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J/ApJ/839/97 HeI 5876 & 10830{AA} EWs of solar-type stars (Andretta+, 2017)

Estimates of active region area coverage through simultaneous measurements of the He I $\{\lambda\lambda\}$ 5876 and 10830 lines.

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ADC_Keywords: Stars, G-type ; Equivalent widths ; Rotational velocities

Keywords: stars: activity ; stars: magnetic field ; stars: solar-type ;
techniques: spectroscopic

Abstract:

Simultaneous, high-quality measurements of the neutral helium triplet features at 5876{AA} and 10830{AA} in a sample of solar-type stars are presented. The observations were made with ESO telescopes at the La Silla Paranal Observatory under program ID 088.D-0028(A) and MPG Utility Run for Fiber Extended-range Optical Spectrograph 088.A-9029(A). The equivalent widths of these features combined with chromospheric models are utilized to infer the fractional area coverage, or filling factor, of magnetic regions outside of spots. We find that the majority of the sample is characterized by filling factors less than unity. However, discrepancies occur among the coolest K-type and the warmest and most rapidly rotating F-type dwarf stars. We discuss these apparently anomalous results and find that in the case of K-type stars, they are an artifact of the application of chromospheric models best suited to the Sun than to stars with significantly lower Teff. The case of the F-type rapid rotators can be explained by the measurement uncertainties of the equivalent widths, but they may also be due to a non-magnetic heating component in their atmospheres. With the exceptions noted above, preliminary results suggest that the average heating rates in the active regions are the same from one star to the other, differing in the spatially integrated, observed level of activity due to the area coverage. Hence, differences in activity in this sample are mainly due to the filling factor of active regions.

Description:

A total of 134 FEROS spectra (R=48000) of our targets (including telluric standards) were acquired on the night of UT 2011 December 6-7; spectral coverage from 3500 to 9200{AA}. The Fiber Extended-range Optical Spectrograph (FEROS) was mounted at the 2.2m Max-Planck Gesellschaft/European Southern Observatory (MPG/ESO) telescope at La Silla (Chile).

The HeI $\{\lambda\lambda\}$ 10830 spectroscopic observations were carried out on the same night as the FEROS D_3_ observations, using the CRyogenic high-resolution InfraRed Echelle Spectrograph (CRIRES), mounted at Unit Telescope 1 (Antu) of the VLT array at Cerro Paranal.

The details of the observations is given in table 1.

File Summary:

FileName	Lrecl	Records	Explanations
ReadMe	80	.	This file
table1.dat	62	134	Journal of observations for 41 HD stars
table3.dat	100	18	Helium equivalent width measurements and data for program stars: B-V<=0.5
table4.dat	100	16	Helium equivalent width measurements and data for program stars: B-V>0.5

See also:

V/50 : Bright Star Catalogue, 5th Revised Ed. (Hoffleit+, 1991)

IX/10 : ROSAT All-Sky Bright Source Catalogue (1RXS) (Voges+ 1999)
 III/244 : Catalog of Stellar Rotational Velocities (Glebocki+ 2005)
 J/A+AS/132/155 : Main-sequence and subgiants ROSAT data (Huensch+ 1998)
 J/A+AS/135/319 : ROSAT data of Nearby Stars (Huensch+ 1999)
 J/A+A/397/147 : Activity-rotation relationship in stars (Pizzolato+ 2003)
 J/A+A/493/1099 : CaII HK emission in rapidly rotating stars (Schroeder+, 2009)
 J/A+A/511/A54 : Magnetic cycles & radial-velocity for 8 stars (Santos+, 2010)
 J/A+A/542/A116 : Rotation in A-F stars (Ammeler-von Eiff+, 2012)
 J/A+A/557/L10 : Rotation periods of 12000 Kepler stars (Nielsen+, 2013)
 J/A+A/560/A4 : Rotation periods of active Kepler stars (Reinhold+, 2013)
 J/ApJS/211/24 : Rotation periods of Kepler MS stars (McQuillan+, 2014)
 J/A+A/579/A136 : HAT-P-36 and WASP-11/HAT-P-10 light curves (Mancini+, 2015)

Byte-by-byte Description of file: table1.dat

Bytes	Format	Units	Label	Explanations
1- 2	A2	---	---	[HD]
4- 9	I6	---	HD	HD number
10	A1	---	m_HD	HD component
12- 26	A15	---	SpType	MK spectral type (A0V to K2.5V) (1)
28- 31	F4.2	mag	B-V	[0.02/1] The (B-V) color index (1)
33- 34	I2	h	FEROS.h	Hour of FEROS start time; UT (2)
36- 37	I2	min	FEROS.m	Minute of FEROS start time; UT (2)
39- 40	I2	s	FEROS.s	Second of FEROS start time; UT (2)
42- 43	I2	h	CRIRES.h	? Hour of CRIRES start time; UT (2)
45- 46	I2	min	CRIRES.m	? Minute of CRIRES start time; UT (2)
48- 49	I2	s	CRIRES.s	? Second of CRIRES start time; UT (2)
51	A1	---	NodPos	[AB] CRIRES nodding position
53- 62	A10	---	Notes	Additional note(s) (3)

Note (1): From the Bright Star Catalog (Hoffleit & Jaschek 1991bsc..book....H ; see V/50) or the Simbad data base.

Note (2): The UT date for all start times is 2011 December 7.

Note (3): Note as follows:

std = telluric standards;

No A0 = CRIRES A0 off.

Byte-by-byte Description of file: table[34].dat

Bytes	Format	Units	Label	Explanations
1- 2	A2	---	---	[HD]
4- 9	I6	---	HD	HD number
10	A1	---	m_HD	HD component
12- 15	F4.2	mag	B-V	[0.3/1] B-V color index
17- 21	F5.1	km/s	vsini	[1/118] Rotational velocity (1)
23- 27	F5.2	[10-7W]	logLx	[26/30] Log of X-ray luminosity (2)
29- 32	F4.1	10-13m	WHeI5876	[3/77] HeI{lambda}5876 equivalent width
34- 36	F3.1	10-13m	e_WHeI5876	[1/7] WHeI5876 uncertainty
38- 41	F4.1	10-13m	WHeI5876c	[3/65] Corrected HeI{lambda}5876 equivalent width
43- 45	F3.1	10-13m	e_WHeI5876c	[1/8] WHeI5876c uncertainty
47- 50	F4.1	10-13m	WHeI5876b	[1/13]? Undetected stellar blends in the line profile
52- 54	F3.1	10-13m	e_WHeI5876b	[0.7/3]? WHeI5876b uncertainty
56- 60	F5.1	10-13m	W10830	[51/410]? HeI{lambda}10830 equivalent width
62- 65	F4.1	10-13m	e_W10830	[1/21]? W10830 uncertainty
67- 70	F4.1	10-13m	W10829	[12/70]? HeI{lambda}10829.1 equivalent width
72- 75	F4.1	10-13m	e_W10829	[1/16]? W10829 uncertainty
77- 80	F4.2	---	f(C)	[0.1/1]? Filling factor f for the C serie of models derived from Equation 1 (3)
82- 85	F4.2	---	e_f(C)	[0.03/0.2]? f(C) uncertainty
87- 90	F4.2	---	f(C-np)	[0.1/1]? Filling factor f for the C-np serie of models derived from Equation 1 (3)

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92- 95  F4.2  ---   e_f(C-np)  [0.02/0.2]? f(C-np) uncertainty
97-100 F4.2  ---   fmin       [0.03/1]? The minimum filling factor (4)
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Note (1): From Ammler-von Eiff & Reiners (2012, J/A+A/542/A116) when available, otherwise from Glebocki & Gnacinski (2005, III/244) or (HD 48189A) from Schroder et al. (2009, J/A+A/493/1099).

Note (2): From Hunsch et al. (1999, J/A+AS/135/319).

Note (3): The two series of theoretical models, labeled C and C-np, are described in Section 2.1 and shown in Figure 4.

Equation 1 (in Section 2):

$W_{\text{obs}} = (1-f)W_{\text{q}} + f.W_{\text{a}}$ where W_{obs} is the observed equivalent width of a line, W_{q} is the contributions from the quiescent atmosphere and W_{a} the active (plage-like) atmosphere.

Note (4): The minimum filling factor from Equation 2 obtained from the measurement of the $\lambda 10830$ line only. Equation 2 (in Section 2): $f \geq (W_{\text{obs}} - W_{\text{q}}) / (W_{\text{max}} - W_{\text{q}})$ with W_{obs} , the observed equivalent width of a line and W_{q} the contributions from the quiescent atmosphere.

History:

From electronic version of the journal

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(End)                               Prepared by [AAS], Emmanuelle Perret [CDS]    30-Nov-2017

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