MEGASTAR
MEGARA-GTC stellar spectral library

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20.05.22

MEGASTAR

An empirical library

For the correct interpretation of the stellar content of more complex systems
(e.g. galaxies and star clusters) observed with MEGARA

Spectra → to stellar populations synthesis models **HR-py-PopStar** Mollá, García-Vargas,
High Resolution-Python -PopStar   & Bressan 2009
                                                                   Martín-Manjón et al. 2010
                                                                   García-Vargas et al. 2013,
                                                                   Millán-Irigoyen et al. 2020

MEGASTAR

MEGARA efficiency & GTC collecting area
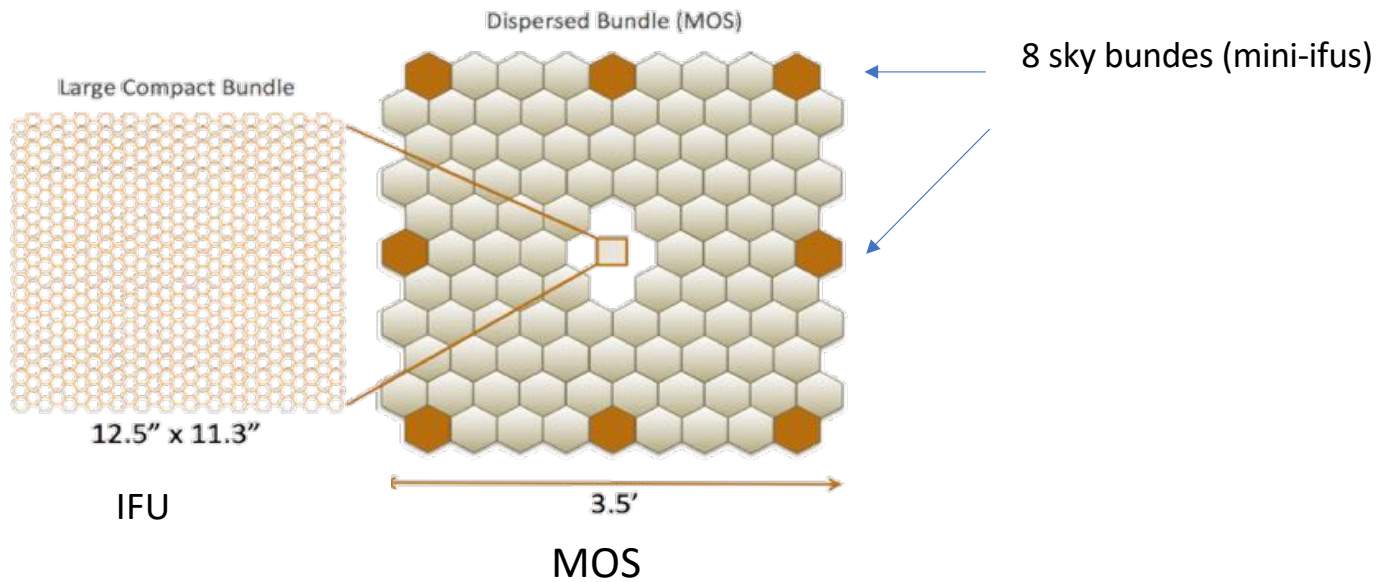MEGARA deserves its own library

MUSE-**VLT** (Ivanov et al. 2019), with 35 spectra for XSL stars
X-shooter/**VLT**, XSL (Chen et al. 2014, DR1 with 237 stars, Gonneau et al. 2020, DR2, 666 stars)

IRCS in **Subaru** (Nhuyen Le et al. 2011)

GNIRS and NIFS in **Gemin**i (Winge, Riffe and Storchi-Bergmann 2009)
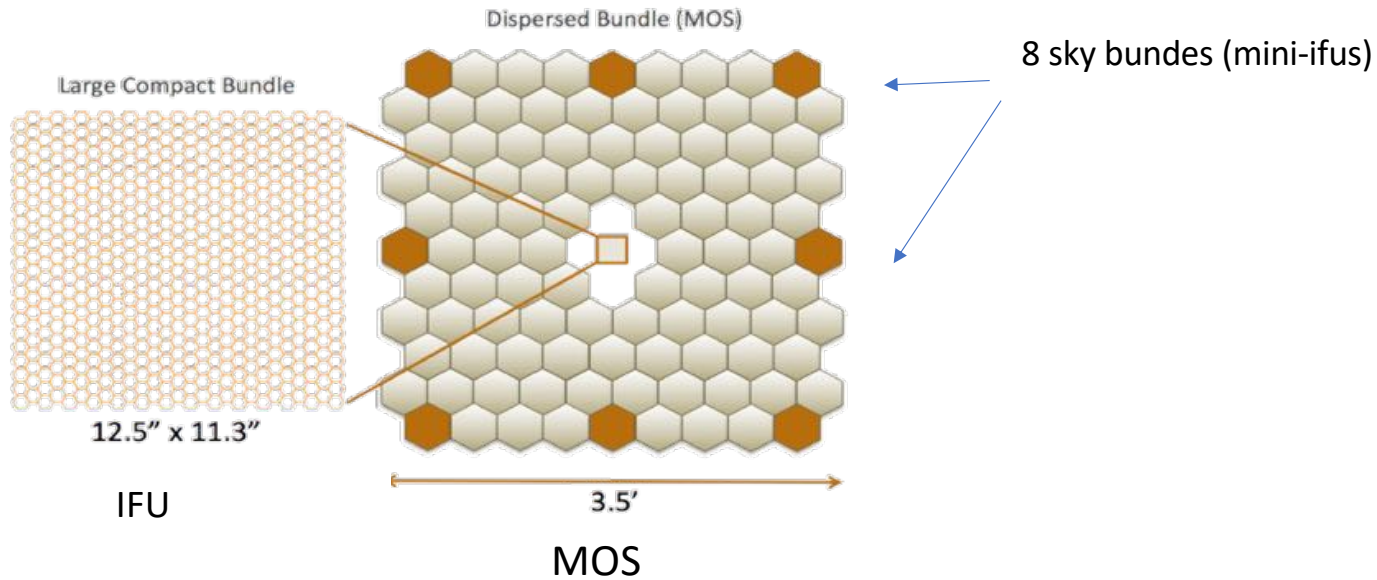
MEGARA

Dispersed Bundle (MOS)

Large Compact Bundle

8 sky bundes (mini-ifus)

12.5" x 11.3"

IFU

3.5'

MOS

Bidimensional spectroscopy **and** multiobject spectroscopy (MOS) @ GTC
Integral field unit (IFU)   92 robotic positioners   (1.6 arcsec /minibundle)
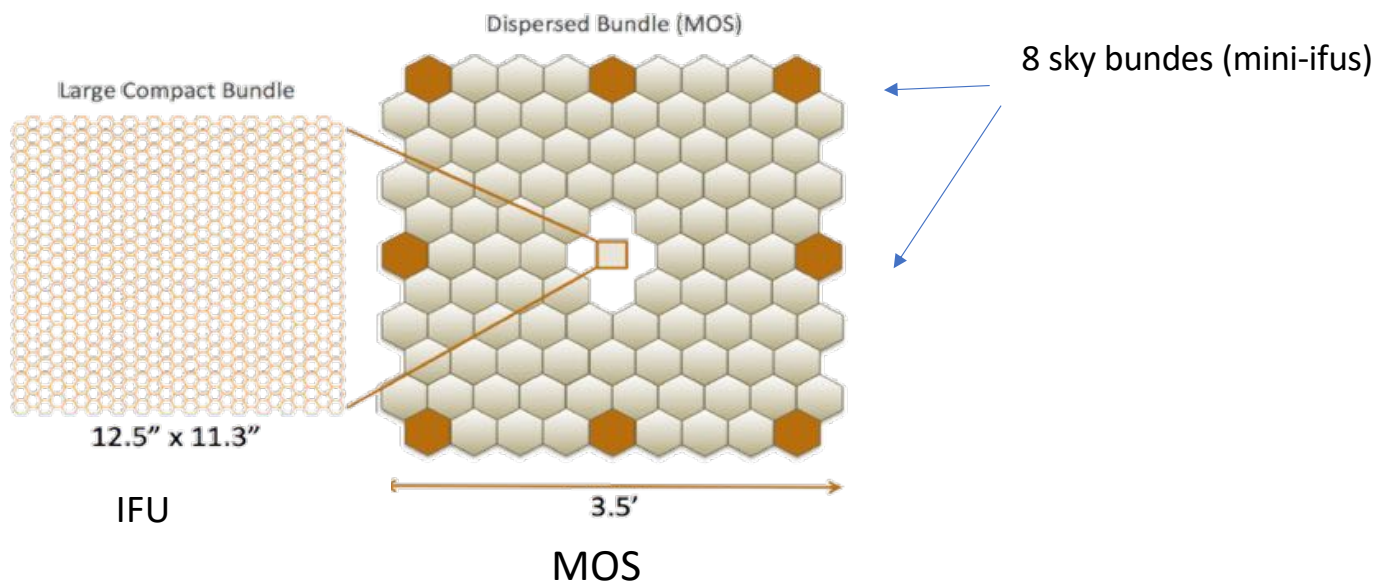   mini -ifu of 7 fibers

0.62 arcsec/spaxel

MEGARA

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LR: R ~ 6,000   3650 - 9750 Å
MR: R ~ 12,000   3650 - 9750 Å
HR: R ~ 20,000   6420 – 6790 Å, Halpha (HR-R)
                                  & 8370 – 8885 Å, CaII (HR-I)

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Integral field unit (IFU)   92 robotic positioners (1.6 arcsec/mini bundle)
mini-ifus of 7 fibers
0.62 arcsec/spaxel

Commissed in 2017   & offered to the community
in 2018B

LR: R ~ 6,000   3650 - 9750 Å
MR: R ~ 12,000   3650 - 9750 Å
 HR: R ~ 20,000   6420 – 6790 Å, Halpha (HR-R)
                          & 8370 – 8885 Å, CaII (HR-I)

MEGASTAR

A library oriented to MEGARA

MEGARA integral field spectroscopy mode

HR: **R ~ 20,000** $6420 - 6790$ Å, Halpha (HR-R) & $8370 - 8885$ Å, CaII (HR-
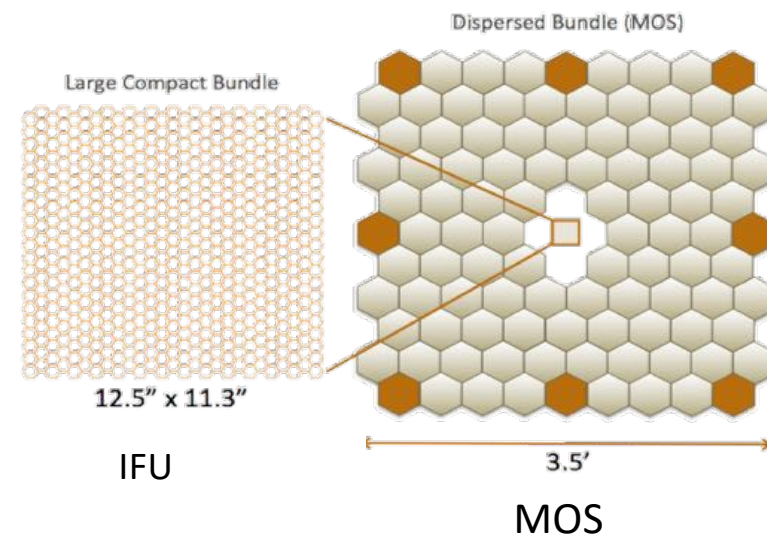
There is not an empirical library with high resolution in these spectral ranges
  &
 R ~ 20,000 is not offered in any other integral field spectrograph

Large Compact Bundle

Dispersed Bundle (MOS)

12.5" x 11.3"

IFU

3.5'

MOS

MEGASTAR

The main advantage

Spectra are obtained with an integral field unit

→ **homogeneous spectral resolution**

The resolution is independent of

- alignment errors between the object and the spectrograph entrance slit

- seeing conditions

8 sky bundles (mini-ifus

MEGARA IFU

Large Compact Bundle

12.5" x 11.3"

3.5'
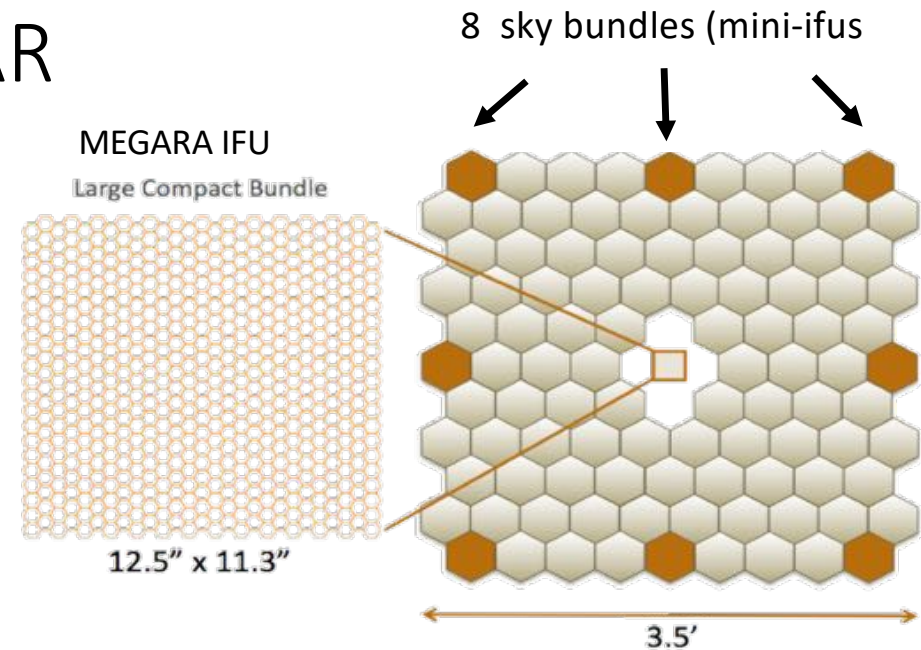
MEGASTAR

Spaxel
0.62 arcsec
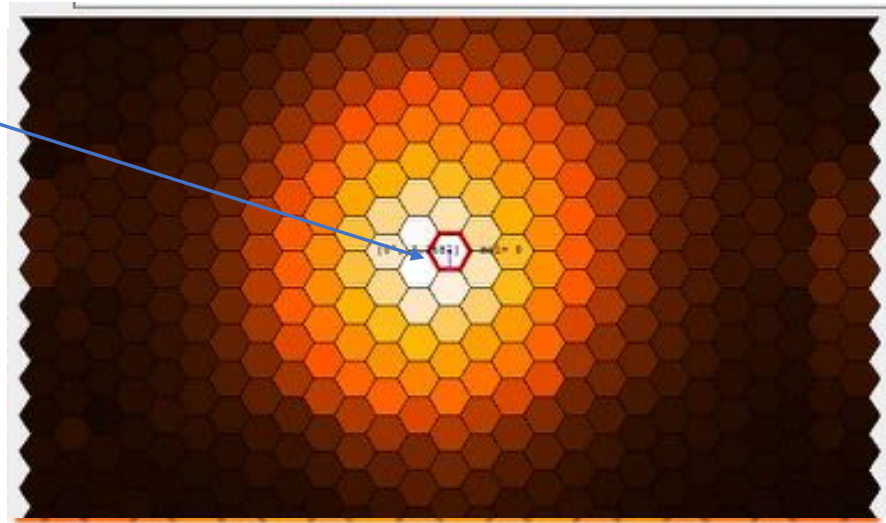
Reconstructed imaged
of BD +083095
@ HR-I

The spectrograph entrance stop is the **fibre**

R α 1/slit width

The spectral resolution is fixed as the slit width remains constant

spaxel: fiber projected on the CCD

MEGASTAR

7 spaxels

2 arcsec
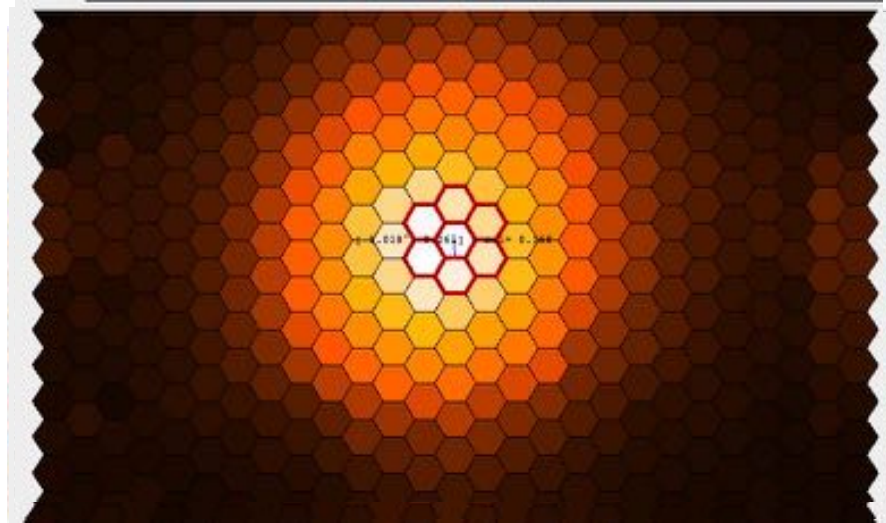
Reconstructed imaged
of of BD +083095

@ HR-I

MEGASTAR

19 spaxels
3 arcsec
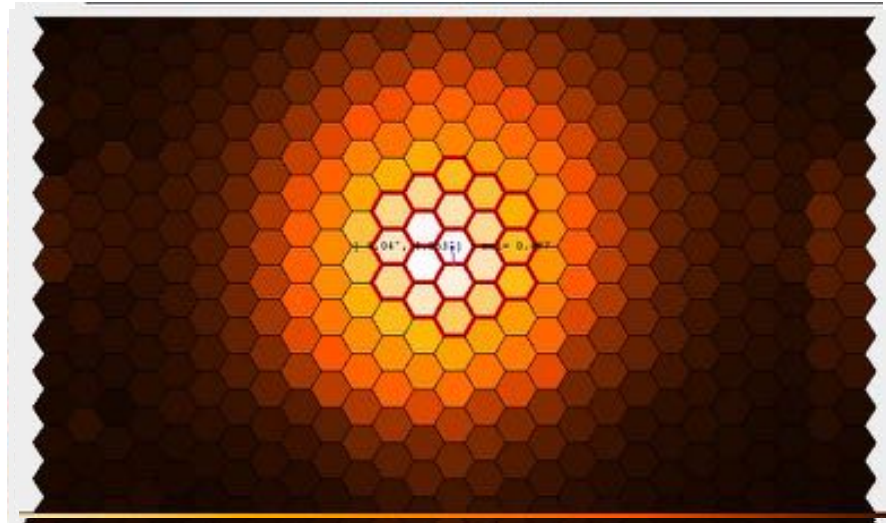
Reconstructed imaged
of of BD +083095
 @ HR-I

MEGASTAR

37 spaxels

5 arcsec
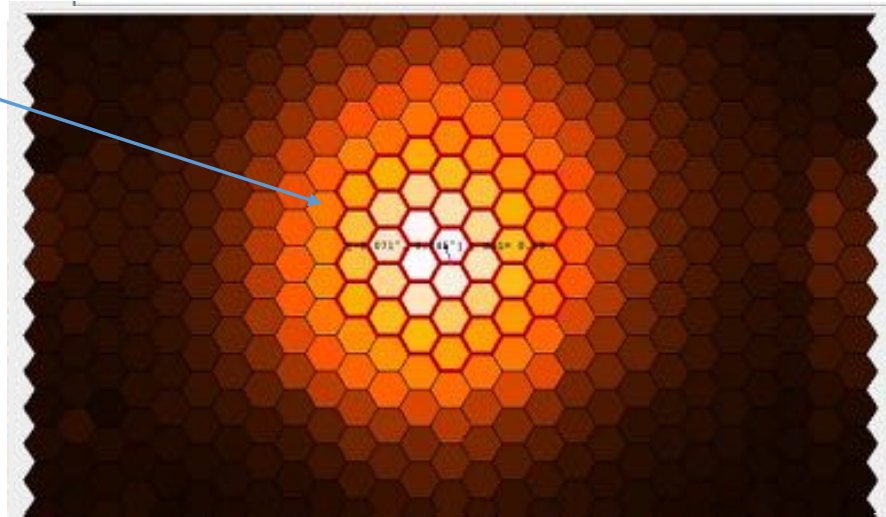
Reconstructed imaged
of of BD +083095
 @ HR-I

- The resolving power on the detector does not change with seeing

- The flux is recovered

MEGASTAR status

Concluded observing semester: **7**   (2018B to 2021B in **filler mode** i.e. under-optimum conditions)

GTC open time requested (h): **550**   MEGASTAR is ideal for filler mode

Open time awarded (h): **400**

Open time observed (h): **239**

Percentage: **60**

Number of stars observed: **680**

60% is good given the large number of simultaneous instruments and the nature of MEGASTAR

MEGASTAR: paper I

Introduction to the library
Rationale behind the building of the catalogue

Pilot program during commissioning @ feasibility
HR-I spectra of 77 stars:
21 individual stars
56 of the globular cluster M15 obtained in the MOS mode
+
20 individual stars with HR-R & HR-I open time observations
97 stars

Calculate Teff, log g & [Fe/H] for the 97 stars

Identification of some absorption lines

MEGARA-GTC stellar spectral library: I

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[4]Dpto de Física de la Tierra y Astrofísica, Fac. CC. Físicas, Universidad Complutense de Madrid, Plaza de las Ciencias, 1, E-28040 Madrid, Spain
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ABSTRACT

MEGARA (Multi Espectrógrafo en GTC de Alta Resolución para Astronomía) is an optical (3650–9750 Å), fibre-fed, medium-high spectral resolution ($R = 6000, 12\,000$ and $20\,000$) instrument for the Gran Telescopio CANARIAS (GTC) 10.4-m telescope, commissioned in the summer of 2017, and currently in operation. The scientific exploitation of MEGARA requires a stellar spectra library to interpret galaxy data and to estimate the contribution of the stellar populations. In this paper, we introduce the MEGARA-GTC spectral library, detailing the rationale behind the building of this catalogue. We present the spectra of 97 stars (21 individual stars and 56 members of the globular cluster M15, which are both subsamples taken during the commissioning runs, and 20 stars from our ongoing GTC Open-Time programme). The spectra have $R = 20\,000$ in the HR-R and HR-I set-ups, centred at 6563 and 8633 Å, respectively. We describe the procedures to reduce and analyse the data. Then, we determine the best-fitting theoretical models to each spectrum through a χ^2 minimization technique, to derive the stellar physical parameters, and we discuss the results. We have also measured some absorption lines and indices. Finally, we introduce our project to complete the library and the data base in order to make the spectra available to the community.

Key words: atlases – catalogues – stars: abundances – stars: fundamental parameters – globular clusters: individual: M15.

MEGASTAR catalogue

Existing stellar libraries used for MEGARA catalogue: **2988 stars**

Library	Resolving Power	Spectral Range	Number	set-up	Reference
INDO-US	5000	3460 - 9460	1237	LR	Valdes et al. (2004)
MILES	2000	3520 - 7500	987	LR	Sánchez-Blázquez et al. (2006)
NGSL	1000	1670 - 10250	374	LR	Gregg et al. (2006)
STELIB	2000	3200 - 9300	249	LR	Le Borgne et al. (2003)
ELODIE	10000	3900 - 6800	1388	MR	Prugniel & Soubiran (2001, 2004)
FOE	12000	3800 - 10000	125	MR	Montes, Ramsey, & Welty (1999)
X-SHOOTER	10000	3000 - 25000	379	MR	Chen et al. (2012)
ELODIE	42000	3900 - 6800	1388	HR	Prugniel & Soubiran (2001, 2004)
UES	55000	4800 - 10600	83	HR	Montes & Martin (1998)
UVES-POP	80000	3070 - 10300	300	HR	Bagnulo et al. (2003)

15

HR: **R ~ 20,000** en **6420 – 6790 Å (HR-R)** Halfa & **8370 – 8885 Å (HR-I)** CaII

No Integral Field Spectrograph   with R ~ 20,000 combining efficiency   & telescope collecting area

MEGASTAR catalogue

Name	RA (hh:mm:ss.s)	Dec. (dd:dd:ss.s)	pmRA (masyr^{-1})	pmDec (mas yr^{-1})	Sp.type	V	R	I	J	T_{eff}	log g	[M/H]	Catalogue
HD 006229	01:03:36.5	23:46:06.4	14.592	− 20.505	G5 IIIw	8.6			7.1	5218	3.00	− 1.09	X-SHOOTER
HD 006397	01:05:05.4	14:56:46.1	8.265	53.750	F5 III	5.6							
HD 006461	01:05:25.4	− 12:54:12.1	62.973	50.091	G2 V	7.7			6.1				
HD 006474	01:07:00.0	63:46:23.4	− 2.077	− 0.304	G4 Ia	7.6			4.8				
HD 006482	01:05:36.9	− 09:58:45.6	− 31.450	− 34.294	K0 III	6.1			4.4				
HD 006497	01:07:00.2	56:56:05.9	94.445	− 108.658	K2 III	6.4			4.7				
HD 006582	01:08:16.4	54:55:13.2	3422.230	− 1598.930	G5 Vb	5.1	4.7	4.4	4.0	5320	4.49	− 0.76	ELODIE low
HD 006695	01:07:57.2	20:44:20.7	80.020	− 94.096	A3 V	5.6				8266	3.91	− 0.46	ELODIE low
HD 006715	01:08:12.5	21:58:37.2	400.593	− 46.588	G5	7.7	7.2	6.9	6.3	5652	4.40	− 0.20	ELODIE low
HD 006734	01:08:00.0	01:59:35.0	145.370	− 437.902	K0 IV	6.5	5.9	5.5	4.9	4934	3.18	− 0.58	MONTES

All coordinates and star data have been checked by parsing the catalogue against the SIMBAD4 release 1.7 database

M.Sc. thesis of Sara Rodríguez Berlanas, 2014

MEGASTAR catalogue

Stellar parameters measured

Name	RA (hh:mm:ss.s)	Dec. (dd:dd:ss.s)	pmRA (masyr⁻¹)	pmDec (mas yr⁻¹)	Sp.type	V	R	I	J	T_{eff}	log g	[M/H]	Catalogue
HD 006229	01:03:36.5	23:46:06.4	14.592	− 20.505	G5 IIIw	8.6			7.1	5218	3.00	− 1.09	X-SHOOTER
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HD 006482	01:05:36.9	− 09:58:45.6	− 31.450	− 34.294	K0 III	6.1			4.4				
HD 006497	01:07:00.2	56:56:05.9	94.445	− 108.658	K2 III	6.4			4.7				
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All coordinates and star data have been checked by parsing the catalogue against the SIMBAD4 release 1.7 database

M.Sc. thesis of Sara Rodríguez Berlanas, 2014

MEGASTAR: paper I

Cardiel & Pascual 2018, Pascual et. al. 2018, 2019
Castillo-Morales, Pascual, Gil de Paz, 2018

Observations: queue mode

Same Observing Block for HR-R and HR-I
Bias
Halogen lamp   @ daytime
Arc (HeNe) lamp @ daytime
Standard Star
Star

Data Reduction Pipeline
Python based tool

Bias → *MegaraBiasImage*
Halogen → *MegaraTraceMap* → *MegaraModelMap*
Arc → *MegaraArcCalibration*
Standard Star → *MegaraStandarStar*
Star → *MegaraReduceLCB*

https://github.com/guaix-ucm/megaradrp

Integration times (5 – 900 s) → MEGARA Exposure Time Calculator (ETC) @ Signal to noise ratio (SNR) 20 – 300

GTC Phase II is updated each semester

Sky subtracted & flux calibrated spectrum (final_rss.fits)

→ Quick Look Analysis Tool (**QLA)**

Gómez-Álvarez et al. 2018
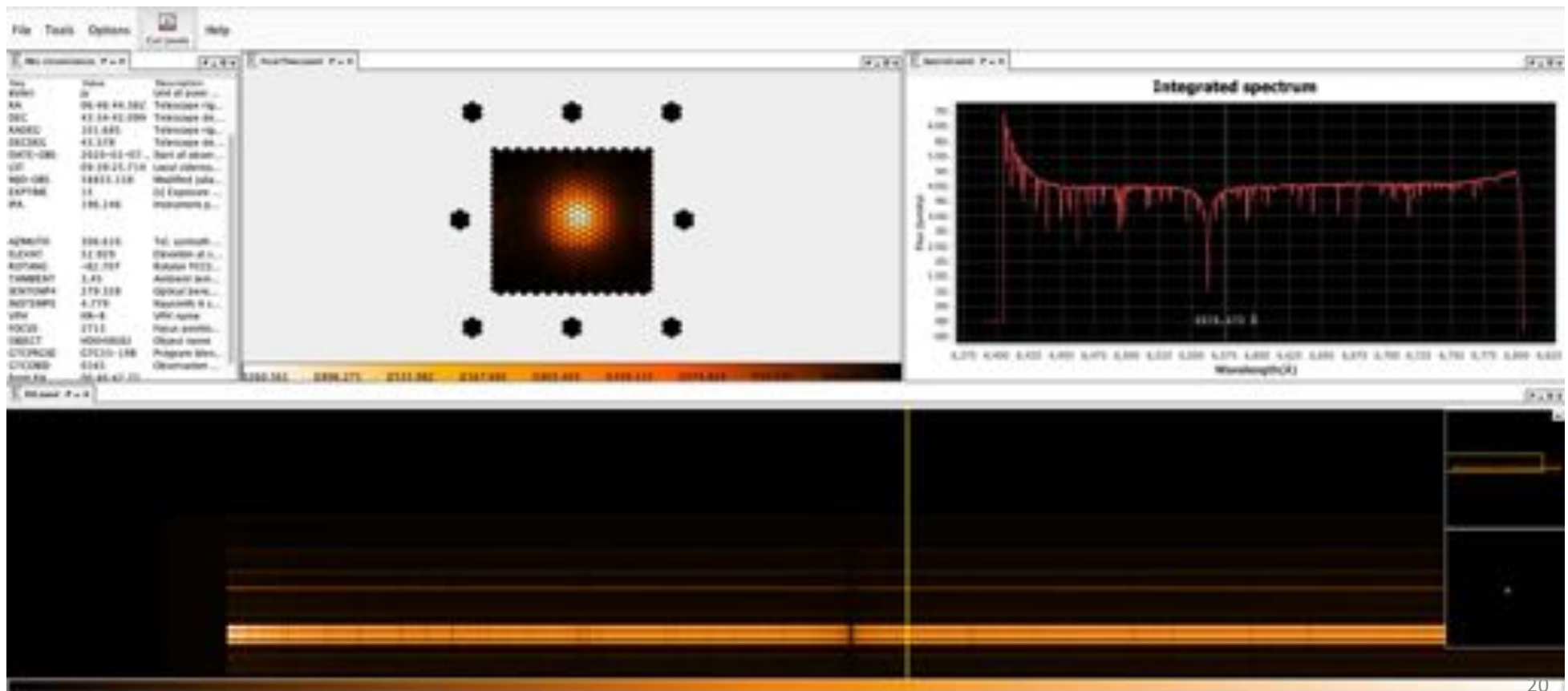
37 spaxels
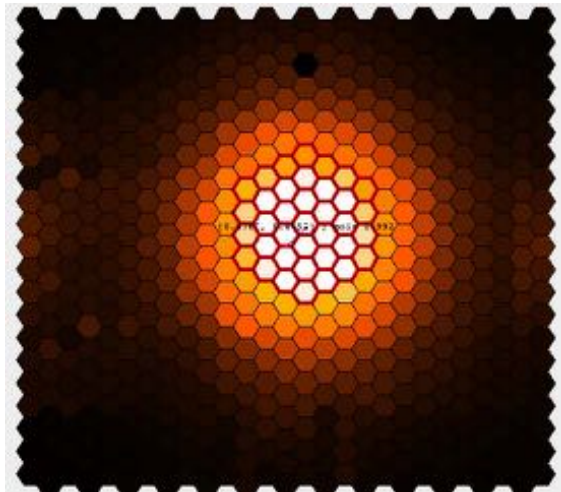
To recover the flux
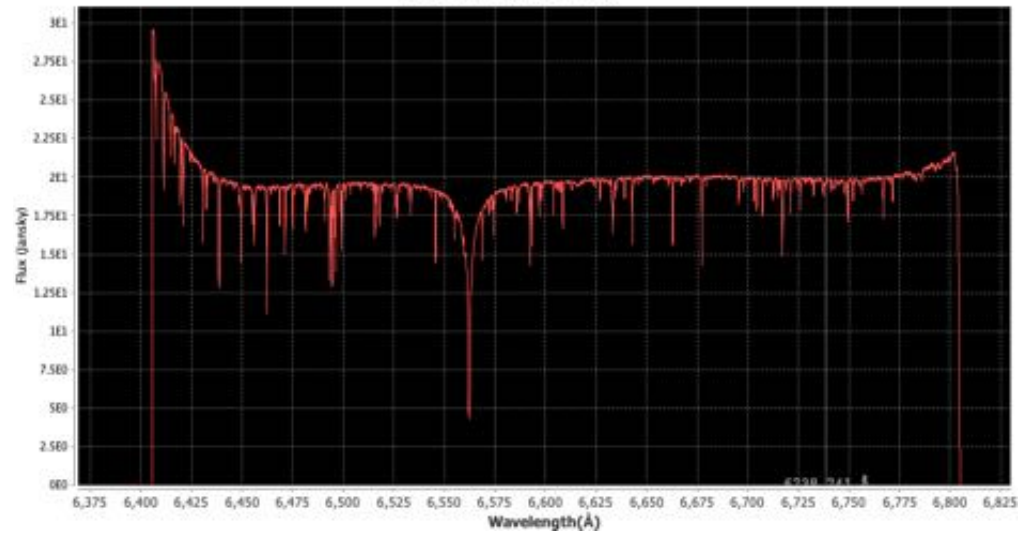
HD048682
Spectral type G0V

Seeing = 2.5 arcsec
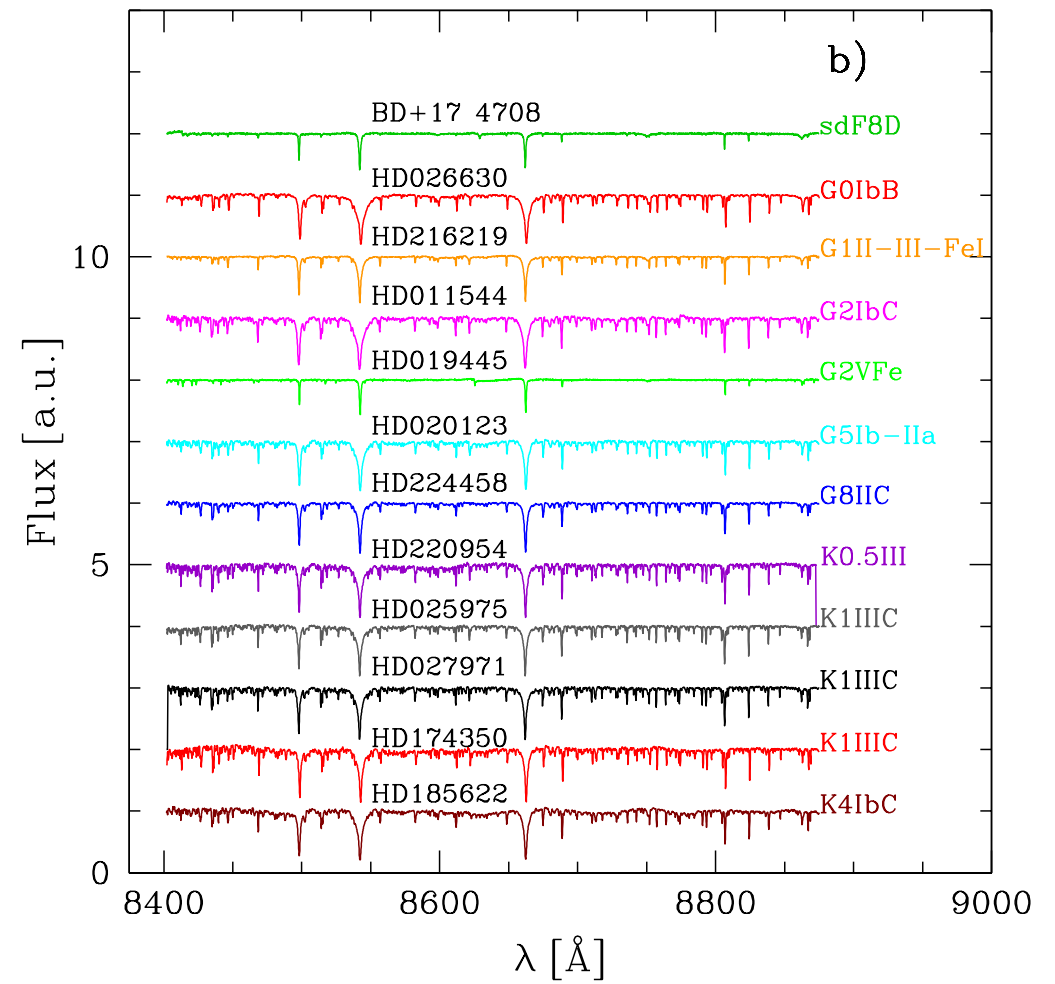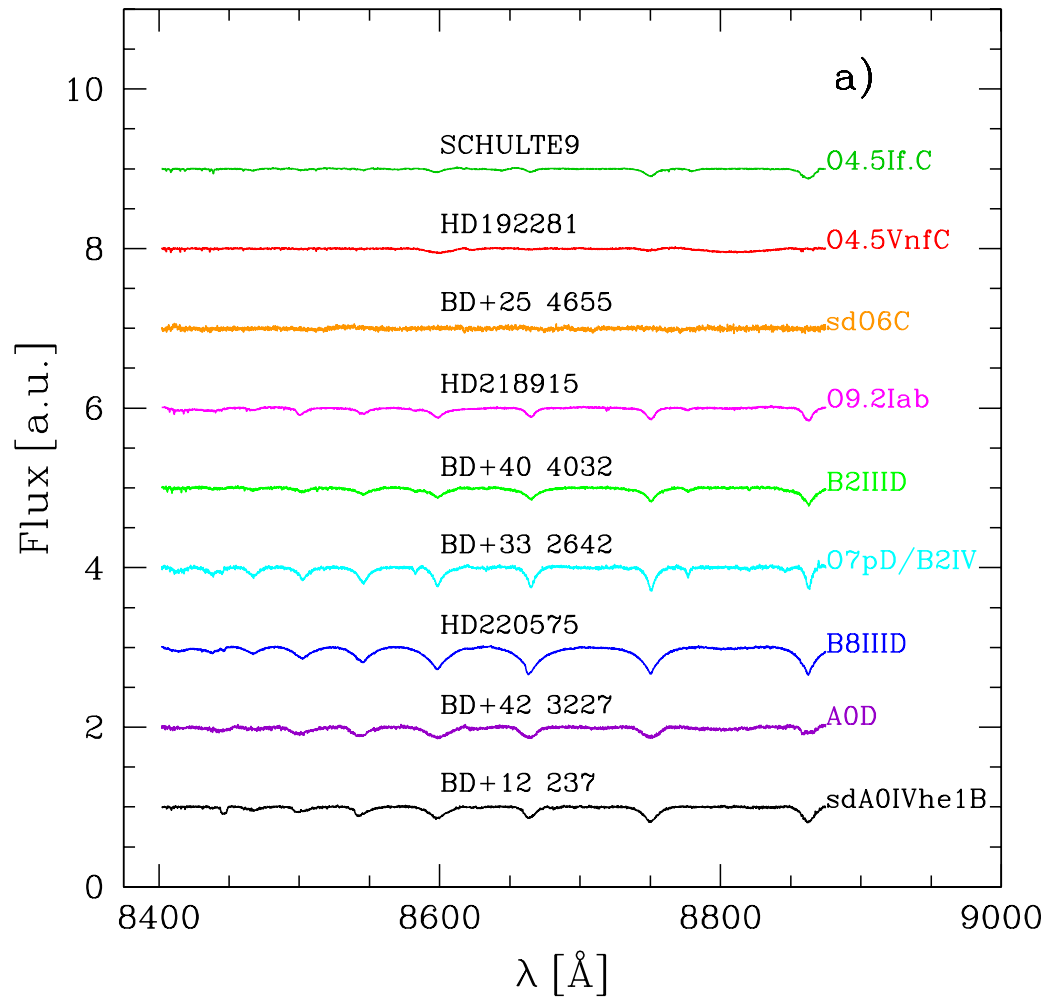
21 HR-I spectra for (a) the hottest and (b) the coldest stars of the *Commissioning* sample

MEGASTAR: paper 1

Teff, log g and [Fe/H]

Applying the $\chi 2$ minimization technique   (Koleva et al. 2009, Jofrey et al. 2010, Boeche & Grebel 2016)

to the best-fit of the Munari theoretical atmosphere models to each MEGARA spectrum (Munari et al. 2005)

Goal

→ To develop a method to determine Teff, log g and [Fe/H] for all the star of the library

Halpha
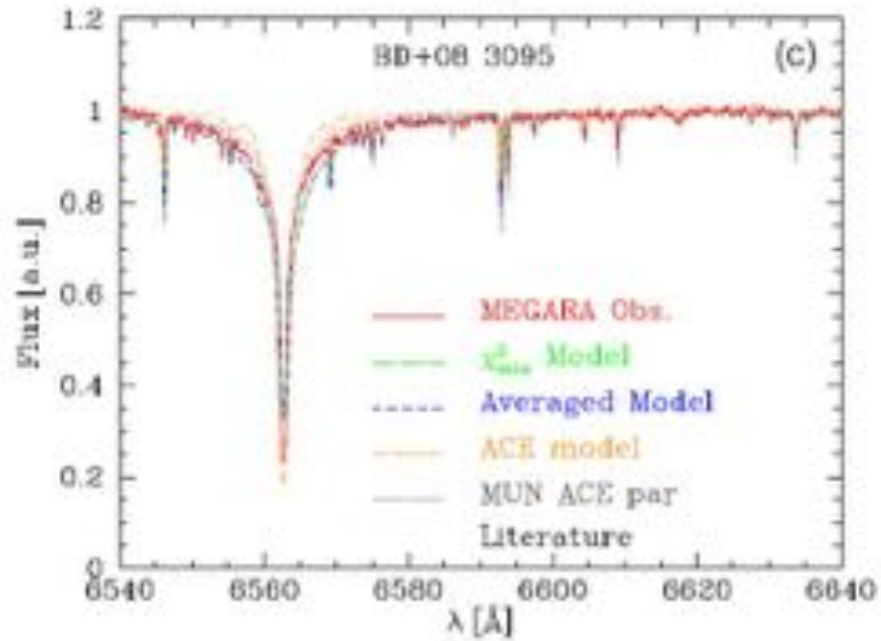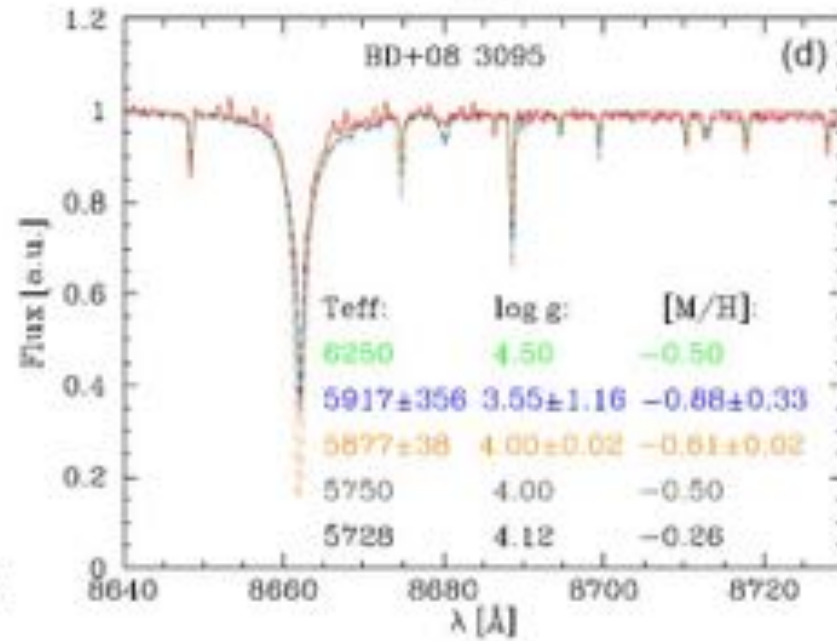
CaII

HR-R

HR-I

Red: observations
Green: the best model obtained using the $\chi2$ technique

Fitting HR-R and HR-I combined

24

Halpha

CaII

@ model

@ literature

HR-R

HR-I
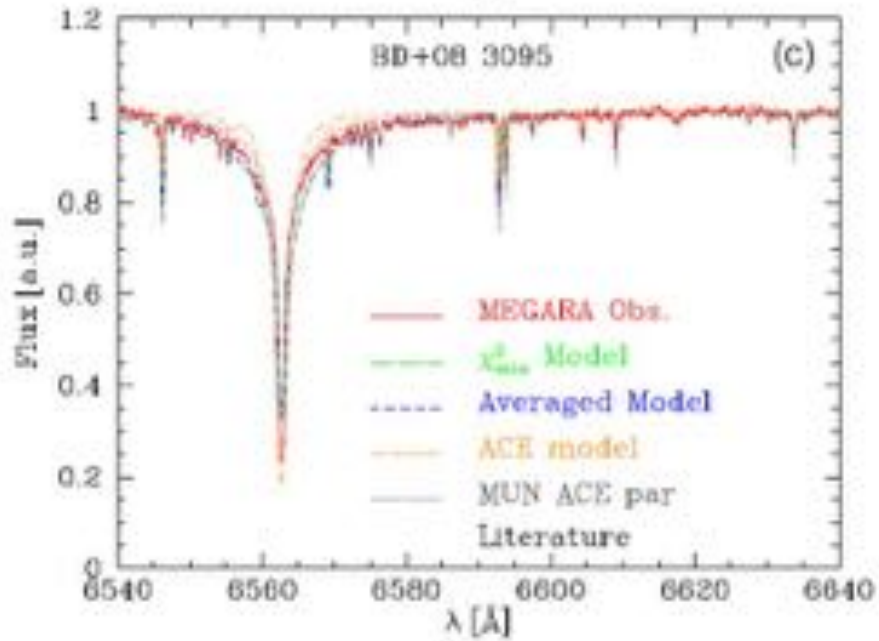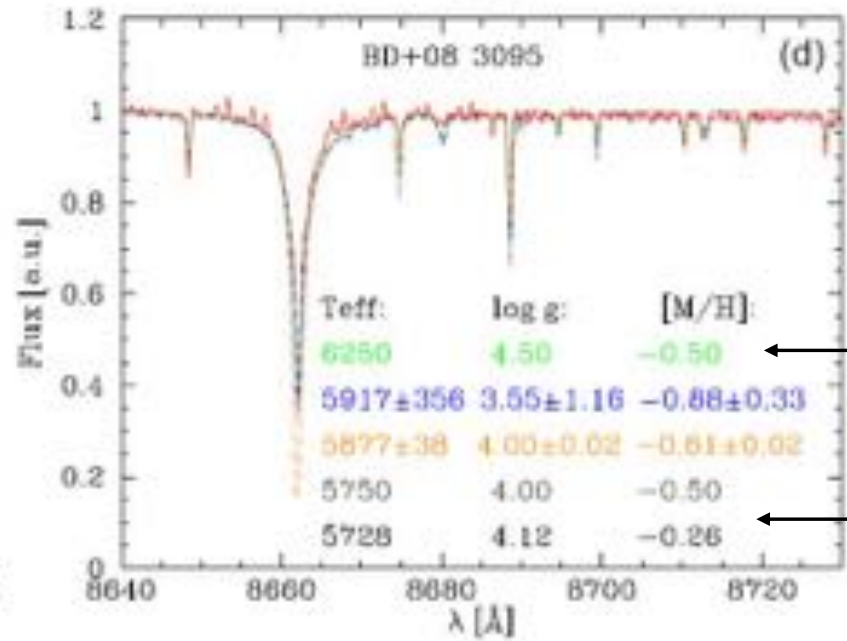
Red: observations
Green: the best model obtained using the $\chi 2$ technique

Fitting HR-R and HR-I combined

Fitting examples @ HR-I
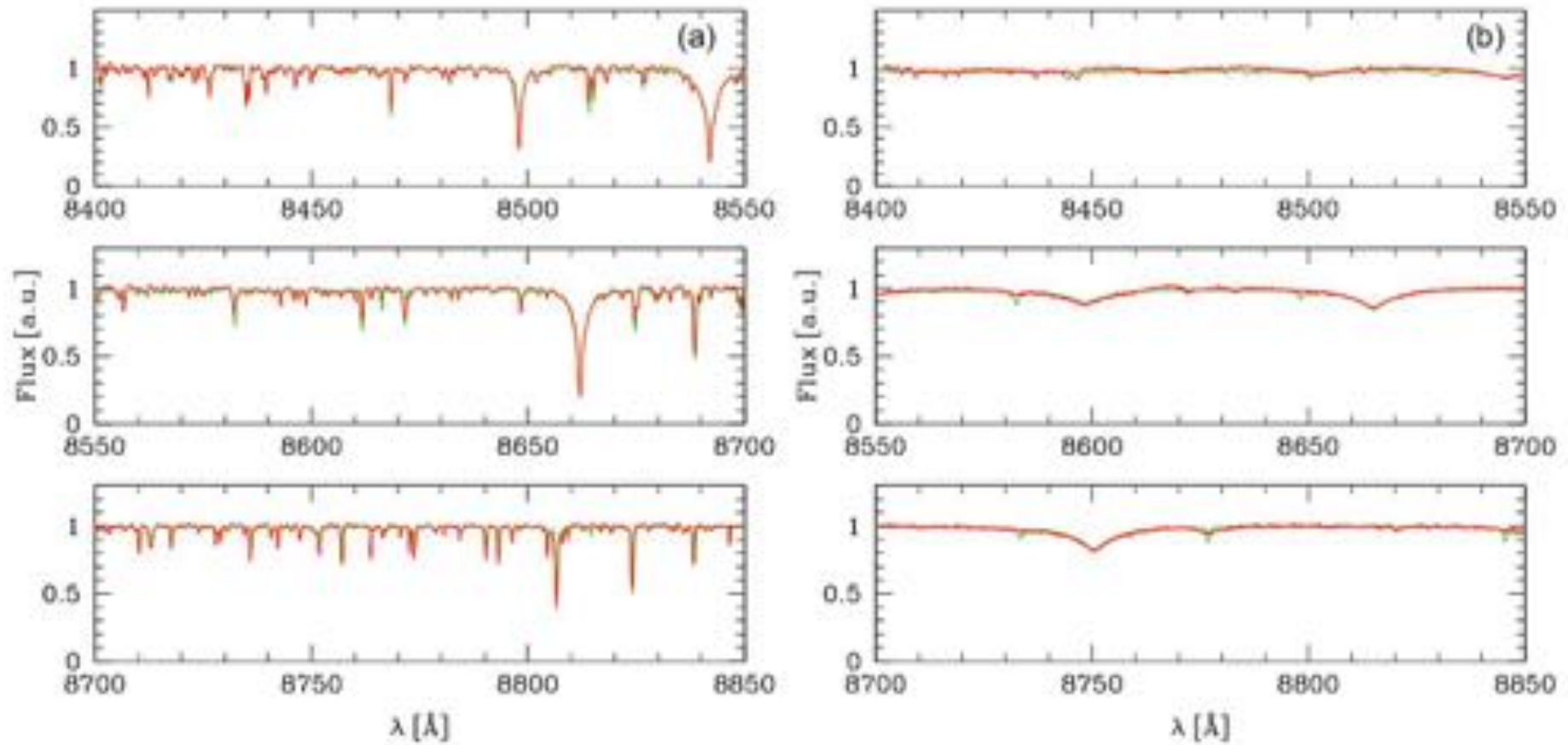
Giant K1 III star: HD025975
Teff: 4750 K ; log g: 3.0; [M/H]: -0.5

B2 III D star: BD+404032
Teff: 28,000 K; log g: 3; [M/H]:0.0

Lines identified

6420 – 6790 Å (HR-R)

8370 – 8885 Å (HR-I)

Hot stars

Cold stars
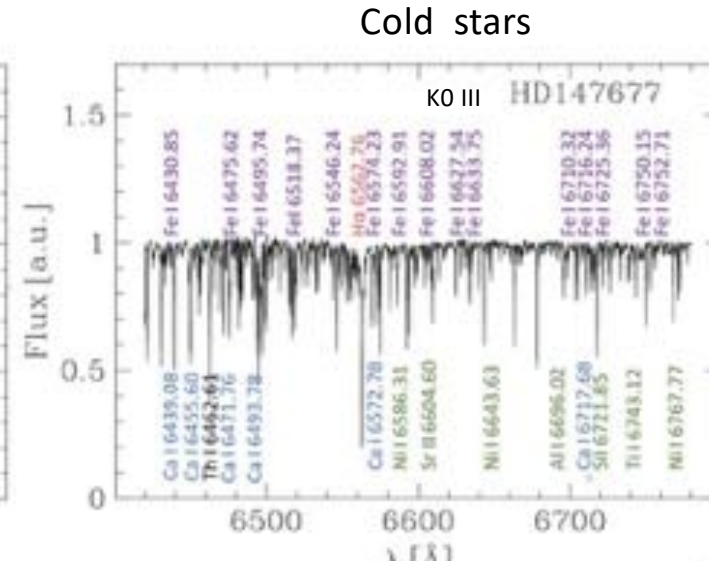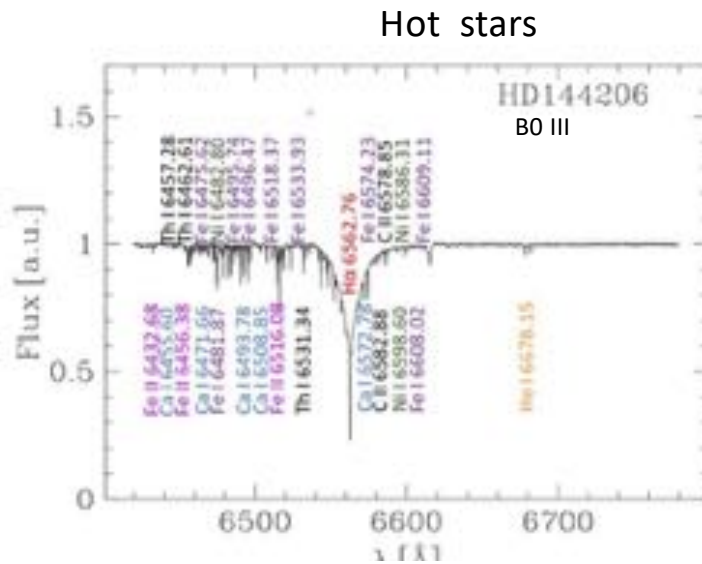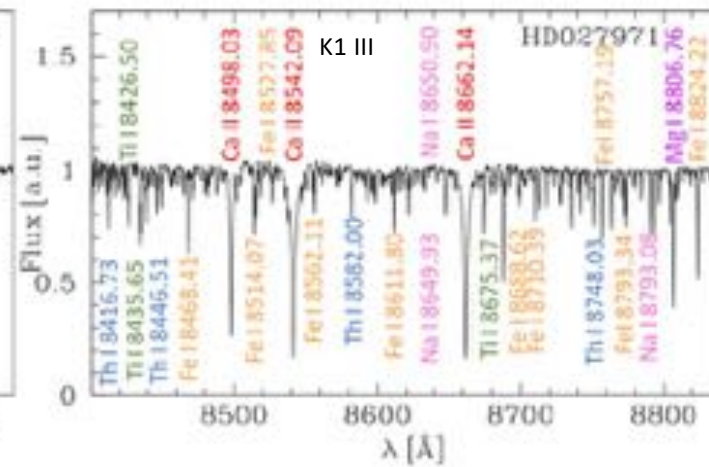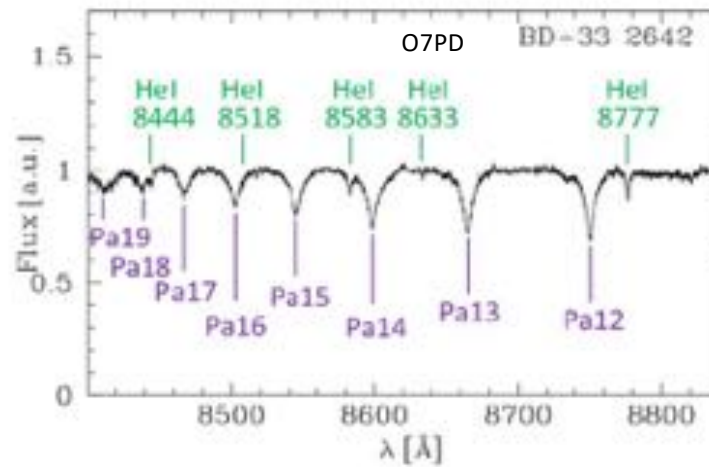
MEGASTAR: paper II

Data Release 1.0 (DR1)

838 spectra of 414 ✶s in HR-R & HR-I

Result of three observing semesters

2018B, 2019A, 2019B

152.24 h observed

Out of 250 h granted

Database description

Gaia DR2 data for a subset ✶s of MEGASTAR DR1

MEGARA-GTC stellar spectral library – II. MEGASTAR first release

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ABSTRACT
MEGARA is an optical integral field and multi-object fibre-based spectrograph for the 10.4 m Gran Telescopio CANARIAS that offers medium-to-high spectral resolutions (FWHM) of $R \simeq 6000$, 12 000, 20 000. Commissioned at the telescope in 2017, it started operation as a common-user instrument in 2018. We are creating an instrument-oriented empirical spectral library from MEGARA-GTC stars observations, MEGASTAR, crucial for the correct interpretation of MEGARA data. This piece of work describes the content of the first release of MEGASTAR, formed by the spectra of 414 stars observed with $R \simeq 20\,000$ in the spectral intervals 6420–6790 Å and 8370–8885 Å, and obtained with a continuum average signal-to-noise ratio around 260. We describe the release sample, the observations, the data reduction procedure and the MEGASTAR data base. Additionally, we include in Appendix A an atlas with the complete set of 838 spectra of this first release of the MEGASTAR catalogue.

Key words: astronomical data bases: atlases – astronomical data bases: catalogues – stars: abundance – stars: fundamental parameters.

MEGASTAR: paper II – Data release 1
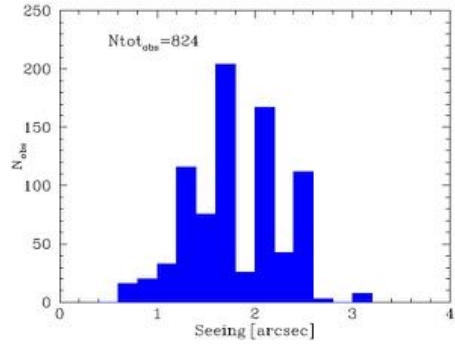
1st quartile: 1.4 arcsec
median: 1.8
3rd quartile: 2.0

Adding 37 spaxels around the star center
(~ 2.5 arcsec)

Seeing histogram

HR-R   HR-I

SNR ~ 261   SNR ~ 260
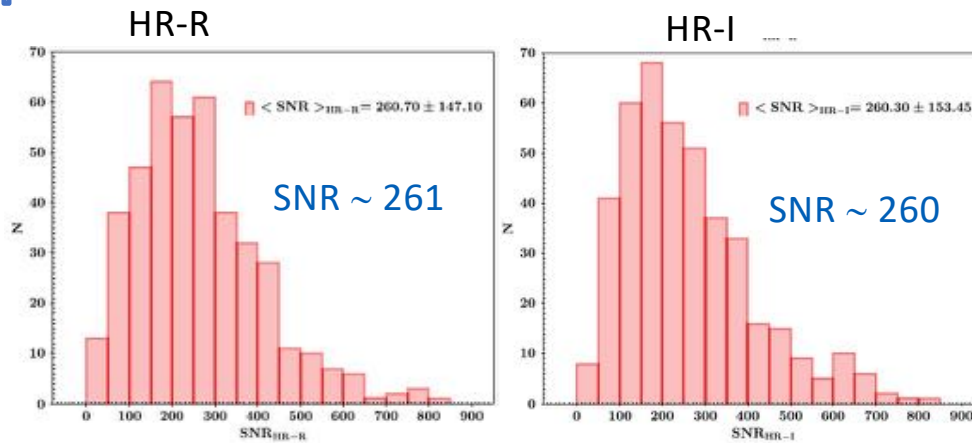
Filler mode observing conditions

Continuum SNR (Stoehr, 2008)

29

MEGASTAR: paper II – Data release 1
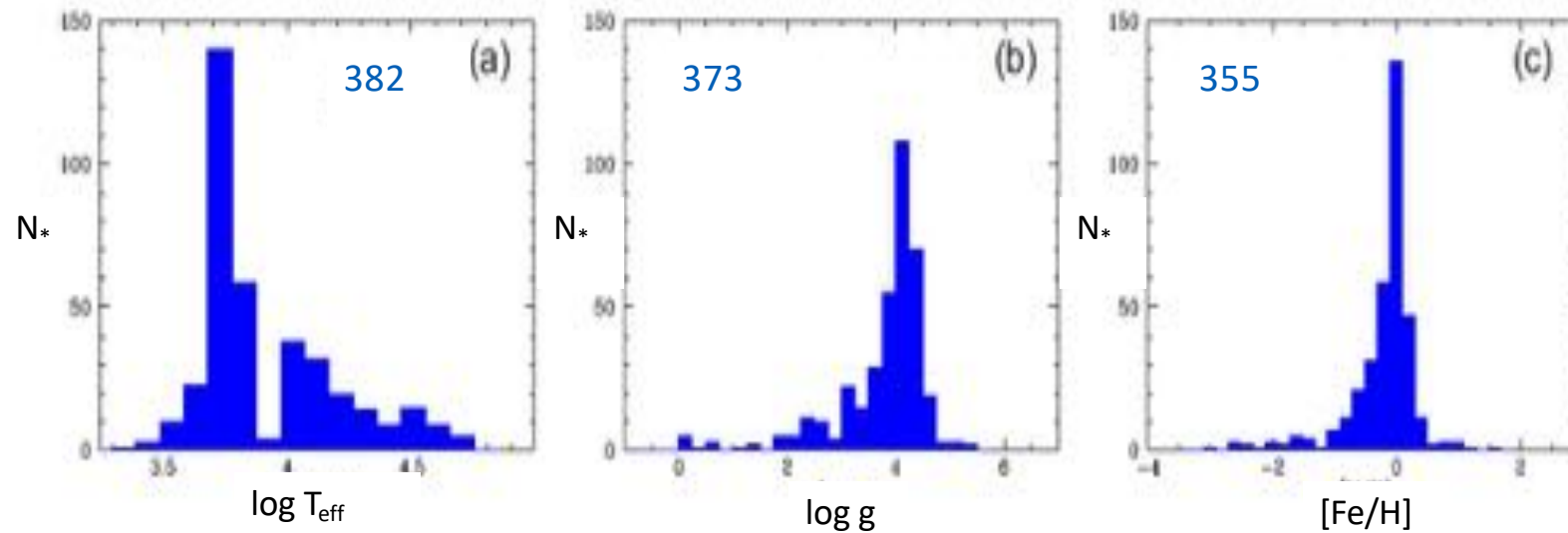
Not all the MEGASTAR ✷s have   log Teff, log g & [Fe/H]   from previous works

MEGASTAR: paper II – Data release 1
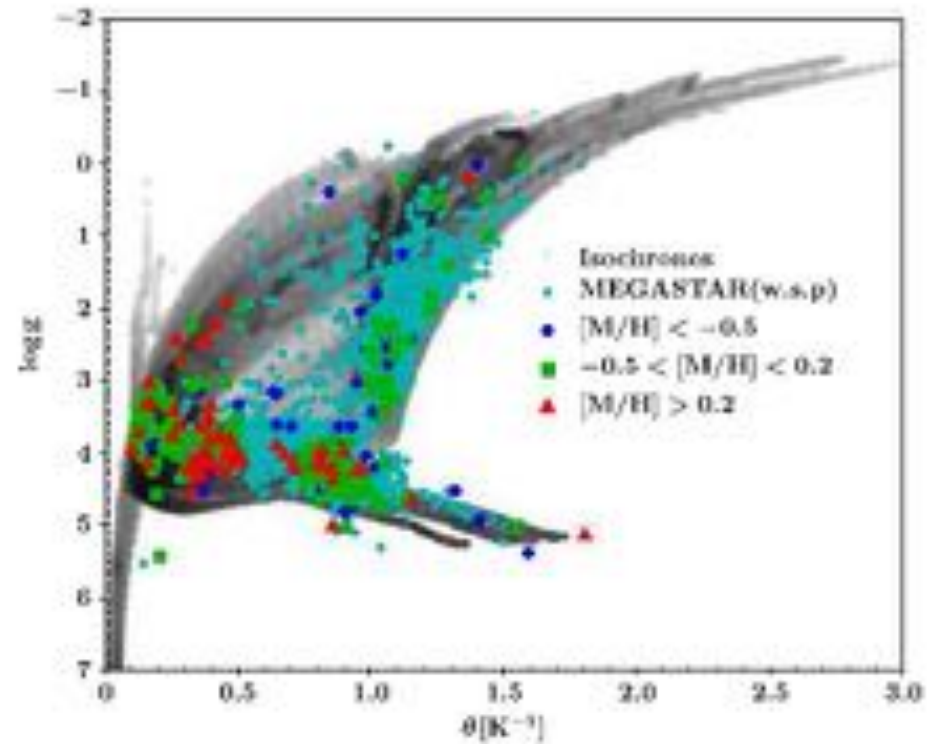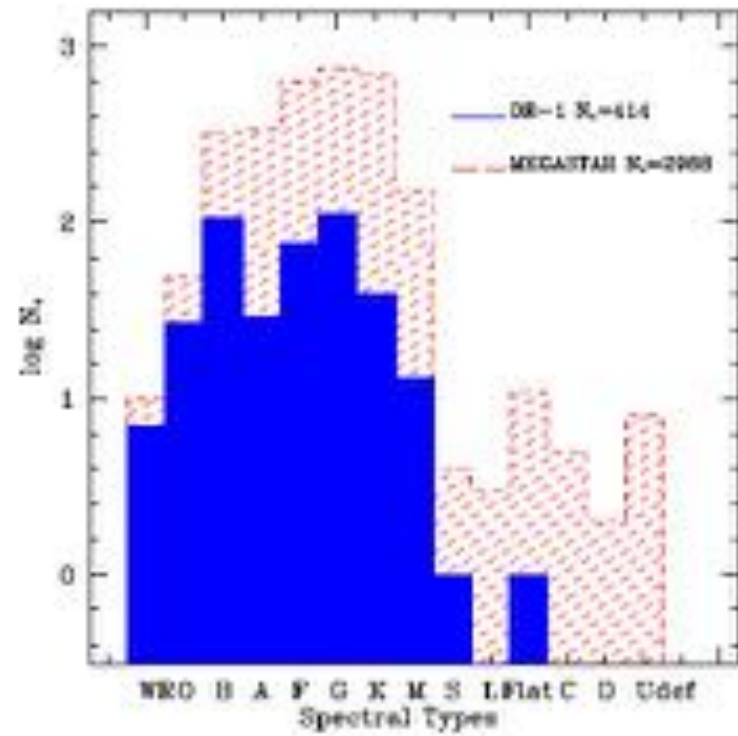
For each star …

Column	Description
Name	Star name (∗)
RA	Right ascension (2000.0) (hh:mm:ss.s) (∗)
Dec.	Declination (2000.0) (dd:dd:ss.s) (∗)
Sp. type	Spectral type (∗)
U	Johnson–Cousins U magnitude (∗)
B	Johnson–Cousins B magnitude (∗)
V	Johnson–Cousins V magnitude (∗)
R	Johnson–Cousins R magnitude (∗)
I	Johnson–Cousins I magnitude (∗)
J	Johnson–Cousins J magnitude (∗)
Other name	Alternative name for the star
VPH	Grating of the observed spectrum
T_{eff}	Effective temperature from the literature
$\log g$	Surface gravity (log) from the literature
[Fe/H]	Iron abundance (log) from the literature
Reference	Original catalogue from which it was inherited
Other comments	Comments relating to the star
ASCII/FITS file	Name of the ASCII/FITS spectrum file
Obs. period	GTC observing semester
No. exp.	Number of exposures
Exp. time	Time of the individual exposures (s)
Seeing	Value of the seeing as reported by GTC (arcsec)
Obs-GTC	Comments relating to the observations

Note.(∗) Source: SIMBAD.

MEGASTAR: paper II

Database

Search
Visualization &
Download
Sources and
products

MEGASTAR webApp technologies:

Web Servers: Apache and Tomcat

Database: MySQL

Languages: Java, Java Servlets

HTML and JavaScript

Libraries: JFreeChart, Plotly and nom.tam FITS

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User manual

Source list

Observation list

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Observed HR-R
Observed HR-I

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Observed HR-R
Observed HR-I

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Search &
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GTC22-18B_0154
20190222

MEGASTAR: paper II

Database

Download
.jpeg / .ascii

Name

Sp Type

Teff, log g, [Fe/H]

Download

The release of the observed and reduced star spectra includes:

- A README.txt with the download instructions
- Files (ASCII and MSExcel) with detailed information about the products delivered for each star in the
- zip file with the products described above
- A Java tool application for observations display (spectraplot.jar)

Click here to download the latest release.

Java app to manipulate the spectrum @ basic analysis
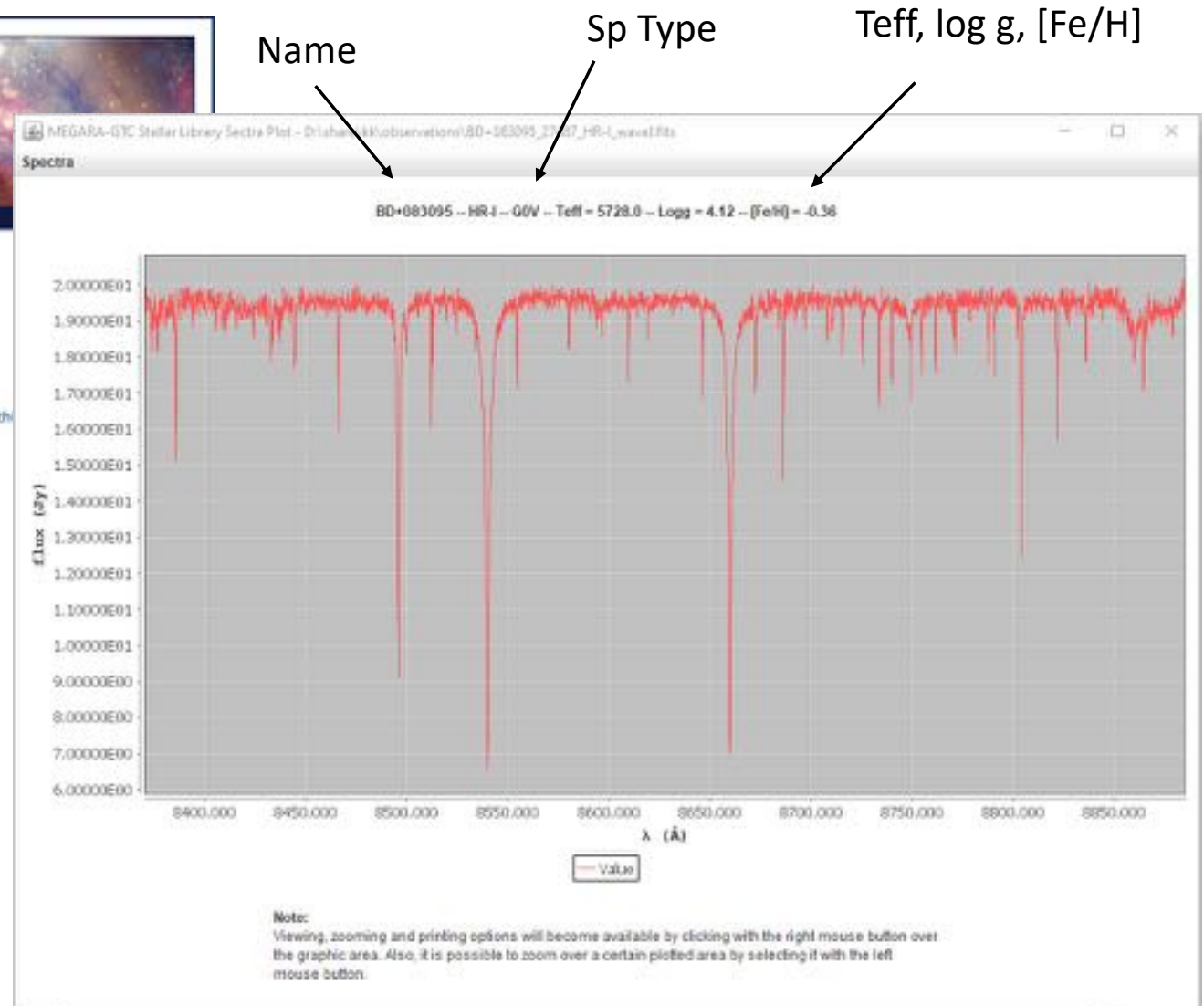
MEGASTAR: paper II

Page	Stars						
A3	BD−032525	BD−122669	BD+083095	BD+092190	BD+130013	BD+191730	BD+195116B
	BD+203603	BD+241676	BD+262606	BD+351484	BD+381670	BD+511696	BD+541399
A4	BD+800245	G171−010	G197−45	G202−65	G234−28	HD 000108	HD 000358
	HD 000560	HD 000886	HD 003360	HD 003369	HD 003628	HD 003644	HD 004004
A5	HD 004539	HD 006327	HD 006815	HD 007374	HD 009974	HD 009996	HD 013267
	HD 013268	HD 014191	HD 014633	HD 014947	HD 015318	HD 015558	HD 015570
A6	HD 015629	HD 016429	HD 016523	HD 016523	HD 016581	HD 017081	HD 017145
	HD 017506	HD 017638	HD 017638	HD 018144	HD 018296	HD 018409	HD 019308
A7	HD 020084	HD 020512	HD 021742	HD 022484	HD 023862	HD 024341	HD 024451

MEGASTAR: paper II

Appendix A: atlas (pdf) of **838** spectra of **414** ✷s

Appendix B: table (txt, excel) all DR1 information

Appendix C: table (txt, excel) with *Gaia* DR2 data

Appendix A

Name

Sp Type

Stellar parameters from the literature
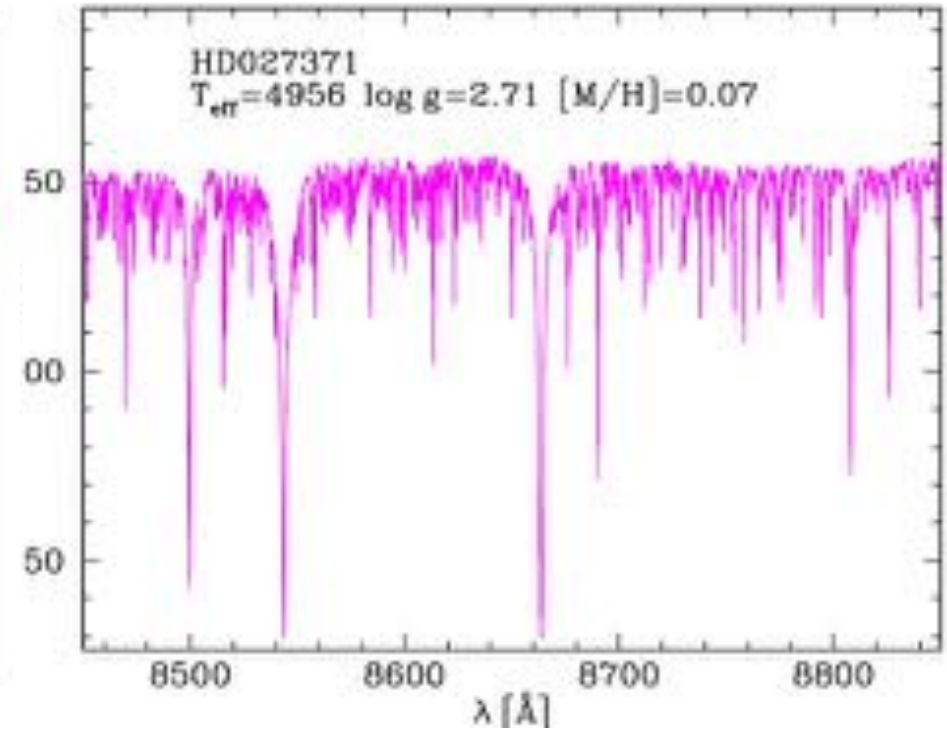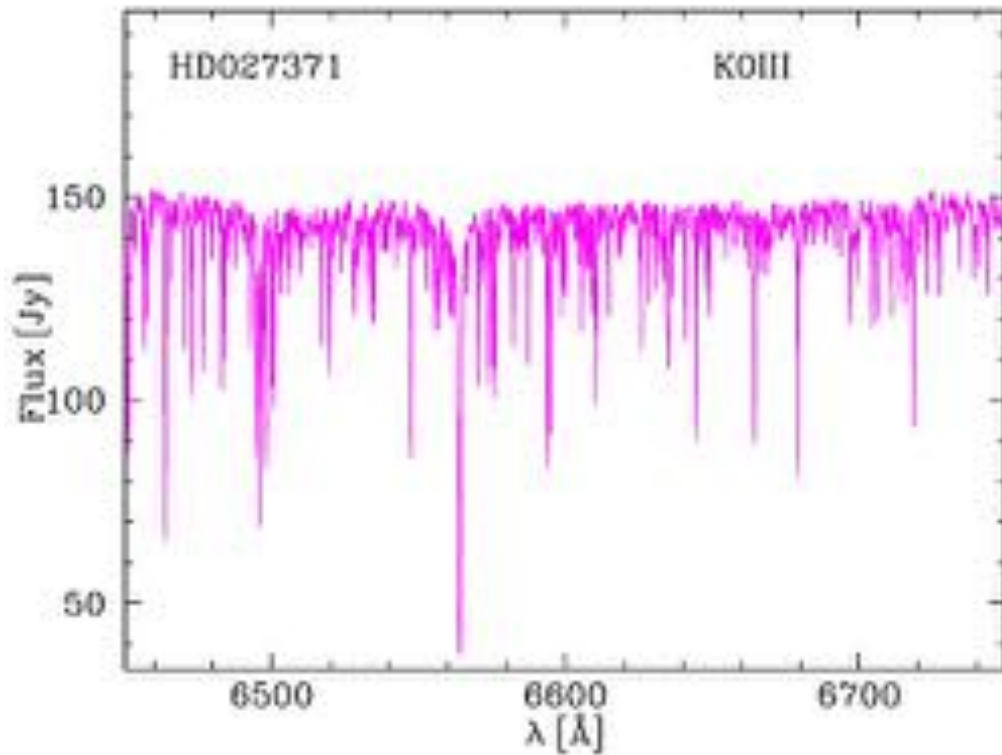
HR-R and HR-I spectra for each star of the Data Release
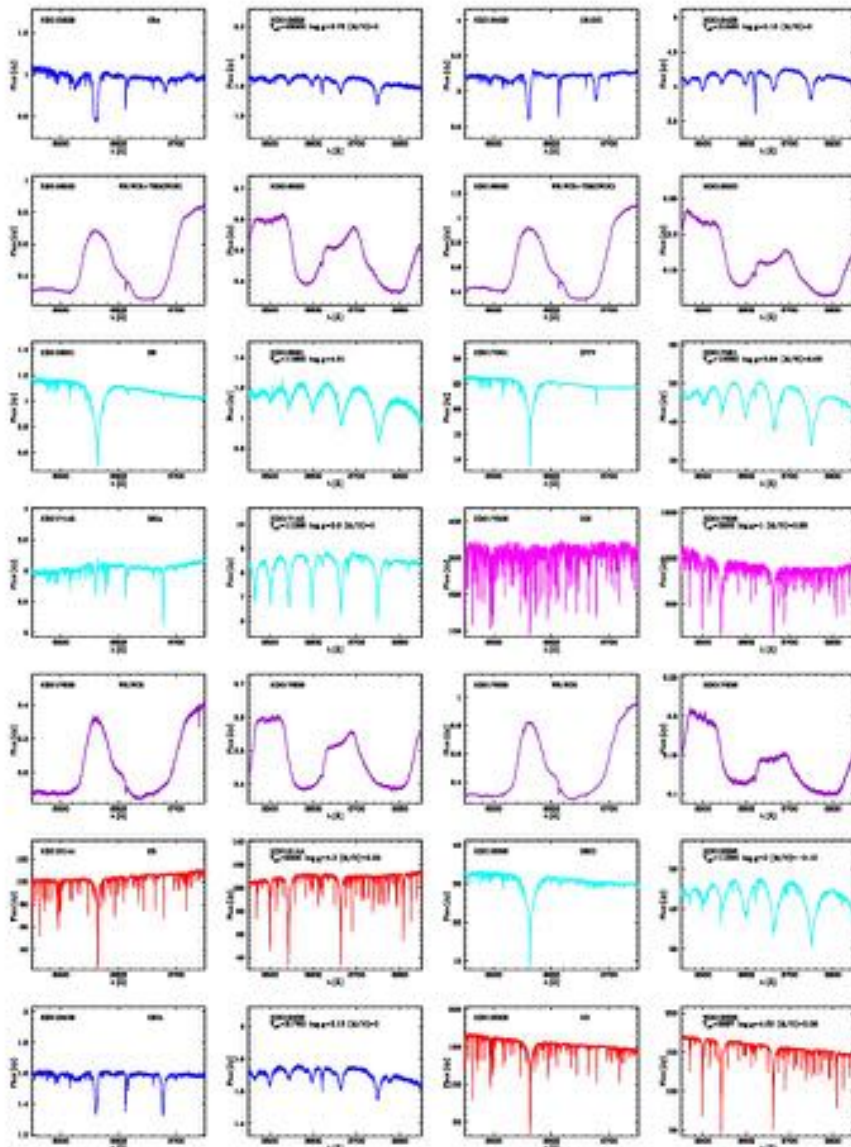
Figure 1 – *continued* 4. Stars shown in this page are: HD015629, HD016429, HD016523, HD016523, HD016581, HD017081, HD017145, HD017506, HD017638, HD017638, HD018144, HD018296, HD018409 and HD019308.
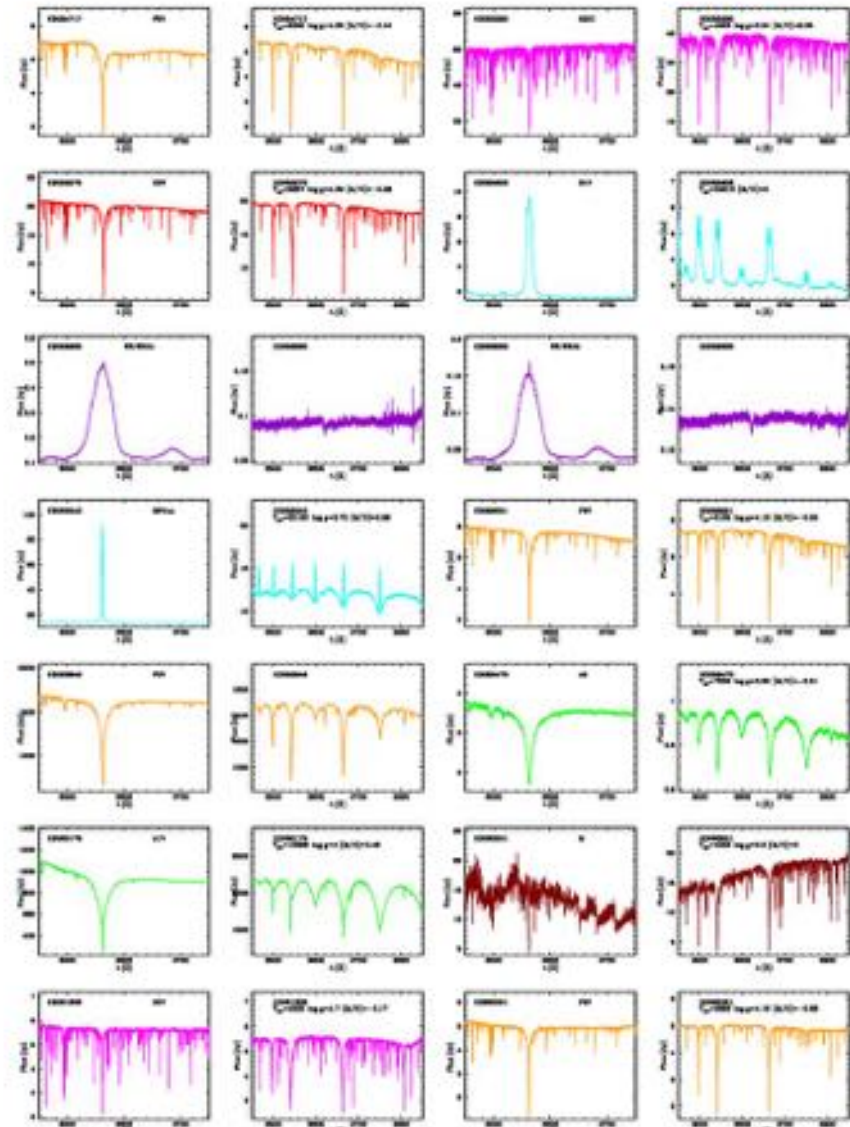
WR purple;
O: blue;
B cyan;
A green;
F orange;
G red;
K magenta;
M maroon;
S grey
Flat black

Figure 1 – *continued* 13. Stars shown in this page are: HD054717, HD055280, HD055575, HD055606, HD056925, HD056925, HD058043, HD058551, HD059046, HD059473, HD060179, HD060501, HD061606 and HD062301.
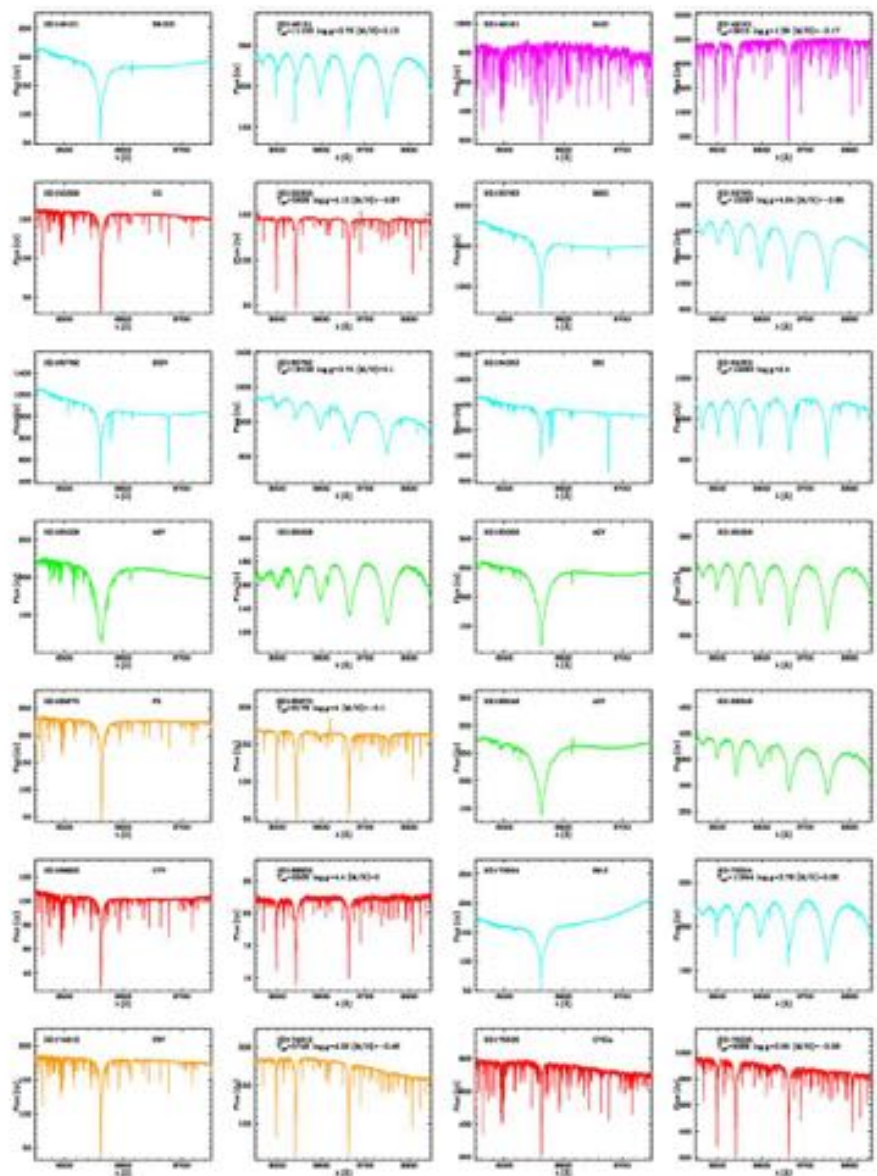
Figure 1 – *continued* 25. Stars shown in this page are: HD149121, HD149161, HD155358, HD155763, HD160762, HD064353, HD165029, HD065358, HD165670, HD166046, HD169822, HD173524, HD174912 and HD175535.
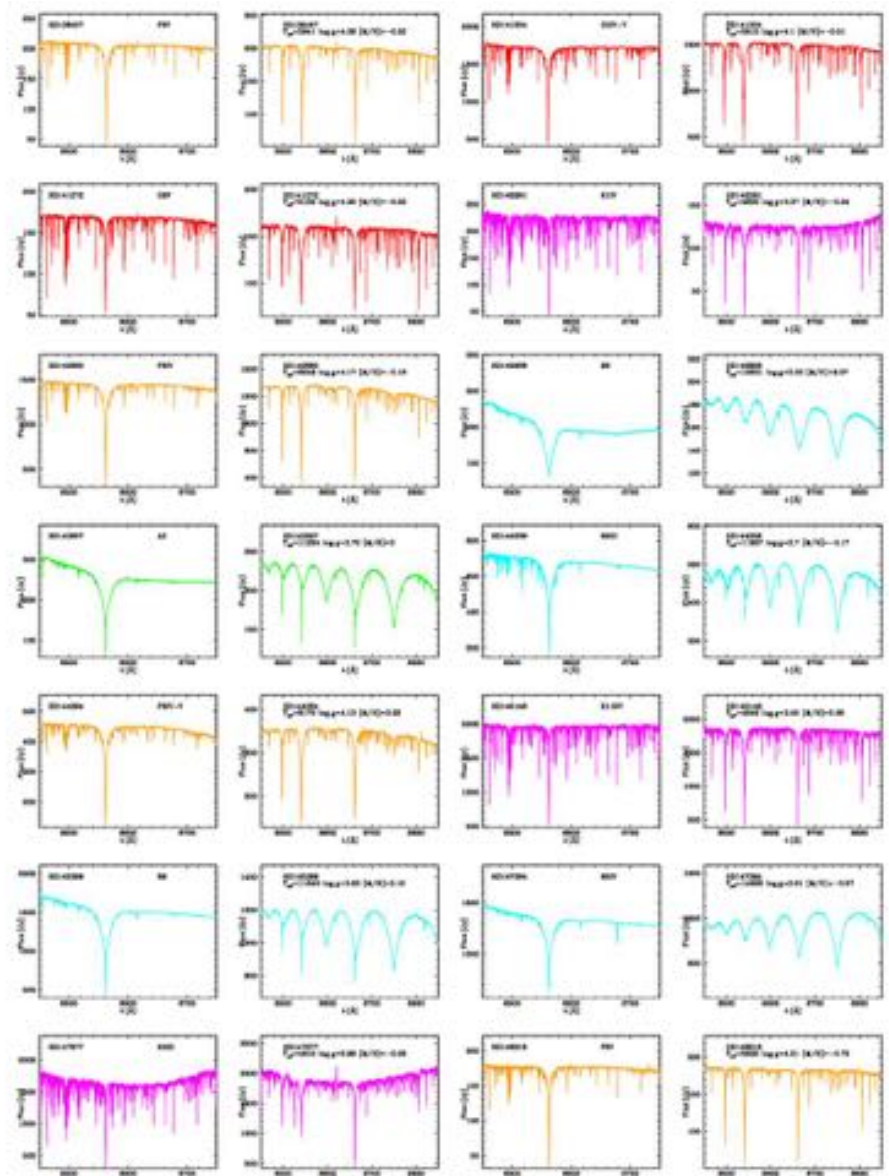
Figure 1 – *continued* 24. Stars shown in this page are: HD139457, HD161004, HD141772, HD142001, HD142860, HD142926, HD143607, HD144206...

WR purple;
O: blue;
B cyan;
A green;
F orange;
G red;
K magenta;
M maroon;
S grey;
Flat black

Appendix B

MEGASTAR DR1 information

Database Source form

Database Observation form

Column	Description
Name	Star name (*)
RA	Right ascension (2000.0) (hh:mm:ss.s) (*)
Dec.	Declination (2000.0) (dd:dd:ss.s) (*)
Sp. type	Spectral type (*)
U	Johnson–Cousins U magnitude (*)
B	Johnson–Cousins B magnitude (*)
V	Johnson–Cousins V magnitude (*)
R	Johnson–Cousins R magnitude (*)
I	Johnson–Cousins I magnitude (*)
J	Johnson–Cousins J magnitude (*)
Other name	Alternative name for the star
VPH	Grating of the observed spectrum
T_{eff}	Effective temperature from the literature
$\log g$	Surface gravity (log) from the literature
[Fe/H]	Iron abundance (log) from the literature
Reference	Original catalogue from which it was inherited
Other comments	Comments relating to the star
ASCII/FITS file	Name of the ASCII/FITS spectrum file
Obs. period	GTC observing semester
No. exp.	Number of exposures
Exp. time	Time of the individual exposures (s)
Seeing	Value of the seeing as reported by GTC (arcsec)
Obs-GTC	Comments relating to the observations

Note.(*) Source: SIMBAD.

419 columns
414 stars + 5 observed twice

Appendix C

Column	Description
Name	Star name (*)
RA	Right ascension (2000.0) hh:mm:ss.s (*)
Dec.	Declination (2000.0) dd:dd:ss.s (*)
Sp. type	Spectral type (*)
RV_VALUE	Radial velocity (km s^{-1}) (*) (n)
U	Johnson–Cousins U magnitude (*) (n)
B	Johnson–Cousins B magnitude (*) (n)
V	Johnson–Cousins V magnitude (*) (n)
R	Johnson–Cousins R magnitude (*) (n)
I	Johnson–Cousins I magnitude (*) (n)
J	Johnson–Cousins J magnitude (*) (n)
H	Johnson–Cousins H magnitude (*) (n)
K	Johnson–Cousins K magnitude (*) (n)
Other name	Alternative name of the star (n)
T_{eff}	Effective temperature from the literature (K) (n)
$\log g$	Surface gravity (log) from the literature (n)
[Fe/H]	Iron abundance (log) from the literature (n)
Reference	Original catalogue from which it was inherited (n)
Other comments	Comments relating to the star (n)
MAIN_ID	Default name in the SIMBAD data base
id_variable	ID if the star is identified as a known variable (n)
id_hipparcos	Star name in the *Hipparcos* catalogue (n)
id_tycho	Star name in the *Tycho* catalogue (n)
id_gaiadr2	Star name in the *Gaia* DR2 catalogue
RA_ICRS	Barycentric right ascension (ICRS) at Ep = 2015.5 (°)
e_RA_ICRS	Standard error of right ascension (mas)
DE_ICRS	Barycentric declination (ICRS) at Ep = 2015.5 (°)
e_DE_ICRS	Standard error of declination (mas)
Source	Unique source identifier (unique within a particular data release)
Plx	Absolute stellar parallax (mas) (n)
e_Plx	Standard error of parallax (mas) (n)
pmRA	Proper motion in RA direction (mas yr^{-1}) (n)
e_pmRA	Standard error of proper motion in RA (mas yr^{-1}) (n)
pmDE	Proper motion in Dec. direction (mas yr^{-1}) (n)
e_pmDE	Standard error of proper motion in Dec. (mas yr^{-1}) (n)
Dup	[0/1] Source with duplicate sources

MEGASTAR DR1

Gaia DR2

Column	Description
FG	G-band mean flux (e- s^{-1})
e_FG	Error on G-band mean flux (e- s^{-1})
Gmag	G-band mean magnitude (Vega)
e_Gmag	Standard error of G-band mean magnitude (Vega)
FBP	Mean flux in the integrated BP band (e- s^{-1}) (n)
e_FBP	Error on the integrated BP mean flux (e- s^{-1}) (n)
BPmag	Integrated BP mean magnitude (Vega) (n)
e_BPmag	Standard error of BP mean magnitude (Vega) (n)
FRP	Mean flux in the integrated RP band (e- s^{-1}) (n)
e_FRP	Error on the integrated RP mean flux (e- s^{-1}) (n)
RPmag	Integrated RP mean magnitude (Vega) (n)
e_RPmag	Standard error of RP mean magnitude (Vega)(n)
BP-RP	BP − RP colour
RV	Spectroscopic radial velocity in the solar barycentric reference frame (km s^{-1}) (n)
e_RV	Radial velocity error (km s^{-1})
Teff_2	Stellar effective temperature from A–P (K)
AG	Estimate of extinction in the G band from (n)
E(BP-RP)	Estimate of reddening from A–P (n)
Rad	Estimate of radius from A-FLAME (solRad) (n)
Lum	Estimate of luminosity from A-FLAME (solLum) (n)

Notes. (*) Source: SIMBAD.

Gaia DR2 data for 388 stars out of DR1 414

388 columns

Data available

Username: *public*
Password: *Q50ybAZm*

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MEGASTAR: paper III

Mollá et al. 2022, to be submitted

Teff, log g and [Fe/H] determination
for the cool stars of DR1

Use of DR1 spectra @ PopStar models

NEXT TALK

MEGARA-GTC stellar spectral library - III. Estimating the MEGASTAR stellar parameters for using in a synthesis model.

M. Mollá[1]*, N. Cardiel[2,3], M.L. García-Vargas[4], I. Millán-Irigoyen[1], E. Carrasco[5], A. Gil de Paz[2,3], S. R. Berlanas[6], and P. Gómez-Álvarez[4]

[1] Dpto. de Investigación Básica, CIEMAT, Avda. Complutense 40, E-28040 Madrid, Spain
[2] Dpto. de Física de la Tierra y Astrofísica, Fac. CC. Físicas, Universidad Complutense de Madrid, Plaza de las Ciencias, 1, E-28040 Madrid, Spain
[3] Instituto de Física de Partículas y del Cosmos, IPARCOS, Fac. CC. Físicas, Universidad Complutense de Madrid, Plaza de las Ciencias 1, E-28040 Madrid, S
[4] FRACTAL S.L.N.E., Calle Tulipán 2, portal 13, 1A, E-28231 Las Rozas de Madrid, Spain
[5] Instituto Nacional de Astrofísica, Óptica y Electrónica, INAOE, Calle Luis Enrique Erro 1, C.P. 72840 Santa María Tonantzintla, Puebla, Mexico
[6] Departamento de Física Aplicada, Universidad de Alicante, 03690 San Vicente del Raspeig, Alicante, Spain

ABSTRACT

MEGARA is the optical integral field and multi-object fibre-based spectrograph for the 10.4m Gran Telescopio Canarias that offers medium-to-high spectral resolutions (FWHM) of $R \approx 6\,000$, $12\,000$, and $20\,000$. We have created MEGASTAR an instrument-oriented empirical stellar spectral library observed with MEGARA-GTC at high-resolution $R = 20\,000$ (HR-R and HR-I VPH-grating configurations). To correctly interpret the observations of galaxies and stellar clusters obtained with this instrument, we aim to develop an evolutionary synthesis model to produce Spectral Energy Distributions for Simple Stellar Populations of different ages and metallicities by using MEGASTAR stellar spectra. To achieve this task we need the stellar parameters, namely effective temperature, surface gravity and metallicity for all the stars in the library. This will allow us to associate, once selected the most appropriate isochrone for the target metallicity, the stellar spectrum that better fit the theoretical parameters (Teff and logg) of a given area of the adopted isochrone. This piece of work describes how we have performed this task for stars cooler than spectral type A. We present here the rectified spectra (once divided by their best-fitted continuum), as MEGASTAR spectra are taken in filler-type GTC time so lack of an absolute flux calibration. We use a χ^2 technique with which, by comparing theoretical stellar models with the observed MEGASTAR spectra, we obtain their stellar parameters from the best fits. Finally, we show preliminary predictions from the evolutionary synthesis MEGAPOPSTAR model, using MEGASTAR stellar library's stellar spectra

MEGASTAR: paper IV

Berlanas et al. 2022 in prep.

Derive Teff, log g & [Fe/H] for B and hotter stars of DR1

The determination of the stellar parameters is very different for hot stars
FASTWIND models extended to the HR-I wavelength

MEGASTAR: paper V

Second Release DR2 with ~700 stars in 2022
414 estrellas de DR1 + 263 (2020A, 2020B, 2021A, 2021B)

Continuum fitting and normalized spectra
(Cardiel MNRAS 396, 2009)

Radial velocity corrected spectra

Physical parameters Teff, log g, [Fe/H] for all the stars determined with the same method

MEGASTAR

A project in progress

Pilot program: MEGARA commissioning (2017)

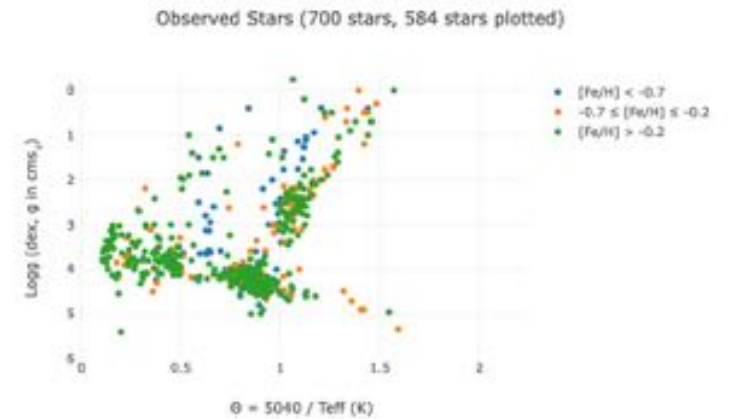Open time requested: 7 semesters (+ 2022A, 174 stars)
in *filler mode*

MEGASTAR ideal

Reduced spectra : + 1200

Database: public

Data Release 1.0: MEGASTAR DR1

Published papers: 2   + 3 in progress

Full Library (2989 stars, 2390 stars plotted)

Observed Stars (700 stars, 584 stars plotted)

SUMMARY

MEGASTAR

Is a precious tool to generate composite populations for the interpretation of MEGARA data

Attractive resource for stellar astrononomers interested in the study of individual stars at high resolution

Resolution HR: R ~ 20,000   6420 – 6790 Å, Halfa (HR-R) & 8370 – 8885 Å, CaII (HR-I)

SUMMARY

MEGASTAR

Is a legacy project for the community

Its data and products are available through a public webpage

Resolution HR: R ~ 20,000 $6420 - 6790$ Å, Halfa (HR-R) & $8370 - 8885$ Å, CaII (HR-I)
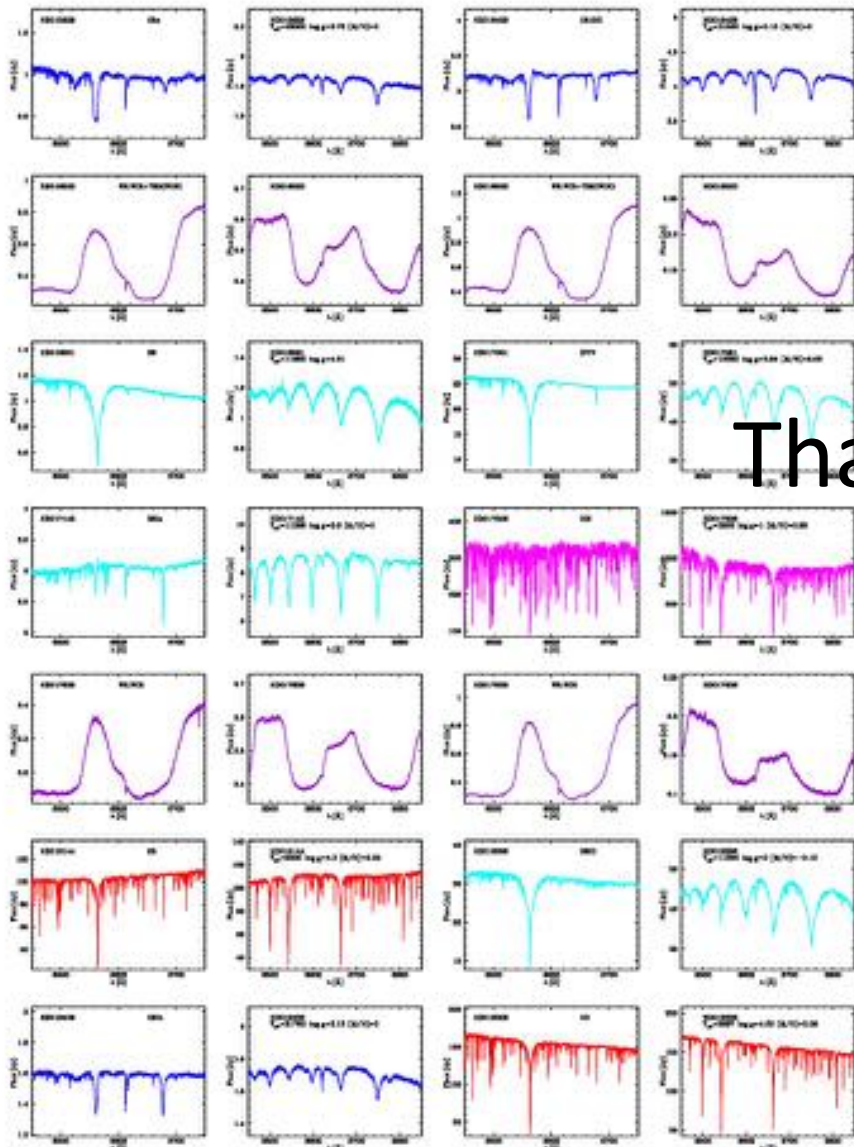
Thank you

Figure 1 — continued 4. Stars shown in this page are: HD015629, HD016429, HD016523, HD016523, HD016581, HD017081, HD017145, HD017506, HD017638, HD017638, HD018144, HD018296, HD018409 and HD019508.
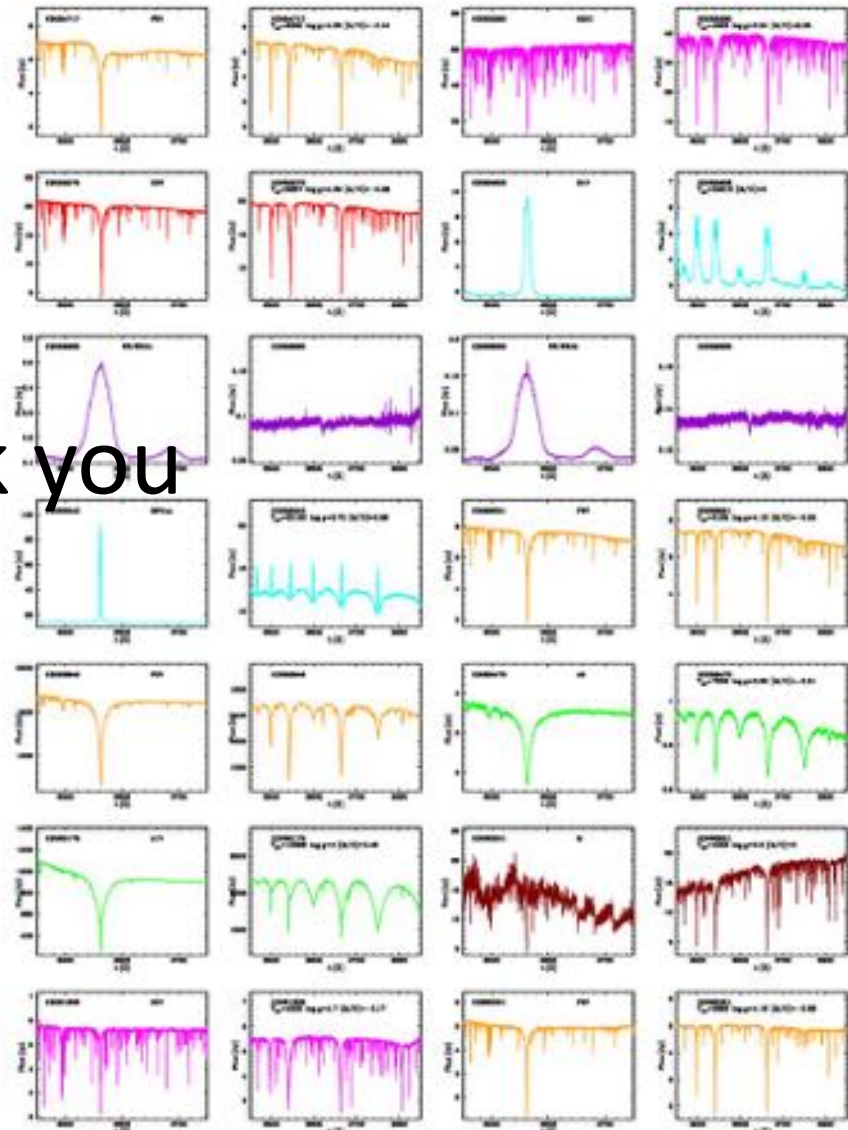
Figure 1 — continued 13. Stars shown in this page are: HD054717, HD055280, HD055575, HD055606, HD056925, HD056925, HD058343, HD058551, HD059946, HD059473, HD060179, HD060501, HD061606 and HD062301.