z-10.0-75k	12.4	23.3	13.0
2800-Z-10.0-100k	10.3	19.3	10.7
2800-Y-1.0-75k	4.1	5.3	4.2
2800-Y-1.0-100k	2.7	3.5	2.7
2800-Y-5.0-75k	7.1	8.7	7.2
2800-Y-5.0-100k	5.6	7.0	5.7
2800-Y-10.0-75k	12.7	15.2	12.9
2800-Y-10.0-100k	10.7	12.8	10.8
2800-J-1.0-75k	6.1	16.0	6.5
2800-J-1.0-100k	4.0	10.2	4.2
2800-J-5.0-75k	10.9	28.9	11.5
2800-J-5.0-100k	8.6	22.8	9.1
2800-J-10.0-75k	20.9	55.0	22.1
2800-J-10.0-100k	17.5	46.1	18.5
2800-H-1.0-75k	4.8	9.3	5.0
2800-H-1.0-100k	3.3	6.4	3.5
2800-H-5.0-75k	8.0	15.3	8.2
2800-H-5.0-100k	6.3	12.1	6.5
2800-H-10.0-75k	15.3	29.9	15.9
2800-H-10.0-100k	12.8	25.0	13.3
2800-K-1.0-75k	5.9	19.5	6.3
2800-K-1.0-100k	4.0	13.5	4.3
2800-K-5.0-75k	10.0	32.2	10.6
2800-K-5.0-100k	7.9	25.6	8.4
2800-K-10.0-75k	19.8	60.9	21.1
2800-K-10.0-100k	16.6	51.1	17.7
2700-Z-1.0-75k	2.6	5.3	2.7
2700-Z-1.0-100k	1.6	3.3	1.7
2700-Z-5.0-75k	5.2	10.2	5.4
2700-Z-5.0-100k	4.0	7.9	4.2
2700-Z-10.0-75k	11.3	21.9	11.8
2700-Z-10.0-100k	9.3	18.1	9.7
2700-Y-1.0-75k	3.7	4.8	3.7
2700-Y-1.0-100k	2.4	3.2	2.4
2700-Y-5.0-75k	6.4	8.0	6.5

Table A.2: continued.

Simulation	σ_{RV} (Cond. 1)	σ_{RV} (Cond. 2)	σ_{RV} (Cond. 3)
2700-Y-5.0-100k	5.1	6.4	5.2
2700-Y-10.0-75k	11.5	13.8	11.6
2700-Y-10.0-100k	9.7	11.6	9.8
2700-J-1.0-75k	5.2	13.6	5.5
2700-J-1.0-100k	3.4	8.7	3.5
2700-J-5.0-75k	9.3	24.9	9.9
2700-J-5.0-100k	7.4	19.6	7.8
2700-J-10.0-75k	18.0	47.1	19.1
2700-J-10.0-100k	15.1	39.5	16.0
2700-H-1.0-75k	4.3	8.3	4.4
2700-H-1.0-100k	3.0	5.8	3.1
2700-H-5.0-75k	7.1	13.9	7.4
2700-H-5.0-100k	5.7	11.0	5.9
2700-H-10.0-75k	13.8	27.6	14.3
2700-H-10.0-100k	11.5	23.1	12.0
2700-K-1.0-75k	5.2	17.2	5.5
2700-K-1.0-100k	3.5	11.9	3.8
2700-K-5.0-75k	8.8	28.5	9.4
2700-K-5.0-100k	6.9	22.7	7.4
2700-K-10.0-75k	17.4	54.0	18.6
2700-K-10.0-100k	14.6	45.3	15.5
2600-Z-1.0-75k	2.5	5.2	2.6
2600-Z-1.0-100k	1.5	3.2	1.6
2600-Z-5.0-75k	4.8	9.9	5.1
2600-Z-5.0-100k	3.8	7.8	3.9
2600-Z-10.0-75k	10.5	21.3	11.0
2600-Z-10.0-100k	8.7	17.6	9.1
2600-Y-1.0-75k	3.3	4.4	3.4
2600-Y-1.0-100k	2.1	2.9	2.2
2600-Y-5.0-75k	5.9	7.4	6.0
2600-Y-5.0-100k	4.7	5.9	4.7
2600-Y-10.0-75k	10.5	12.7	10.6
2600-Y-10.0-100k	8.8	10.7	8.9
2600-J-1.0-75k	4.4	11.7	4.7
2600-J-1.0-100k	2.8	7.4	3.0
2600-J-5.0-75k	8.0	21.6	8.5
2600-J-5.0-100k	6.3	17.0	6.7
2600-J-10.0-75k	15.6	40.8	16.5
2600-J-10.0-100k	13.0	34.2	13.8
2600-H-1.0-75k	3.7	7.4	3.9

Table A.2: continued.

Simulation	σ_{RV} (Cond. 1)	σ_{RV} (Cond. 2)	σ_{RV} (Cond. 3)
2600-H-1.0-100k	2.6	5.1	2.7
2600-H-5.0-75k	6.3	12.4	6.5
2600-H-5.0-100k	5.0	9.8	5.2
2600-H-10.0-75k	12.2	24.8	12.7
2600-H-10.0-100k	10.2	20.7	10.6
2600-K-1.0-75k	4.4	14.4	4.7
2600-K-1.0-100k	3.0	9.9	3.2
2600-K-5.0-75k	7.6	24.3	8.1
2600-K-5.0-100k	6.0	19.3	6.4
2600-K-10.0-75k	15.0	46.5	16.0
2600-K-10.0-100k	12.5	39.1	13.4
2500-Z-1.0-75k	2.5	5.5	2.6
2500-Z-1.0-100k	1.6	3.5	1.6
2500-Z-5.0-75k	4.8	10.4	5.0
2500-Z-5.0-100k	3.7	8.2	3.9
2500-Z-10.0-75k	10.3	22.0	10.9
2500-Z-10.0-100k	8.6	18.3	9.0
2500-Y-1.0-75k	3.1	4.2	3.1
2500-Y-1.0-100k	2.0	2.7	2.0
2500-Y-5.0-75k	5.5	7.1	5.6
2500-Y-5.0-100k	4.4	5.7	4.4
2500-Y-10.0-75k	9.9	12.2	10.0
2500-Y-10.0-100k	8.4	10.3	8.5
2500-J-1.0-75k	3.7	10.0	3.9
2500-J-1.0-100k	2.4	6.3	2.5
2500-J-5.0-75k	6.8	18.7	7.3
2500-J-5.0-100k	5.4	14.7	5.7
2500-J-10.0-75k	13.5	35.7	14.3
2500-J-10.0-100k	11.3	29.9	11.9
2500-H-1.0-75k	3.3	6.5	3.4
2500-H-1.0-100k	2.3	4.4	2.4
2500-H-5.0-75k	5.5	11.0	5.7
2500-H-5.0-100k	4.4	8.7	4.5
2500-H-10.0-75k	10.7	21.9	11.1
2500-H-10.0-100k	9.0	18.3	9.3
2500-K-1.0-75k	3.8	11.8	4.0
2500-K-1.0-100k	2.6	8.0	2.7
2500-K-5.0-75k	6.5	20.5	6.9
2500-K-5.0-100k	5.1	16.2	5.5
2500-K-10.0-75k	12.8	39.8	13.7

Table A.2: continued.

Simulation	σ_{RV} (Cond. 1)	σ_{RV} (Cond. 2)	σ_{RV} (Cond. 3)
2500-K-10.0-100k	10.8	33.4	11.5

Table A.3: RV precisions calculated for the SPIRou ETC. Same simulations as Table A.1 but with the SNR relative to the centre of each individual band.

Simulation (T_{eff}-Band-$v.sini$-R)	σ_{RV} (Cond. 1) [m/s]	σ_{RV} (Cond. 2) [m/s]	σ_{RV} (Cond. 3) [m/s]
3900-Z-1.0-60k	9.9	16.0	10.3
3900-Z-1.0-80k	6.6	10.7	6.8
3900-Z-1.0-100k	4.9	8.1	5.1
3900-Z-5.0-60k	14.5	23.2	15.0
3900-Z-5.0-80k	11.2	18.0	11.6
3900-Z-5.0-100k	9.4	15.2	9.7
3900-Z-10.0-60k	25.0	39.4	25.8
3900-Z-10.0-80k	20.7	32.9	21.4
3900-Z-10.0-100k	18.1	28.8	18.7
3900-Y-1.0-60k	10.0	11.9	10.1
3900-Y-1.0-80k	6.2	7.4	6.3
3900-Y-1.0-100k	4.4	5.3	4.5
3900-Y-5.0-60k	15.9	19.0	16.1
3900-Y-5.0-80k	12.0	14.3	12.1
3900-Y-5.0-100k	10.0	11.8	10.1
3900-Y-10.0-60k	31.6	37.8	32.0
3900-Y-10.0-80k	25.8	30.8	26.1
3900-Y-10.0-100k	22.4	26.7	22.6
3900-J-1.0-60k	15.7	41.7	16.6
3900-J-1.0-80k	10.5	26.9	11.0
3900-J-1.0-100k	7.9	19.6	8.3
3900-J-5.0-60k	22.7	63.6	24.0
3900-J-5.0-80k	17.5	48.1	18.5
3900-J-5.0-100k	14.8	40.3	15.6
3900-J-10.0-60k	38.6	122.9	41.0
3900-J-10.0-80k	32.0	100.7	34.0
3900-J-10.0-100k	28.0	87.6	29.8
3900-H-1.0-60k	7.3	11.5	7.4
3900-H-1.0-80k	5.1	8.1	5.2
3900-H-1.0-100k	4.0	6.4	4.1
3900-H-5.0-60k	10.2	16.0	10.4
3900-H-5.0-80k	7.9	12.5	8.1
3900-H-5.0-100k	6.7	10.5	6.8

Table A.3: continued.

Simulation	σ_{RV} (Cond. 1)	σ_{RV} (Cond. 2)	σ_{RV} (Cond. 3)
3900-H-10.0-60k	17.5	27.3	17.9
3900-H-10.0-80k	14.5	22.7	14.8
3900-H-10.0-100k	12.7	19.8	13.0
3900-K-1.0-60k	10.5	46.3	11.3
3900-K-1.0-80k	7.1	31.8	7.6
3900-K-1.0-100k	5.4	24.5	5.8
3900-K-5.0-60k	15.7	65.4	16.8
3900-K-5.0-80k	12.0	50.8	12.8
3900-K-5.0-100k	10.1	42.9	10.8
3900-K-10.0-60k	28.5	112.6	30.4
3900-K-10.0-80k	23.6	93.1	25.2
3900-K-10.0-100k	20.6	81.2	22.0
3500-Z-1.0-60k	8.3	13.7	8.6
3500-Z-1.0-80k	5.2	8.7	5.4
3500-Z-1.0-100k	3.7	6.3	3.8
3500-Z-5.0-60k	12.9	20.9	13.3
3500-Z-5.0-80k	9.8	16.0	10.1
3500-Z-5.0-100k	8.2	13.4	8.5
3500-Z-10.0-60k	24.0	38.1	24.8
3500-Z-10.0-80k	19.7	31.5	20.4
3500-Z-10.0-100k	17.2	27.5	17.7
3500-Y-1.0-60k	8.7	10.3	8.8
3500-Y-1.0-80k	5.3	6.3	5.4
3500-Y-1.0-100k	3.7	4.5	3.8
3500-Y-5.0-60k	14.1	16.7	14.3
3500-Y-5.0-80k	10.6	12.5	10.7
3500-Y-5.0-100k	8.8	10.4	8.9
3500-Y-10.0-60k	28.5	33.9	28.8
3500-Y-10.0-80k	23.2	27.6	23.5
3500-Y-10.0-100k	20.1	23.9	20.3
3500-J-1.0-60k	15.1	38.4	15.9
3500-J-1.0-80k	9.8	24.0	10.3
3500-J-1.0-100k	7.1	17.1	7.5
3500-J-5.0-60k	22.5	60.2	23.8
3500-J-5.0-80k	17.3	45.4	18.3
3500-J-5.0-100k	14.5	37.8	15.3
3500-J-10.0-60k	39.9	117.8	42.4
3500-J-10.0-80k	33.0	96.4	35.1
3500-J-10.0-100k	28.8	83.7	30.6
3500-H-1.0-60k	7.6	12.2	7.8

Table A.3: continued.

Simulation	σ_{RV} (Cond. 1)	σ_{RV} (Cond. 2)	σ_{RV} (Cond. 3)
3500-H-1.0-80k	5.4	8.7	5.5
3500-H-1.0-100k	4.2	6.9	4.3
3500-H-5.0-60k	10.5	16.7	10.7
3500-H-5.0-80k	8.2	13.1	8.4
3500-H-5.0-100k	6.9	11.1	7.1
3500-H-10.0-60k	17.6	28.0	18.1
3500-H-10.0-80k	14.6	23.3	15.0
3500-H-10.0-100k	12.8	20.4	13.1
3500-K-1.0-60k	9.9	35.8	10.6
3500-K-1.0-80k	6.6	24.0	7.0
3500-K-1.0-100k	5.0	18.2	5.3
3500-K-5.0-60k	14.8	52.3	15.8
3500-K-5.0-80k	11.3	40.2	12.1
3500-K-5.0-100k	9.5	33.8	10.1
3500-K-10.0-60k	27.2	92.1	29.1
3500-K-10.0-80k	22.5	76.0	24.0
3500-K-10.0-100k	19.6	66.3	20.9
2800-Z-1.0-60k	3.8	7.3	3.9
2800-Z-1.0-80k	2.3	4.5	2.4
2800-Z-1.0-100k	1.6	3.2	1.7
2800-Z-5.0-60k	6.1	11.6	6.4
2800-Z-5.0-80k	4.6	8.8	4.8
2800-Z-5.0-100k	3.8	7.3	4.0
2800-Z-10.0-60k	12.2	22.8	12.7
2800-Z-10.0-80k	9.9	18.7	10.4
2800-Z-10.0-100k	8.6	16.2	9.0
2800-Y-1.0-60k	5.6	7.1	5.7
2800-Y-1.0-80k	3.6	4.7	3.7
2800-Y-1.0-100k	2.6	3.4	2.7
2800-Y-5.0-60k	8.3	10.1	8.4
2800-Y-5.0-80k	6.4	7.9	6.5
2800-Y-5.0-100k	5.4	6.7	5.5
2800-Y-10.0-60k	13.8	16.4	13.9
2800-Y-10.0-80k	11.4	13.7	11.6
2800-Y-10.0-100k	10.0	12.0	10.1
2800-J-1.0-60k	8.8	23.2	9.3
2800-J-1.0-80k	5.5	14.4	5.8
2800-J-1.0-100k	4.0	10.2	4.2
2800-J-5.0-60k	13.5	35.9	14.3
2800-J-5.0-80k	10.3	27.3	10.9

Table A.3: continued.

Simulation	σ_{RV} (Cond. 1)	σ_{RV} (Cond. 2)	σ_{RV} (Cond. 3)
2800-J-5.0-100k	8.6	22.8	9.1
2800-J-10.0-60k	24.3	63.8	25.7
2800-J-10.0-80k	20.1	52.9	21.2
2800-J-10.0-100k	17.5	46.1	18.5
2800-H-1.0-60k	6.5	12.6	6.8
2800-H-1.0-80k	4.4	8.5	4.6
2800-H-1.0-100k	3.3	6.4	3.5
2800-H-5.0-60k	9.6	18.3	9.9
2800-H-5.0-80k	7.3	14.1	7.6
2800-H-5.0-100k	6.2	11.8	6.4
2800-H-10.0-60k	17.2	33.5	17.8
2800-H-10.0-80k	14.2	27.6	14.7
2800-H-10.0-100k	12.4	24.1	12.8
2800-K-1.0-60k	6.3	20.8	6.7
2800-K-1.0-80k	4.2	13.9	4.5
2800-K-1.0-100k	3.1	10.5	3.4
2800-K-5.0-60k	9.5	30.4	10.1
2800-K-5.0-80k	7.2	23.3	7.7
2800-K-5.0-100k	6.0	19.6	6.4
2800-K-10.0-60k	17.5	53.7	18.7
2800-K-10.0-80k	14.4	44.4	15.4
2800-K-10.0-100k	12.6	38.8	13.4
2600-Z-1.0-60k	3.0	6.2	3.1
2600-Z-1.0-80k	1.8	3.8	1.9
2600-Z-1.0-100k	1.3	2.7	1.4
2600-Z-5.0-60k	4.8	9.8	5.0
2600-Z-5.0-80k	3.6	7.4	3.8
2600-Z-5.0-100k	3.0	6.2	3.2
2600-Z-10.0-60k	9.5	19.2	9.9
2600-Z-10.0-80k	7.7	15.7	8.1
2600-Z-10.0-100k	6.7	13.6	7.1
2600-Y-1.0-60k	4.4	5.8	4.5
2600-Y-1.0-80k	2.8	3.8	2.9
2600-Y-1.0-100k	2.0	2.7	2.1
2600-Y-5.0-60k	6.5	8.2	6.6
2600-Y-5.0-80k	5.1	6.4	5.1
2600-Y-5.0-100k	4.3	5.4	4.3
2600-Y-10.0-60k	10.7	12.9	10.8
2600-Y-10.0-80k	8.9	10.8	9.0
2600-Y-10.0-100k	7.8	9.5	7.9

Table A.3: continued.

Simulation	σ_{RV} (Cond. 1)	σ_{RV} (Cond. 2)	σ_{RV} (Cond. 3)
2600-J-1.0-60k	6.4	17.1	6.8
2600-J-1.0-80k	4.0	10.5	4.2
2600-J-1.0-100k	2.8	7.4	3.0
2600-J-5.0-60k	10.0	26.9	10.6
2600-J-5.0-80k	7.6	20.4	8.0
2600-J-5.0-100k	6.3	17.0	6.7
2600-J-10.0-60k	18.1	47.2	19.1
2600-J-10.0-80k	15.0	39.2	15.8
2600-J-10.0-100k	13.0	34.2	13.8
2600-H-1.0-60k	5.2	10.3	5.4
2600-H-1.0-80k	3.5	6.9	3.6
2600-H-1.0-100k	2.7	5.2	2.8
2600-H-5.0-60k	7.7	15.3	8.0
2600-H-5.0-80k	5.9	11.7	6.1
2600-H-5.0-100k	5.0	9.8	5.2
2600-H-10.0-60k	13.9	28.4	14.5
2600-H-10.0-80k	11.5	23.3	11.9
2600-H-10.0-100k	10.0	20.4	10.4
2600-K-1.0-60k	5.0	16.2	5.3
2600-K-1.0-80k	3.3	10.7	3.5
2600-K-1.0-100k	2.5	8.0	2.6
2600-K-5.0-60k	7.4	23.9	7.9
2600-K-5.0-80k	5.7	18.3	6.1
2600-K-5.0-100k	4.8	15.4	5.1
2600-K-10.0-60k	13.7	42.5	14.6
2600-K-10.0-80k	11.3	35.1	12.1
2600-K-10.0-100k	9.9	30.7	10.5

Bibliography

Adibekyan, V. Z., Sousa, S. G., Santos, N. C., Mena, E. D., Hernández, J. I. G., Israelian, G., Mayor, M., and Khachatryan, G.: 2012, *Astronomy and Astrophysics* **5**45, A32

Allard, F.: 2013, *Proceedings of the International Astronomical Union* **8**(S299), 271, 00007

Allard, F., Homeier, D., and Freytag, B.: 2010, *arXiv:1011.5405 [astro-ph]*, 00066

Andreasen, D. T., Sousa, S. G., Delgado Mena, E., Santos, N. C., Tsantaki, M., Rojas-Ayala, B., and Neves, V.: 2016, *Astronomy and Astrophysics* **5**85, A143

Artigau, E., Kouach, D., Donati, J.-F., Doyon, R., Delfosse, X., Baratchart, S., Lacombe, M., Moutou, C., Rabou, P., Parès, L. P., Micheau, Y., Thibault, S., Reshetov, V. A., Dubois, B., Hernandez, O., Vallée, P., Wang, S.-Y., Dolon, F., Pepe, F. A., Bouchy, F., Striebig, N., Hénault, F., Loop, D., Saddlemyer, L., Barrick, G., Vermeulen, T., Dupieux, M., Hébrard, G., Boisse, I., Martioli, E., Alencar, S. H. P., do Nascimento, J.-D., and Figueira, P.: 2014, in *Proc.SPIE*, Vol. 9147, p. 914715, International Society for Optics and Photonics, 00047

Artigau, E., Malo, L., Doyon, R., Figueira, P., Delfosse, X., and Astudillo-Defru, N.: 2018, *The Astronomical Journal* **1**55, 198

Asplund, M., Grevesse, N., Sauval, A. J., and Scott, P.: 2009, *Annual Review of Astronomy and Astrophysics* **4**7, 481

Astudillo-Defru, N., Bonfils, X., Delfosse, X., Ségransan, D., Forveille, T., Bouchy, F., Gillon, M., Lovis, C., Mayor, M., Neves, V., Pepe, F., Perrier, C., Queloz, D., Rojo, P., Santos, N. C., and Udry, S.: 2015, *Astronomy and Astrophysics* **5**75, A119

Baraffe, I., Chabrier, G., Barman, T., Allard, F., and Hauschildt, P. H.: 2003, *Astronomy and Astrophysics* **4**02(2), 701, 00000

Baraffe, I., Homeier, D., Allard, F., and Chabrier, G.: 2015, *Astronomy and Astrophysics* **5**77, A42, 00280

Barnes, J. R., Barman, T. S., Jones, H. R. A., Leigh, C. J., Cameron, A. C., Barber, R. J., and Pinfield, D. J.: 2008, *Monthly Notices of the Royal Astronomical Society* **3**90(3), 1258

Barros, S. C. C., Gosselin, H., Lillo-Box, J., Bayliss, D., Mena, E. D., Brugger, B., Santerne, A., Armstrong, D. J., Adibekyan, V., Armstrong, J. D., Barrado, D., Bento, J., Boisse, I., Bonomo, A. S., Bouchy, F., Brown, D. J. A., Cochran, W. D., Cameron, A. C., Deleuil, M., Demangeon, O., Díaz, R. F., Doyle, A., Dumusque, X., Ehrenreich, D., Espinoza, N., Faedi, F., Faria, J. P., Figueira, P., Foxell, E., Hébrard, G., Hojjatpanah, S., Jackman, J., Lendl, M., Ligi, R., Lovis, C., Melo, C., Mousis, O., Neal, J. J., Osborn, H. P., Pollacco, D., Santos, N. C., Sefako, R., Shporer, A., Sousa, S. G., Triaud, A. H. M. J., Udry, S., Vigan, A., and Wyttenbach, A.: 2017, *Astronomy & Astrophysics* **6**08, A25

Bean, J. L., Miller-Ricci Kempton, E., and Homeier, D.: 2010, *Nature* **4**68, 669, 00283

Benedict, G. F. and Harrison, T. E.: 2017, *The Astronomical Journal* **1**53, 258

Bertaux, J. L., Lallement, R., Ferron, S., Boonne, C., and Bodichon, R.: 2014, *Astronomy and Astrophysics* **5**64, A46, 00041

Bevington, P. R. and Robinson, D. K.: 2003, *Data Reduction and Error Analysis for the Physical Sciences*, McGraw-Hill, p.g. 208-212

Birkby, J. L., de Kok, R. J., Brogi, M., Schwarz, H., and Snellen, I. a. G.: 2017, *The Astronomical Journal* **1**53(3), 138

Bonfanti, A., Ortolani, S., and Nascimbeni, V.: 2016, *Astronomy and Astrophysics* **5**85, A5

Bouchy, F., Doyon, R., Artigau, E., Melo, C., Hernandez, O., Wildi, F., Delfosse, X., Lovis, C., Figueira, P., Canto Martins, B. L., González Hernández, J. I., Thibault, S., Reshetov, V., Pepe, F., Santos, N. C., de Medeiros, J. R., Rebolo, R., Abreu, M., Adibekyan, V. Z., Bandy, T., Benz, W., Blind, N., Bohlender, D., Boisse, I., Bovay, S., Broeg, C., Brousseau, D., Cabral, A., Chazelas, B., Cloutier, R., Coelho, J., Conod, U., Cumming, A., Delabre, B., Genolet, L., Hagelberg, J., Jayawardhana, R., Käufl, H.-U., Lafrenière, D., de Castro Leão, I., Malo, L., de Medeiros Martins, A., Matthews, J. M., Metchev, S., Oshagh, M., Ouellet, M., Parro, V. C., Rasilla Piñeiro, J. L., Santos, P., Sarajlic, M., Segovia, A., Sordet, M., Udry, S., Valencia, D., Vallée, P., Venn, K., Wade, G. A., and Saddlemyer, L.: 2017, *The Messenger* **1**69, 21, 00000

Bouchy, F., Pepe, F., and Queloz, D.: 2001, *Astronomy and Astrophysics* **3**74(2), 733, 00258

Brogi, M., de Kok, R. J., Albrecht, S., Snellen, I. A. G., Birkby, J. L., and Schwarz, H.: 2016, *The Astrophysical Journal* **8**17(2), 106, 00000

Brogi, M., de Kok, R. J., Birkby, J. L., Schwarz, H., and Snellen, I. A. G.: 2014, *Astronomy and Astrophysics* **5**65, A124, 00000

Brogi, M., Snellen, I. A. G., de Kok, R. J., Albrecht, S., Birkby, J., and de Mooij, E. J. W.: 2012, *Nature* **4**86, 502, 00000

Burrows, A., Marley, M., Hubbard, W. B., Lunine, J. I., Guillot, T., Saumon, D., Freedman, R., Sudarsky, D., and Sharp, C.: 1997, *The Astrophysical Journal* **4**91, 856

Chabrier, G. and Baraffe, I.: 2000, *Annual Review of Astronomy and Astrophysics* **3**8(1), 337, 00483

Chen, J. and Kipping, D. M.: 2016, *The Astrophysical Journal* **8**34(1), 17

Ciddor, P. E.: 1996, *Applied Optics* **3**5(9), 1566

Clough, S. A. and Iacono, M. J.: 1995, *Journal of Geophysical Research: Atmospheres* **1**00(D8), 16519, 00002

Collaboration, G., Brown, A. G. A., Vallenari, A., Prusti, T., Bruijne, D., J, J. H., Babusiaux, C., and Bailer-Jones, C. a. L.: 2018, *ArXiv e-prints* p. arXiv:1804.09365

Connes, P.: 1985, *Astrophysics and Space Science* **1**10(2), 211

Connes, P., Martic, M., and Schmitt, J.: 1996, *Astrophysics and Space Science* **2**41(1), 61

Correia, A. C. M., Udry, S., Mayor, M., Laskar, J., Naef, D., Pepe, F., Queloz, D., and Santos, N. C.: 2005, *aap* **4**40, 751, 00000

Cotton, D. V., Bailey, J., and Kedziora-Chudczer, L.: 2014, *Monthly Notices of the Royal Astronomical Society* **4**39, 387, 00007

Crepp, J. R., Gonzales, E. J., Bechter, E. B., Montet, B. T., Johnson, J. A., Piskorz, D., Howard, A. W., and Isaacson, H.: 2016, *The Astrophysical Journal* 831, 00004

Czekala, I., Andrews, S. M., Mandel, K. S., Hogg, D. W., and Green, G. M.: 2015, *The Astrophysical Journal* **8**12(2), 128, 00022

Czesla, S., Molle, T., and Schmitt, J. H. M. M.: 2018, *Astronomy and Astrophysics* **6**09, A39

de Kok, R. J., Brogi, M., Snellen, I. A., Birkby, J., Albrecht, S., and de Mooij, E. J.: 2013, *Astronomy and Astrophysics* **5**54, A82, 00086

Deeg, H.: 1998, in *Brown Dwarfs and Extrasolar Planets*, Vol. 134 of *ASP Conference Series #134*, p. 216

Dorn, R. J., Finger, G., Huster, G., Kaeufl, H.-U., Lizon, J.-L., Mehrgan, L., Meyer, M., Pirard, J.-F., Silber, A., Stegmeier, J., and Moorwood, A. F. M.: 2004, in *Optical and Infrared Detectors for Astronomy*, Vol. 5499, pp 510–518, International Society for Optics and Photonics

Dorn, R. J., Follert, R., Bristow, P., Cumani, C., Eschbaumer, S., Grunhut, J., Haimerl, A., Hatzes, A., Heiter, U., and Hinterschuster, R.: 2016, in *Ground-Based and Airborne Instrumentation for Astronomy VI*, Vol. 9908, p. 99080I, International Society for Optics and Photonics, 00002

Edlén, B.: 1953, *JOSA* **4**3(5), 339

ESO: 2017, *ESO Call for Proposals - P101*

Ferluga, S., Floreano, L., Bravar, U., and Bédalo, C.: 1997, *Astronomy and Astrophysics Supplement Series* **1**21(1), 201, 00012

Figueira, P., Adibekyan, V. Z., Oshagh, M., Neal, J. J., Rojas-Ayala, B., Lovis, C., Melo, C., Pepe, F., Santos, N. C., and Tsantaki, M.: 2016, *Astronomy and Astrophysics* **5**86, A101, 00002

Figueira, P. and Neves, S.: 2015, *Astro Homus*, CAUP

Figueira, P., Pepe, F., Melo, C. H. F., Santos, N. C., Lovis, C., Mayor, M., Queloz, D., Smette, A., and Udry, S.: 2010, *Astronomy and Astrophysics* **5**11, A55, 00057

Freudling, W., Romaniello, M., Bramich, D. M., Ballester, P., Forchi, V., García-Dabló, C. E., Moehler, S., and Neeser, M. J.: 2013, *Astronomy and Astrophysics* **5**59, A96

Gray, D. F.: 2005, *The Observation and Analysis of Stellar Photospheres*, Cambridge University Press, 3 edition

Gullikson, K., Dodson-Robinson, S., and Kraus, A.: 2014, *The Astronomical Journal* **1**48(3), 53, 00015

Hadrava, P.: 2009, *arXiv:0909.0172 [astro-ph]*, 00013

Halbwachs, J.-L., Arenou, F., Mayor, M., Udry, S., and Queloz, D.: 2000, *Astronomy and Astrophysics* **3**55, 581, 00198

Hatzes, A. P. and Cochran, W. D.: 1992, Vol. 40, p. 275

Hatzes, A. P. and Rauer, H.: 2015, *The Astrophysical Journal Letters* **8**10, L25

Hoeijmakers, H. J., Kok, D., J, R., Snellen, I. a. G., Brogi, M., Birkby, J. L., and Schwarz, H.: 2015, *Astronomy and Astrophysics* **5**75, A20

Horne, K.: 1986, *Publications of the Astronomical Society of the Pacific* **9**8, 609, 01548

Husser, T.-O., von Berg, S. W., Dreizler, S., Homeier, D., Reiners, A., Barman, T., and Hauschildt, P. H.: 2013, *Astronomy and Astrophysics* **5**53, A6, 00243

Kaeufl, H.-U., Ballester, P., Biereichel, P., Delabre, B., Donaldson, R., Dorn, R., Fedrigo, E., Finger, G., Fischer, G., Franza, F., Gojak, D., Huster, G., Jung, Y., Lizon, J.-L., Mehrgan, L., Meyer, M., Moorwood, A., Pirard, J.-F., Paufique, J., Pozna, E., Siebenmorgen, R., Silber, A., Stegmeier, J., and Wegerer, S.: 2004, *Ground-based Instrumentation for Astronomy* **5**492, 1218, 00000

Kerber, F., Nave, G., Sansonetti, C. J., and Bristow, P.: 2009, *Physica Scripta* **2**009(T134), 014007, 00009

Kolbl, R., Marcy, G. W., Isaacson, H., and Howard, A. W.: 2015, *The Astronomical Journal* **1**49, 18

Kostogryz, N., Kürster, M., Yakobchuk, T., Lyubchik, Y., and Kuznetsov, M.: 2013, *Astronomische Nachrichten* **3**34(7), 648, 00000

Ku, H. H.: 1966, *Notes on the Use of Propagation of Error Formulas*, National Bureau of Standards

Lillo-Box, J., Leleu, A., Parviainen, H., Figueira, P., Mallonn, M., Correia, A. C. M., Santos, N. C., Robutel, P., Lendl, M., Boffin, H. M. J., Faria, J. P., Barrado, D., and Neal, J.: 2018, *arXiv:1807.00773 [astro-ph]*

Maldonado, J. and Villaver, E.: 2017, *Astronomy and Astrophysics* **6**02, A38

Martins, J. H. C., Santos, N. C., Figueira, P., Faria, J. P., Montalto, M., Boisse, I., Ehrenreich, D., Lovis, C., Mayor, M., Melo, C., Pepe, F., Sousa, S. G., Udry, S., and Cunha, D.: 2015, *Astronomy and Astrophysics* **5**76, A134

Mathar, R. J.: 2007, *Journal of Optics A: Pure and Applied Optics* **9**(5), 470

Mayor, M. and Queloz, D.: 1995, *Nature* **3**78(6555), 355

Meier, R. J.: 2005, *Vibrational Spectroscopy* **3**9(2), 266

Moutou, C., Vigan, A., Mesa, D., Desidera, S., Thébault, P., Zurlo, A., and Salter, G.: 2017, *Astronomy and Astrophysics* **6**02, A87, 00001

Murray, C. D. and Correia, A. C. M.: 2010, in S. Seager (ed.), *Exoplanets*, pp 15–23, University of Arizona Press, 00000

Nemravová, J. A., Harmanec, P., Brož, M., Vokrouhlický, D., Mourard, D., Hummel, C. A., Cameron, C., Matthews, J. M., Bolton, C. T., Božić, H., Chini, R., Dembsky, T., Engle, S., Farrington, C., Grunhut, J. H., Guenther, D. B., Guinan, E. F., Korčáková, D., Koubský, P., Kříček, R., Kuschnig, R., Mayer, P., McCook, G. P., Moffat, A. F. J., Nardetto, N., Prša, A., Ribeiro, J., Rowe, J., Rucinski, S., Škoda, P., Šlechta, M., Tallon-Bosc, I., Votruba, V., Weiss, W. W., Wolf, M., Zasche, P., and Zavala, R. T.: 2016, *Astronomy and Astrophysics* **5**94, A55

Nicholls, C. P., Lebzelter, T., Smette, A., Wolff, B., Hartman, H., Käufl, H.-U., Przybilla, N., Ramsay, S., Uttenthaler, S., Wahlgren, G. M., and others: 2017, *Astronomy and Astrophysics* **5**98, A79, 00000

Passegger, V. M., Berg, S. W.-v., and Reiners, A.: 2016, *Astronomy and Astrophysics* **5**87, A19, 00006

Peck, E. R. and Reeder, K.: 1972, *JOSA* **6**2(8), 958

Pilyavsky, G., Mahadevan, S., Kane, S. R., Howard, A. W., Ciardi, D. R., de Pree, C., Dragomir, D., Fischer, D., Henry, G. W., Jensen, E. L. N., Laughlin, G., Marlowe, H., Rabus, M., von Braun, K., Wright, J. T., and Wang, X. X.: 2011, *apj* **7**43, 162, 00014

Piskorz, D., Benneke, B., Crockett, N. R., Lockwood, A. C., Blake, G. A., Barman, T. S., Bender, C. F., Bryan, M. L., Carr, J. S., Fischer, D. A., Howard, A. W., Isaacson, H., and Johnson, J. A.: 2016, *The Astrophysical Journal* **8**32(2), 131

Piskunov, N. E. and Valenti, J. A.: 2002, *Astronomy and Astrophysics* **3**85(3), 1095, 00257

Quarteroni, A., Sacco, R., and Saleri, F.: 2000, *Numerical Mathematics*, No. 37 in Texts in applied mathematics, Springer, New York

Quirrenbach, A., Amado, P. J., Caballero, J. A., Mundt, R., Reiners, A., Ribas, I., Seifert, W., Abril, M., Aceituno, J., Alonso-Floriano, F. J., Ammler-von Eiff, M., Antona Jiménez, R., Anwand-Heerwart, H., Azzaro, M., Bauer, F., Barrado, D., Becerril, S., Béjar, V. J. S., Benítez, D., Berdiñas, Z. M., Cárdenas, M. C., Casal, E., Claret, A., Colomé, J., Cortés-Contreras, M., Czesla, S., Doellinger, M., Dreizler, S., Feiz, C., Fernández, M., Galadí, D., Gálvez-Ortiz, M. C., García-Piquer, A., García-Vargas, M. L., Garrido, R., Gesa, L., Gómez Galera, V., González Álvarez, E., González Hernández, J. I., Grözinger, U., Guàrdia, J., Guenther, E. W., de Guindos, E., Gutiérrez-Soto, J., Hagen, H.-J., Hatzes, A. P., Hauschildt, P. H., Helmling, J., Henning, T., Hermann, D., Hernández Castaño, L., Herrero, E., Hidalgo, D., Holgado, G., Huber, A., Huber, K. F., Jeffers, S., Joergens, V., de Juan, E., Kehr, M., Klein, R., Kürster, M., Lamert, A., Lalitha, S., Laun, W., Lemke, U., Lenzen, R., López del Fresno, M., López Martí, B., López-Santiago, J., Mall, U., Mandel, H., Martín, E. L., Martín-Ruiz, S., Martínez-Rodríguez, H., Marvin, C. J., Mathar, R. J., Mirabet, E., Montes, D., Morales Muñoz, R., Moya, A., Naranjo, V., Ofir, A., Oreiro, R., Pallé, E., Panduro, J., Passegger, V.-M., Pérez-Calpena, A., Pérez Medialdea, D., Perger, M., Pluto, M., Ramón, A., Rebolo, R., Redondo, P., Reffert, S., Reinhardt, S., Rhode, P., Rix, H.-W., Rodler, F., Rodríguez, E., Rodríguez-López, C., Rodríguez-Pérez, E., Rohloff, R.-R., Rosich, A., Sánchez-Blanco, E., Sánchez Carrasco, M. A., Sanz-Forcada, J., Sarmiento, L. F., Schäfer, S., Schiller, J., Schmidt, C., Schmitt, J. H. M. M., Solano, E., Stahl, O., Storz, C., Stürmer, J., Suárez, J. C., Ulbrich, R. G., Veredas, G., Wagner, K., Winkler, J., Zapatero Osorio, M. R., Zechmeister, M., Abellán de Paco, F. J., Anglada-Escudé, G., del Burgo, C., Klutsch, A., Lizon, J. L., López-Morales, M., Morales, J. C., Perryman, M. A. C., Tulloch, S. M., and Xu, W.: 2014, in *Prococeedings of SPIE: Ground-Based and Airborne Instrumentation for Astronomy V*, Vol. 9147, p. 91471F

Rodler, F., Lopez-Morales, M., and Ribas, I.: 2012, *The Astrophysical Journal Letters* **7**53(1), L25, 00077

Rothman, L., Gordon, I., Babikov, Y., Barbe, A., Chris Benner, D., Bernath, P., Birk, M., Bizzocchi, L., Boudon, V., Brown, L., Campargue, A., Chance, K., Cohen, E., Coudert, L., Devi, V., Drouin, B., Fayt, A., Flaud, J.-M., Gamache, R., Harrison, J., Hartmann, J.-M., Hill, C., Hodges, J., Jacquemart, D., Jolly, A., Lamouroux, J., Le Roy, R., Li, G., Long, D., Lyulin, O., Mackie, C., Massie, S., Mikhailenko, S., Müller, H., Naumenko, O., Nikitin, A., Orphal, J., Perevalov, V., Perrin, A., Polovtseva, E., Richard, C., Smith, M., Starikova, E., Sung, K., Tashkun, S., Tennyson, J., Toon, G., Tyuterev, V., and Wagner, G.: 2013, *Journal of Quantitative Spectroscopy and Radiative Transfer* **1**30, 4, 01706

Rothman, L., Gordon, I., Barbe, A., Benner, D., Bernath, P., Birk, M., Boudon, V., Brown, L., Campargue, A., Champion, J.-P., Chance, K., Coudert, L., Dana, V., Devi, V., Fally, S., Flaud, J.-M., Gamache, R., Goldman, A., Jacquemart, D., Kleiner, I., Lacome, N., Lafferty, W., Mandin, J.-Y., Massie, S., Mikhailenko, S., Miller, C., Moazzen-Ahmadi, N., Naumenko, O., Nikitin, A., Orphal, J., Perevalov, V., Perrin, A., Predoi-Cross, A., Rinsland, C., Rotger, M., Šimečková, M., Smith, M., Sung, K., Tashkun, S., Tennyson, J., Toth, R., Vandaele, A., and Vander Auwera, J.: 2009, *Journal of Quantitative Spectroscopy and Radiative Transfer* **1**10(9-10), 533, 00000

Sahlmann, J., Segransan, D., Queloz, D., Udry, S., Santos, N. C., Marmier, M., Mayor, M., Naef, D., Pepe, F., and Zucker, S.: 2011, *Astronomy and Astrophysics* **5**25, A95, 00115

Santerne, A., Brugger, B., Armstrong, D. J., Adibekyan, V., Lillo-Box, J., Gosselin, H., Aguichine, A., Almenara, J.-M., Barrado, D., Barros, S. C. C., Bayliss, D., Boisse, I., Bonomo, A. S., Bouchy, F., Brown, D. J. A., Deleuil, M., Mena, E. D., Demangeon, O., Díaz, R. F., Doyle, A., Dumusque, X., Faedi, F., Faria, J. P., Figueira, P., Foxell, E., Giles, H., Hébrard, G., Hojjatpanah, S., Hobson, M., Jackman, J., King, G., Kirk, J., Lam, K. W. F., Ligi, R., Lovis, C., Louden, T., McCormac, J., Mousis, O., Neal, J. J., Osborn, H. P., Pepe, F., Pollacco, D., Santos, N. C., Sousa, S. G., Udry, S., and Vigan, A.: 2018, *Nature Astronomy* **2**(5), 393

Santerne, A., Díaz, R. F., Moutou, C., Bouchy, F., Hébrard, G., Almenara, J.-M., Bonomo, A. S., Deleuil, M., and Santos, N. C.: 2012, *Astronomy and Astrophysics* **5**45, A76

Santos, N. C., Adibekyan, V., Figueira, P., Andreasen, D. T., Barros, S. C. C., Delgado-Mena, E., Demangeon, O., Faria, J. P., Oshagh, M., Sousa, S. G., Viana, P. T. P., and Ferreira, A. C. S.: 2017, *Astronomy and Astrophysics* **6**03, A30, 00001

Santos, N. C., Israelian, G., and Mayor, M.: 2004, *aap* **4**15, 1153, 00000

Santos, N. C., Israelian, G., Mayor, M., Bento, J. P., Almeida, P. C., Sousa, S. G., and Ecuvillon, A.: 2005, *aap* **4**37, 1127, 00000

Schlaufman, K. C.: 2018, *The Astrophysical Journal* **8**53, 37

Schwarz, G.: 1978, *The Annals of Statistics* **6**(2), 461

Seifahrt, A., Käufl, H. U., Zängl, G., Bean, J. L., Richter, M. J., and Siebenmorgen, R.: 2010, *Astronomy and Astrophysics* **5**24, A11

Skrutskie, M. F., Cutri, R. M., Stiening, R., Weinberg, M. D., Schneider, S., Carpenter, J. M., Beichman, C., Capps, R., Chester, T., Elias, J., Huchra, J., Liebert, J., Lonsdale, C., Monet, D. G., Price, S., Seitzer, P., Jarrett, T., Kirkpatrick, J. D., Gizis, J. E., Howard, E., Evans, T., Fowler, J., Fullmer, L., Hurt, R., Light, R., Kopan, E. L., Marsh, K. A., McCallon, H. L., Tam, R., Van Dyk, S., and Wheelock, S.: 2006, *The Astronomical Journal* **1**31, 1163

Smette, A., Sana, H., Noll, S., Horst, H., Kausch, W., Kimeswenger, S., Barden, M., Szyszka, C., Jones, A. M., Gallenne, A., Vinther, J., Ballester, P., and Taylor, J.: 2015, *Astronomy and Astrophysics* **5**76, A77, 00067

Snellen, I. A. G., Brandl, B. R., Kok, D., J, R., Brogi, M., Birkby, J., and Schwarz, H.: 2014, *Nature* **5**09, 63, 00000

Snellen, I. A. G., Kok, D., J, R., Mooij, D., W, E. J., and Albrecht, S.: 2010, *Nature* **4**65(7301), 1049

Soderblom, D. R.: 2010, *Annual Review of Astronomy and Astrophysics* **4**8, 581, 00241

Sorahana, S., Yamamura, I., and Murakami, H.: 2013, *The Astrophysical Journal* **7**67(1), 77

Sousa, S. G., Santos, N. C., Mayor, M., Udry, S., Casagrande, L., Israelian, G., Pepe, F., Queloz, D., and Monteiro, M. J. P. F. G.: 2008, *aap* **4**87, 373, 00390

Tody, D.: 1993, in R. J. Hanisch, R. J. V. Brissenden, and J. Barnes (eds.), *Astronomical Data Analysis Software and Systems II*, Vol. 52 of *Astronomical Society of the Pacific Conference Series*, p. 173, 00000

Tsantaki, M., Sousa, S. G., Adibekyan, V. Z., Santos, N. C., Mortier, A., and Israelian, G.: 2013, *aap* **5**55, A150, 00077

Udry, S., Mayor, M., Naef, D., Pepe, F., Queloz, D., Santos, N. C., and Burnet, M.: 2002, *Astronomy and Astrophysics* **3**90(1), 267, 00158

Ulmer-Moll, S., Figueira, P., Neal, J. J., Santos, N. C., and Bonnefoy, M.: 2018, *Astronomy and Astrophysics*, in review

Vacca, W. D., Cushing, M. C., and Rayner, J. T.: 2003, *Publications of the Astronomical Society of the Pacific* **1**15(805), 389, 00000

Wenger, M., Ochsenbein, F., Egret, D., Dubois, P., Bonnarel, F., Borde, S., Genova, F., Jasniewicz, G., Laloë, S., Lesteven, S., and Monier, R.: 2000, *Astronomy and Astrophysics Supplement Series* **1**43, 9

Whitworth, A., Bate, M. R., Nordlund, A., Reipurth, B., and Zinnecker, H.: 2007, *Protostars and Planets V* pp 459–476, 00087

Zechmeister, M., Reiners, A., Amado, P. J., Azzaro, M., Bauer, F. F., Béjar, V. J. S., Caballero, J. A., Guenther, E. W., Hagen, H.-J., Jeffers, S. V., Kaminski, A., Kürster, M., Launhardt, R., Montes, D., Morales, J. C., Quirrenbach, A., Reffert, S., Ribas, I., Seifert, W., Tal-Or, L., and Wolthoff, V.: 2018, *Astronomy and Astrophysics* **6**09, A12

Zucker, S. and Mazeh, T.: 2001, *The Astrophysical Journal* **5**62(1), 549, 00060