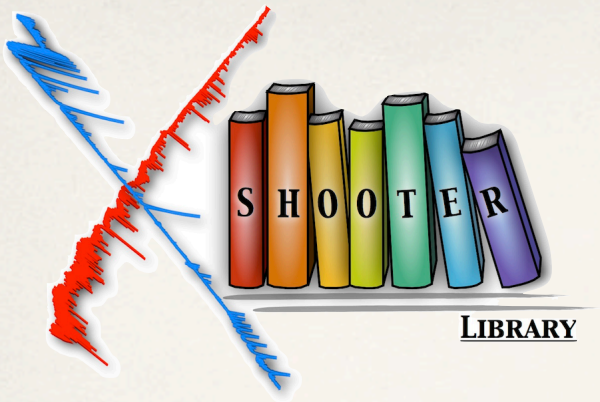


university of groningen / kapteyn astronomical institute

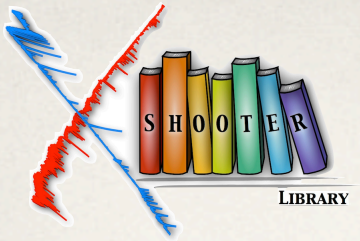
XSL: the X-Shooter Spectral Library

Mariya Lyubenova
Kapteyn Astronomical Institute
University of Groningen

08.10.2015, Rainbows In The Southern Sky, ESO

XSL: the X-Shooter Spectral Library

- Moderate resolution spectral library, containing ~700 unique stars
- ESO Large Program in two phases:
  - Pilot Program: P84 and P85 (Oct 2009 - Oct 2010)
  - Large Program: P89 - P92 (April 2012 - Sept 2013)



XSL: the Team

- PI: S. Trager (Kapteyn), A. Lançon (Strasbourg), R. Peletier (Kapteyn)
- 18 researchers in 9 institutes in 7 countries

university of groningen / kapteyn astronomical institute

Observatoire astronomique de Strasbourg

CRA Lyon

INSTITUTO DE ASTROFISICA DE CANARIAS IAC

OBSERVATÓRIO DE SÃO PAULO SANCTI PAVLI CÆLVM AGER MEVS

AIP

UNIVERSITEIT GENT

UAM UNIVERSIDAD AUTONOMA DE MADRID

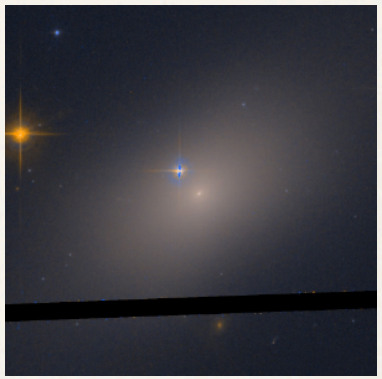
جامعة نيويورك أبوظبي
NYU ABU DHABI

Alexandre Vazdekis, Anaïs Gonneau, C. Jakob Walcher, Jesus Falcón-Barroso, Mariya Lyubenova, Mathieu Powalka, Matthijs Dries, Mina Koleva, Omar Choudhury, Patricia Sanchéz-Blazquéz, Paula Coelho, Philippe Prugniel, Sofia Meneses-Goytia, Yanping Chen

XSL: Science Objectives
Primary

- Develop a stellar spectral library at moderate resolution covering a wide spectral window for use in stellar population studies
  - from the atmospheric cutoff in the NUV (300 nm) to the thermal NIR (2480 nm)

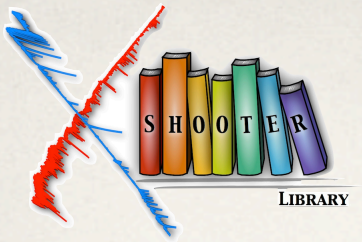




  - Prepare for JWST+E-ELT observations, exploit current generation of instrumentation

XSL: Science Objectives Secondary

- Provide:
  - baseline spectra for studies of individual stellar types
  - test bench for theoretical stellar libraries
  - templates for kinematics studies of stellar systems



The Perfect Stellar Library

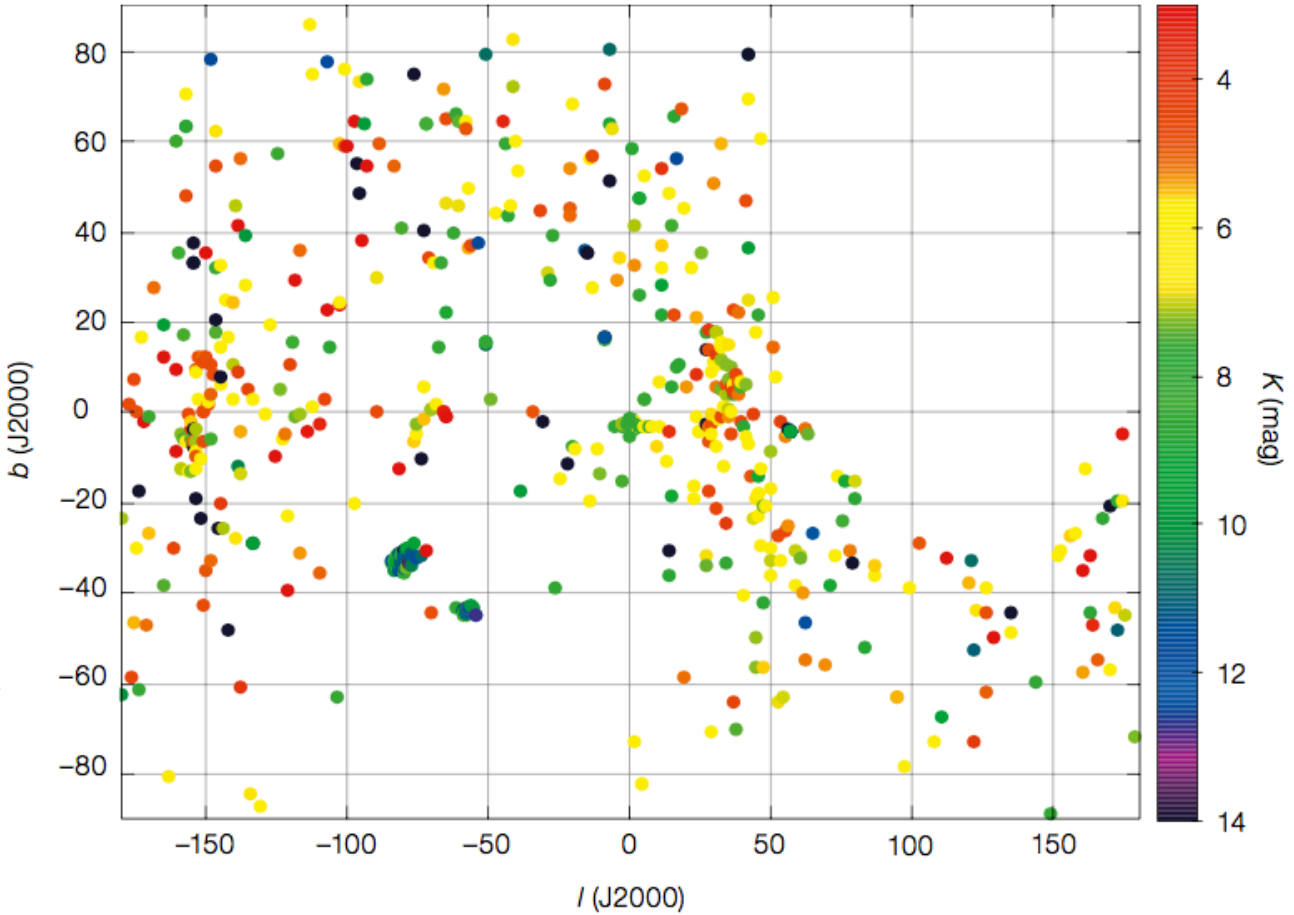
- Lots of stars: all stellar evolutionary phases for all conceivable stellar compositions
- Excellent flux and wavelength calibrations
- Broad wavelength coverage
- Simultaneous observations at all wavelengths of interest

XSL: Target Selection

- Cover as much of the Hertzsprung–Russell diagram as possible:
  - special attention to cool stars in the MW and the Magellanic Clouds
  - Galactic Bulge giants to cover metal-rich stars with abundances similar to those in giant elliptical galaxies.
  - as much overlap as possible with MILES, Lick/IDS, Jones, IRTF, and Lançon-Wood libraries

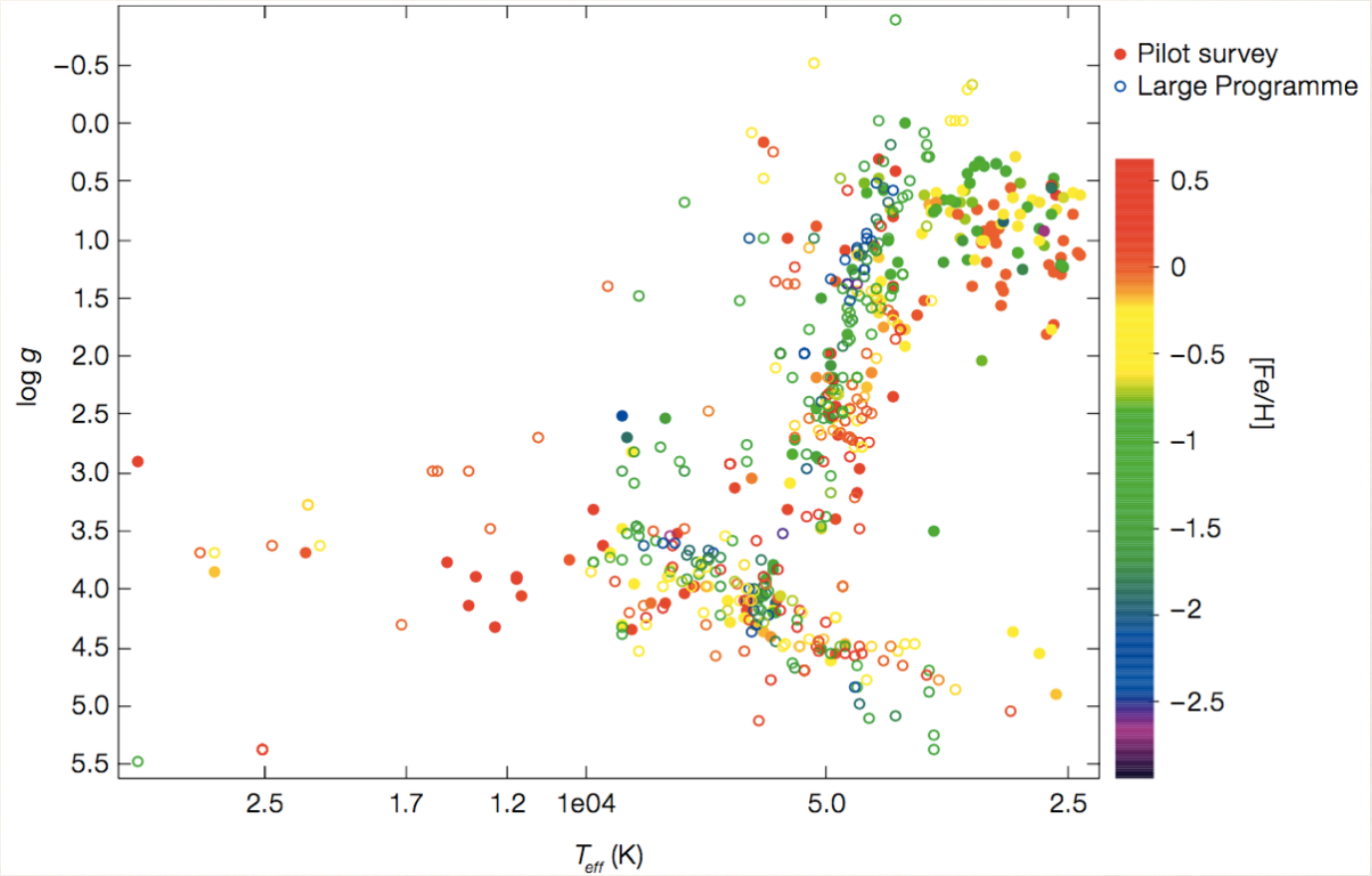
XSL: Target Selection

- Distribution on the sky



Chen et al. 2014, the Messenger

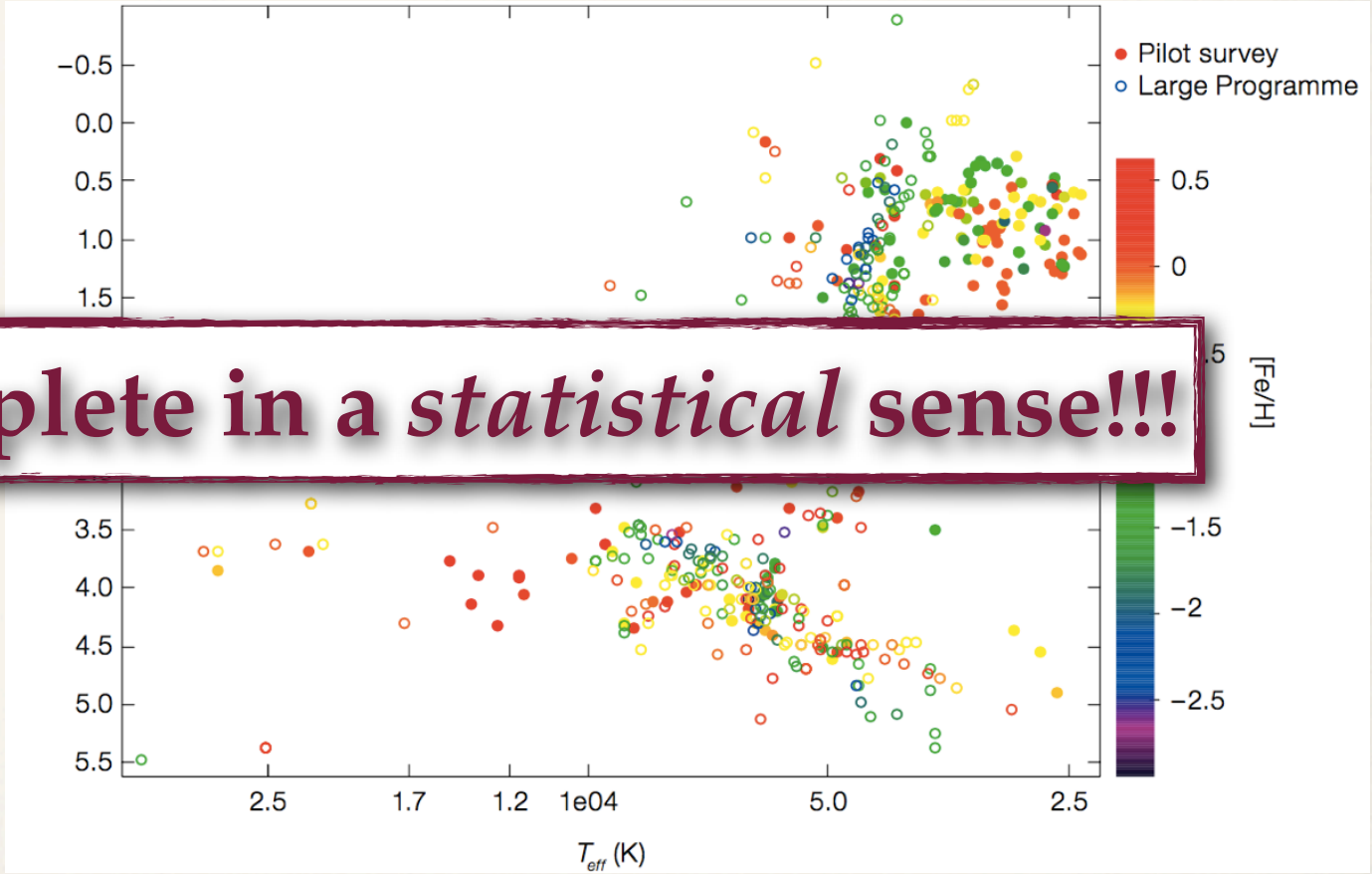
XSL: Target Selection



- XSL atmospheric parameters

Chen et al. 2014, the Messenger

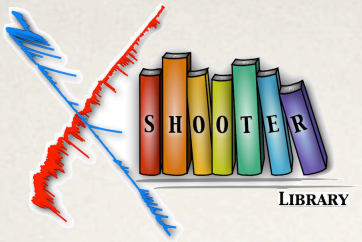
XSL: Target Selection



Not complete in a *statistical* sense!!!

- XSL atmospheric parameters

Chen et al. 2014, the Messenger

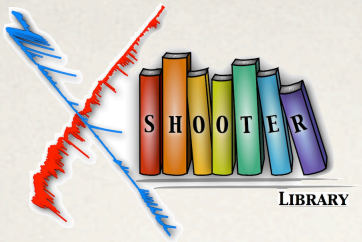


Observations

- Narrow slit

Arm	Slit	λ (nm)	R
UVB	0.5″ × 11″	300 — 600	9100
VIS	0.7″ × 11″	600 — 1020	11000
NIR	0.6″ × 11″	1000 — 2480	8100

- Plus 5″ wide slit for flux loss corrections



Current status

- All observations completed by April 2014
- 697 unique stars observed and almost completely reduced
  - ~1/3 have repeated observations
- DR1, *March 2014*: UVB+VIS spectra from the Pilot Program
  - 246 spectra of 237 unique stars
  - Dedicated web service: http://xsl.u-strasbg.fr

Chen et al. 2014, *A&A*, 565A, 117

DR1: http://xsl.u-strasbg.fr

xsl.u-strasbg.fr

The X-shooter Spectral Library

- Home
- About the spectra
- All stars
- Stars / spectral type
- People
- Papers

The X-shooter Spectral Library is a collection of 3000–25000 Å all stellar spectra observed at a resolving power of R = λ/Δλ ~ 10 000 with the medium-resolution spectrograph X-shooter at the Very Large Telescope (VLT).

The current release contains more than 200 stars, while the final sample will contain more than 700 stars and cover most of the HR diagram with spectral types between O and M, as well as AGB stars.

Figures 1 and 2, taken from Chen et al. (2014), show the distribution of spectral types in DR1 and the HR diagram of these stars.

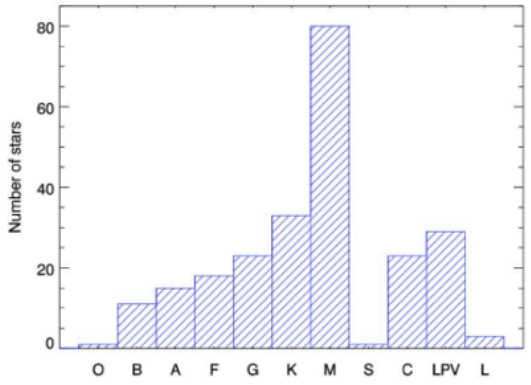


Figure 1: Distribution of the spectral types in XSL observed in Periods 84 and 85 (excluding telluric calibrators). Spectral types were retrieved from SIMBAD or based on educated guesses from the source libraries or atmospheric parameters.

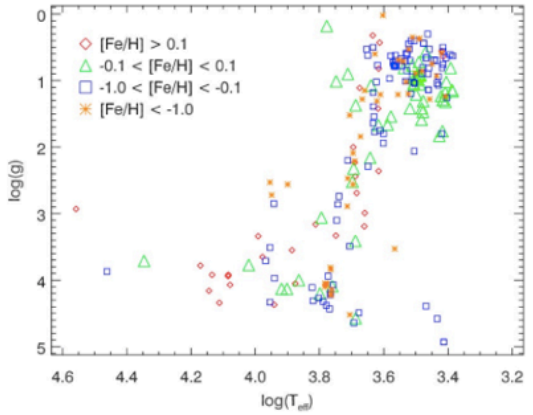
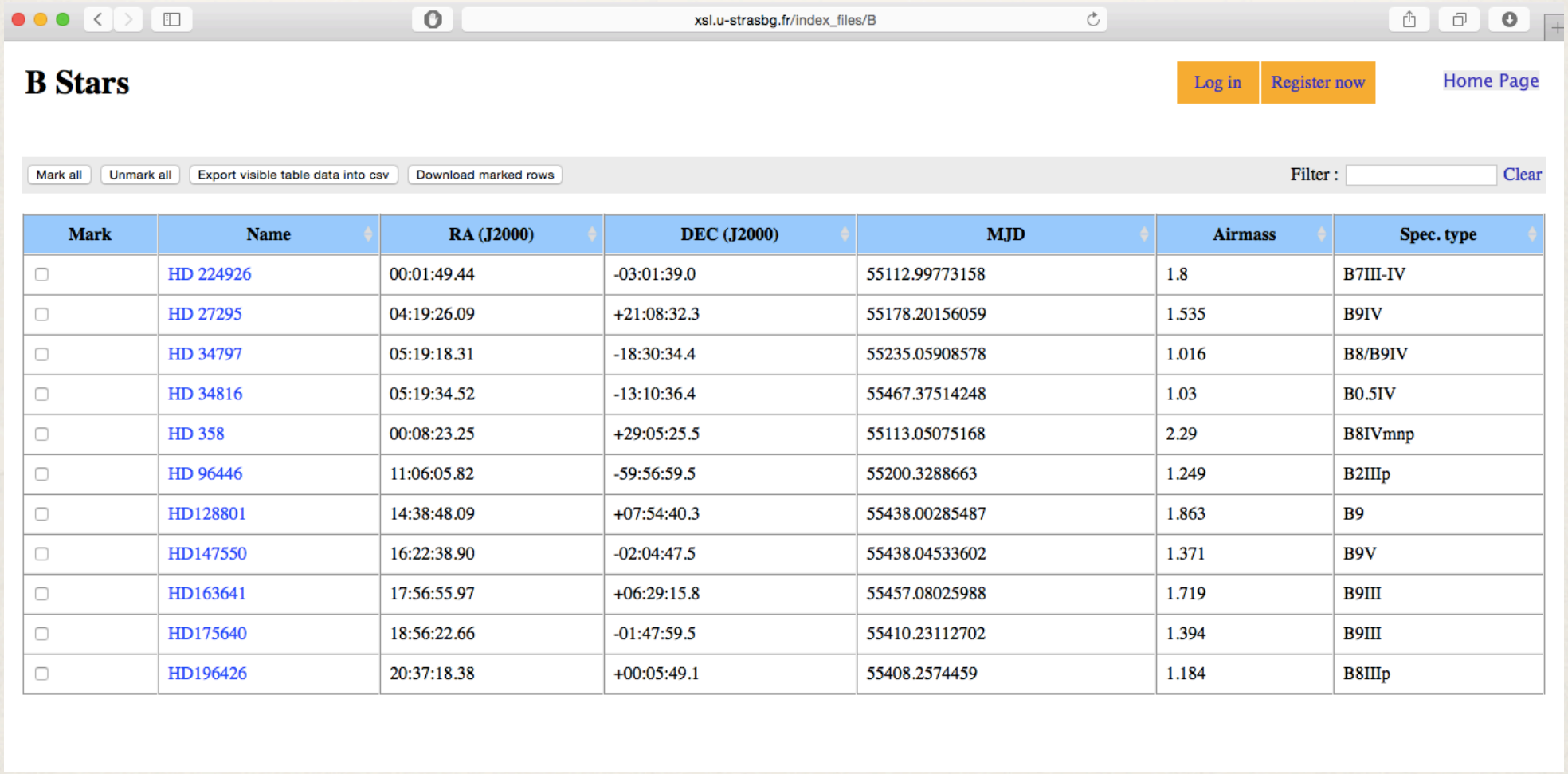


Figure 2: HR diagram of the 219 XSL stars (O-M, LPV, S) with calculated Teff, logg, and [Fe/H], where [Fe/H] is presented in different colors.

Last modified on: September 1, 2014

Maintained by Anaïs Gonneau

DR1: http://xsl.u-strasbg.fr



Mark	Name	RA (J2000)	DEC (J2000)	MJD	Airmass	Spec. type
☐	HD 224926	00:01:49.44	-03:01:39.0	55112.99773158	1.8	B7III-IV
☐	HD 27295	04:19:26.09	+21:08:32.3	55178.20156059	1.535	B9IV
☐	HD 34797	05:19:18.31	-18:30:34.4	55235.05908578	1.016	B8/B9IV
☐	HD 34816	05:19:34.52	-13:10:36.4	55467.37514248	1.03	B0.5IV
☐	HD 358	00:08:23.25	+29:05:25.5	55113.05075168	2.29	B8IVmnp
☐	HD 96446	11:06:05.82	-59:56:59.5	55200.3288663	1.249	B2IIIp
☐	HD128801	14:38:48.09	+07:54:40.3	55438.00285487	1.863	B9
☐	HD147550	16:22:38.90	-02:04:47.5	55438.04533602	1.371	B9V
☐	HD163641	17:56:55.97	+06:29:15.8	55457.08025988	1.719	B9III
☐	HD175640	18:56:22.66	-01:47:59.5	55410.23112702	1.394	B9III
☐	HD196426	20:37:18.38	+00:05:49.1	55408.2574459	1.184	B8IIIp

DR1: http://xsl.u-strasbg.fr

xsl.u-strasbg.fr/index_files/B

B Stars

Log in | Register now | Home Page

Mark all | Unmark all | Export visible table data into csv | Download marked rows | Filter : | Clear

Mark	Name	RA (J2000)	DEC (J2000)	MJD	Airmass	Spec. type
☐	HD 224926	00:01:49.44	-03:01:39.0	55112.99773158	1.8	B7III-IV
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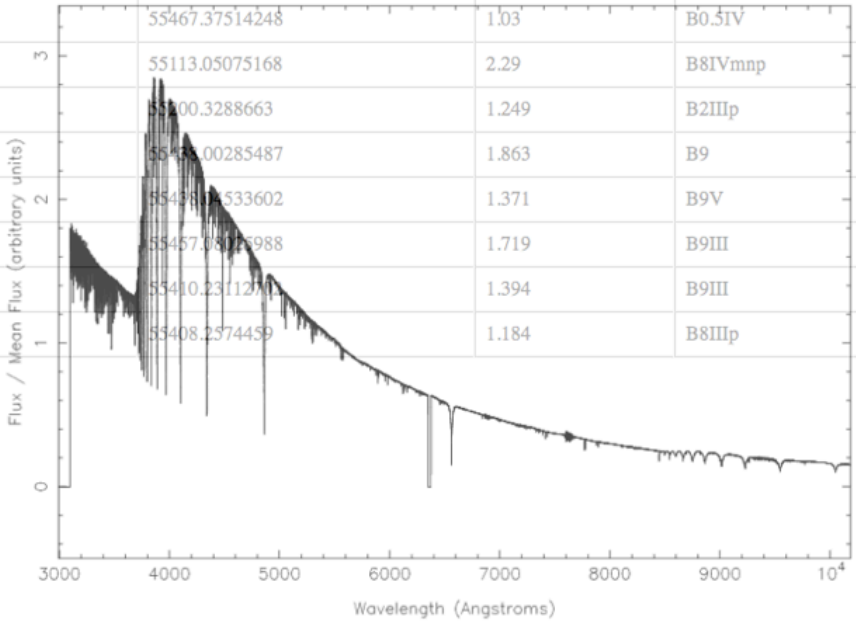
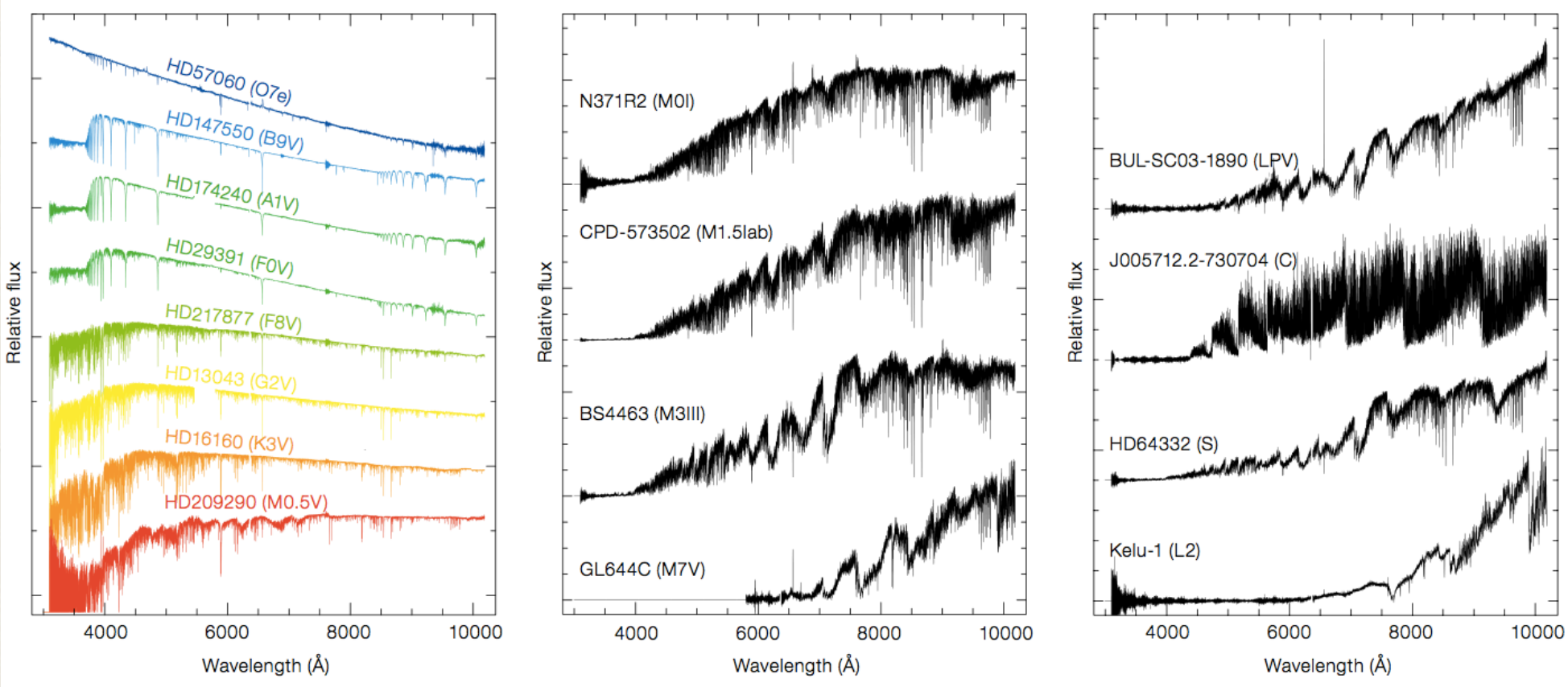
☐	HD 96446	11:06:05.82	-59:56:59.5	55200.3288663	1.249	B2IIIp
☐	HD128801	14:38:48.09	+07:54:40.3	55[illegible].00285487	1.863	B9
☐	HD147550	16:22:38.90	-02:04:47.5	55[illegible].533602	1.371	B9V
☐	HD163641	17:56:55.97	+06:29:15.8	55457.0[illegible]5988	1.719	B9III
☐	HD175640	18:56:22.66	-01:47:59.5	55410.2311[illegible]	1.394	B9III
☐	HD196426	20:37:18.38	+00:05:49.1	55408.2574459	1.184	B8IIIp

File: HD27295_389638_55178_UVB+VIS.fits



Return to Home Page

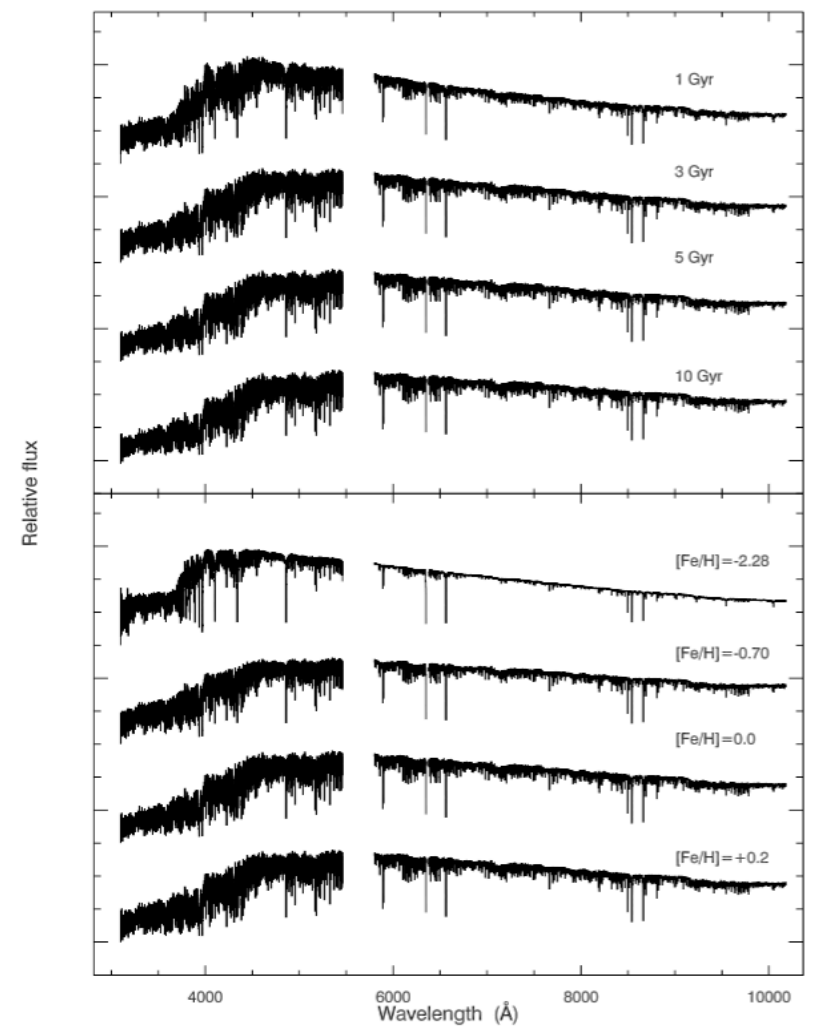
DR1 spectra



Chen et al. 2014, *A&A*, 565A, 117

Stellar population models

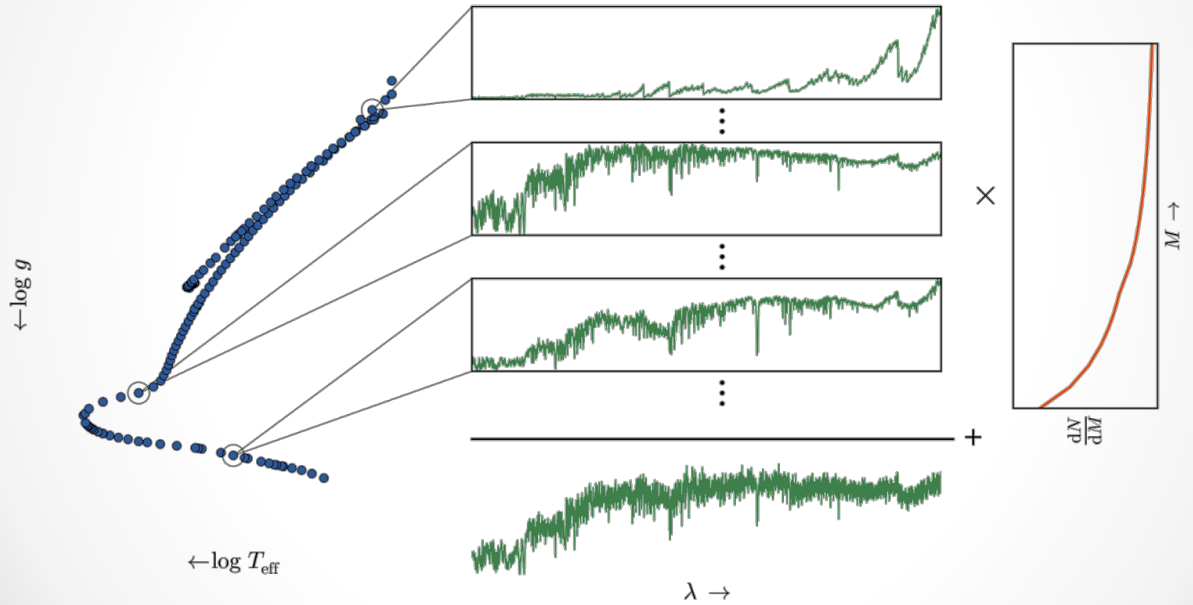
- Yanping Chen, PhD Thesis 2013, *Univ. of Groningen*
  - SED in the range 3100 to 10200 Å
  - $-0.7 < [Fe/H] < +0.2$
  - age from 0.1 to 15 Gyr
  - Marigo and BaSTI isochrones



Stellar population models

Stellar Population Synthesis

a Bayesian approach



Matthijs Dries, Scott Trager & Léon Koopmans
Kapteyn Astronomical Institute, university of Groningen

First Science Results

Carbon stars in the X-shooter Spectral Library ★

A. Gonneau[1,2], A. Lançon[1], S. C. Trager[2], B. Aringer[3], M. Lyubenova[2], W. Nowotny[3], R. F. Peletier[2], P. Prugniel[4], Y.-P. Chen[5], M. Dries[2], O. Choudhury[6], J. Falcón Barroso[7], M. Koleva[8], S. Meneses-Goytia[2], P. Sánchez Blázquez[9], and A. Vazdekis[7]

ABSTRACT

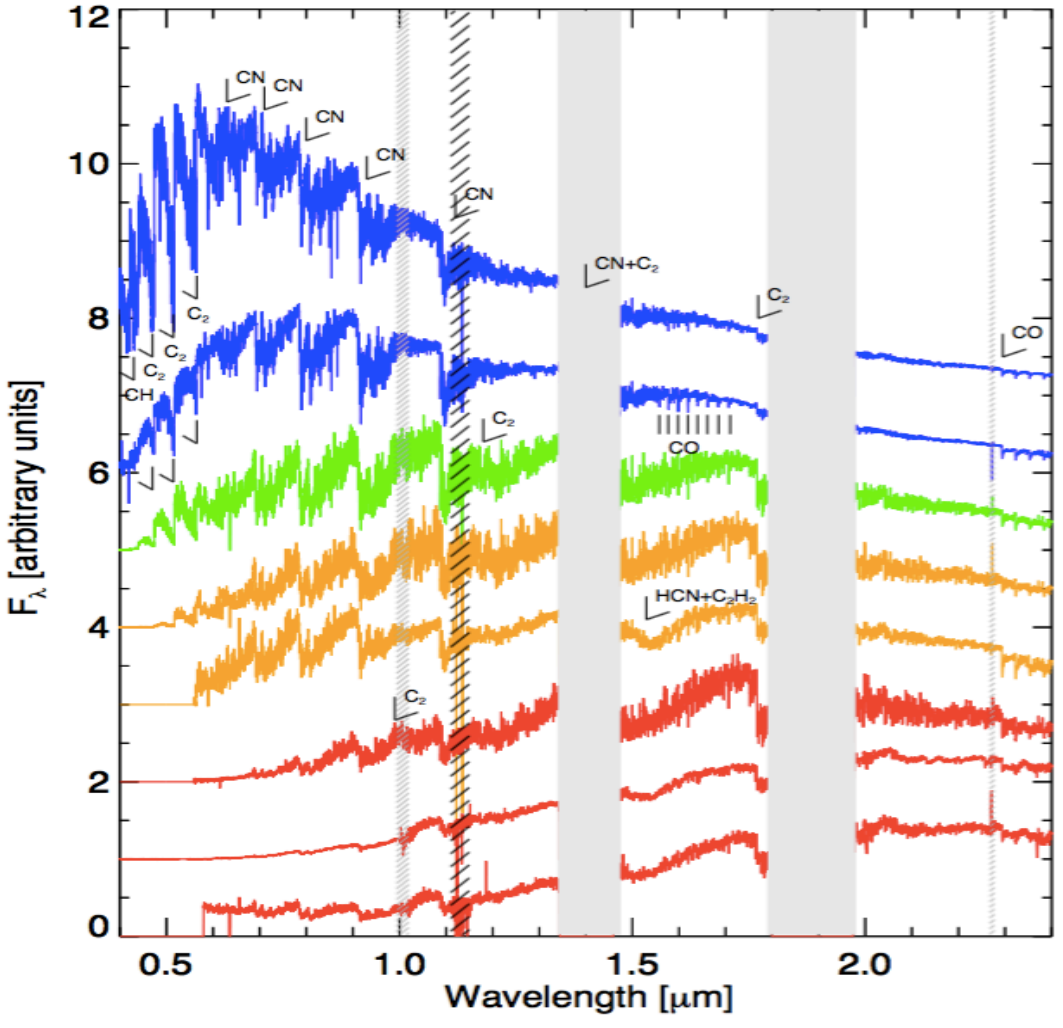
With a relatively tight locus in color-color diagrams, carbon star spectra have been described as displaying little variety compared to their oxygen-rich asymptotic giant branch counterparts.
We provide a new collection of carbon star spectra that will help to improve population synthesis models and that also permits a new assessment of the relationships between colors and spectral features.
The spectra were obtained with the ESO/VLT X-shooter instrument as part of the X-shooter Spectral Library project. The spectra extend from blue optical wavelengths to 2.4 μm with a resolving power above $\sim$ 8000. The sample contains 35 stars with a broad range of $(J - K)$ colors and pulsation properties, located in the Milky Way and the Magellanic Clouds.
We show that the distribution of spectral properties of carbon stars at a given $(J - K)$ color becomes bimodal (in our sample) when $(J - K)$ is larger than about 1.5. We describe the two families of spectra that emerge, characterized by the presence or absence of the absorption feature at 1.53 μm, generally associated with HCN and C_2H_2. Anticipating detailed comparisons with model spectra, we suggest that hot circumstellar dust emission in the near-infrared may help to explain the properties of those stars showing this feature.

Key words. XSL – stars: AGB - carbon – wavelength: UVB to NIR – feature: 1.53 μm

Gonneau et al. 2015, *A&A submitted*

First Science Results

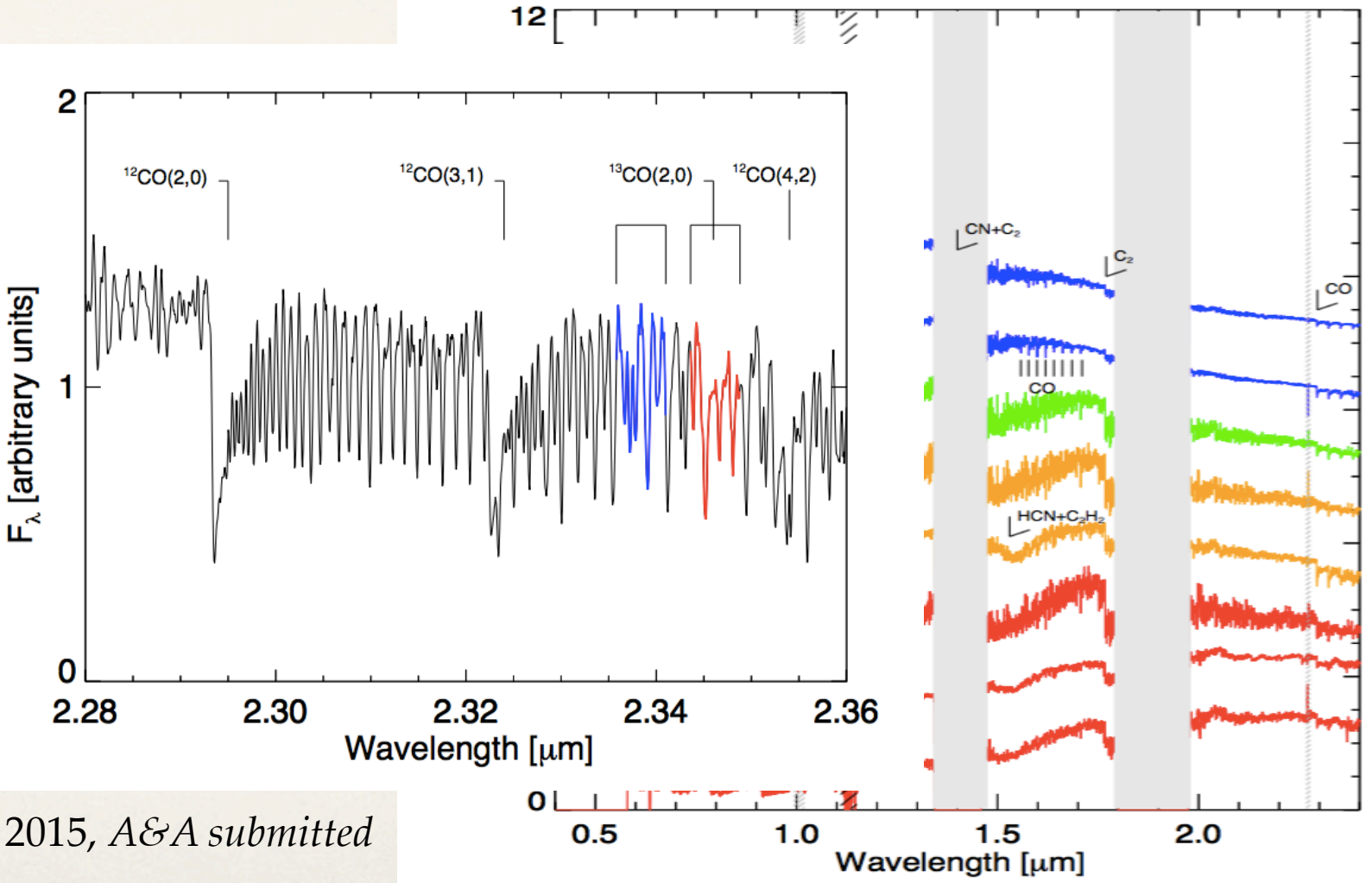
- 35 UVB-to-NIR spectra of Carbon-rich stars in the MW and MC



Gonneau et al. 2015, *A&A submitted*

First Science Results

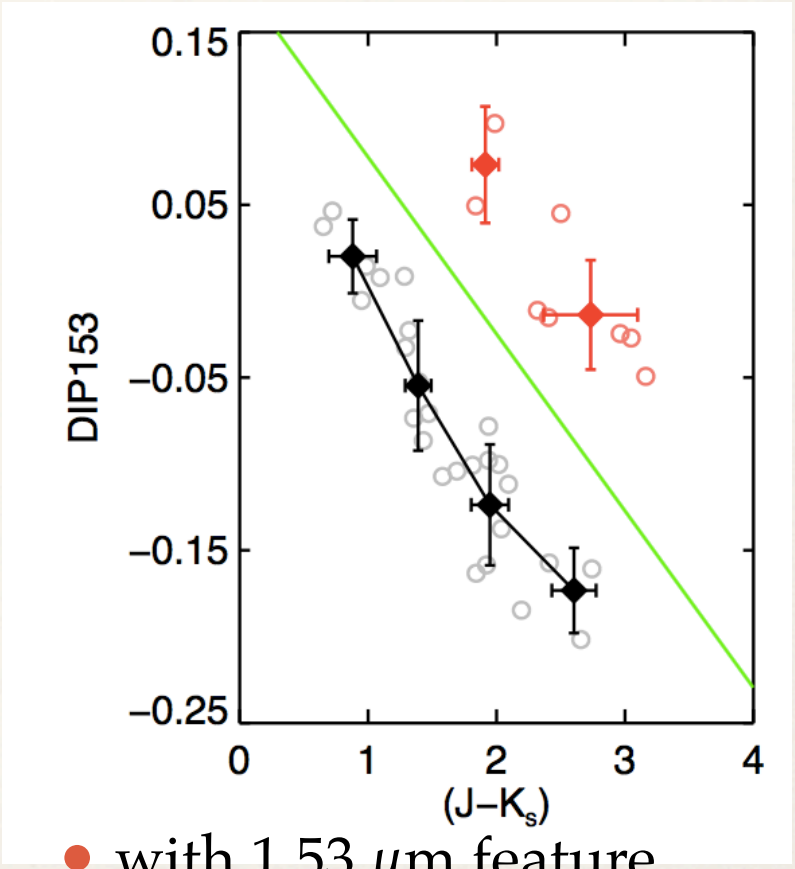
- 35 UVI
of Carl
the MV



Gonneau et al. 2015, *A&A submitted*

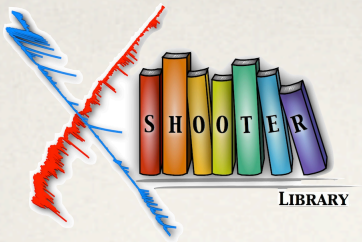
Bimodal behaviour of C-rich stars

- Two distinct families of C-rich stars
- Due to hot circumstellar dust emission in the near-infrared?
- Need comparison with atmospheric models



- with 1.53 μm feature
- without 1.53 μm feature

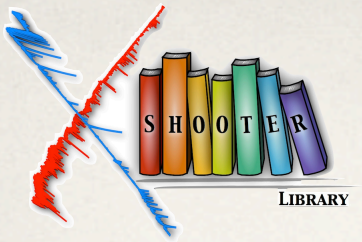
Gonneau et al. 2015, *A&A submitted*



ESO Phase 3

- Currently working on it with ESO/ASG
- Submitted in total 1553 individual narrow slit spectra that passed initial QC
- 1D spectra at native spectral resolution + flux loss and telluric correction

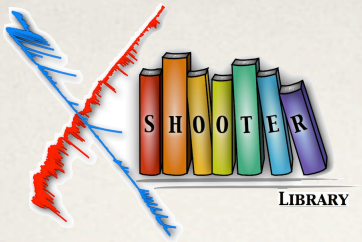
Arm	Total N of spectra	Unique spectra
UVB	628	554
VIS	630	557
NIR	295	267



XSL DR2, end of 2015

- Contains all good spectra of Phase 3 put to rest frame plus:
  - Improved telluric correction
  - Improved flux calibration
  - QC flags
  - spectra per arm at native resolution and merged UVB-to-NIR spectra smoothed to a common resolution

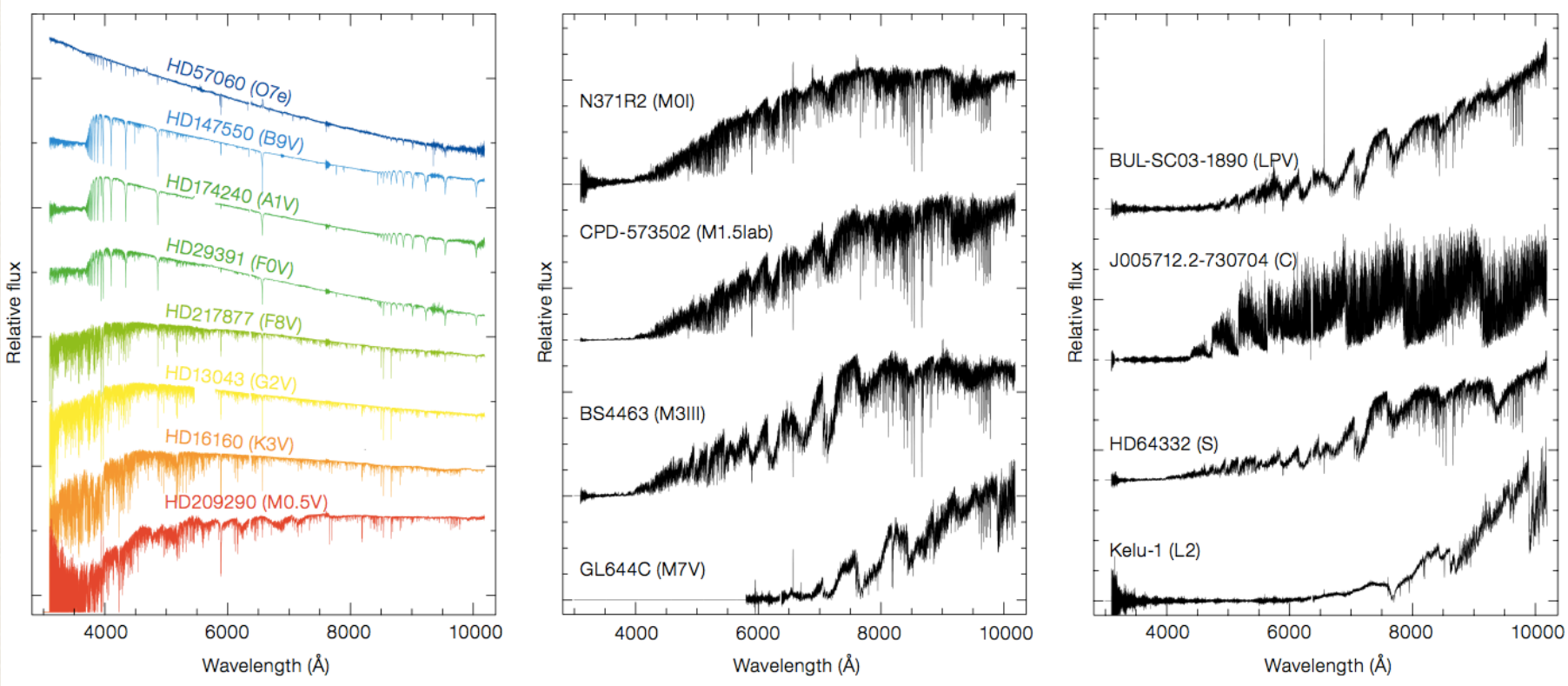
Lyubenova et al., *in prep.*



High level data products

- Radial velocities of stars
- Stellar atmospheric parameters
- VIS telluric library
- ...

XSL: the X-Shooter Spectral Library



http://xsl.u-strasbg.fr