OAG-SVO Star Analyser Spectroscopic Data Base

SASDABA Pro-Am project. README-v4, July 2020

Abstract

SASDABA aims to create an archive of spectroscopic images of some 2,000 bright stars (V< =6) in the Northern and Southern Hemispheres. The spectra are obtained with a diffraction grating Star Analyser100 -200 L/mm to which a prism of 3.8° can be attached, made by Paton Hawksley Education Ltd (UK). The instrument used is a Schmidt-Cassegrain type Celestron-11 Fastar telescope of 288mm aperture F/10 at the Garraf Astronomical Observatory (OAG/VNG Station). Images are captured with different CMOS and CCD cameras coupled to a Rotarion Wheel multi-purpose device designed by AstronScientific (Spain).

SASDABA is designed for teachers, students and amateurs, who wish to perform introductory work of stellar spectroscopy, as well as to consider atmospheric and instrumental factors that affect observations. This database provides raw images which can be treated and analysed by users according to their interests. It is about facilitating access to original observations, as they would have been obtained directly from the observatory. In successive phases, supplementary files can be incorporated in order to allow comparison with our own results.

The approach and methodology of this project is largely inspired by the classic works gathered in the Henry Draper Memorial & Henry Draper Catalogue (Publications of Harvard College Observatory). The uniformity of instrumental techniques and observational procedures have been designed with the purpose of facilitating mutual comparison between spectral types. The extensive literature on this subject will lead the user to deepen and pave the way for more sophisticated observations.

The shared coordination OAG-SVO will allow easy access to stored data, which due to its dynamic nature, will be regularly updated. It currently (July 2020) contains files of about 900 stars. Depending on the conditions of observation and the planned observationsin the Southern Hemisphere, SASDABA could be completed by the end of 2022.

This project is open to all those who wish to participate.

Anyone interested is welcome to contact the coordination team at

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Video Tutorials for analysis of spectra images with RSpec software by T.Field: www.rspec-astro.com

Fig.1: Project's homepage: SASDABA

2. Database

SASDABA's database is developed by the team at the *Spanish Virtual Observatory* (SVO /CAB-CSIC-INTA).They have created the user interface to the observational data obtained from the *Observatori Astronòmic del Garraf* (OAG), whose delivery started after a short test trial in January 2018. In its first phase, (October 2019-v1 / March 2020-v1.2) SASDABA is accommodating the needs of its users in order to achieve the optimal configuration for accessing and retrieving the files. Both teams at OAG and SVO have a background of collaboration in joint projects dealing with the searching and cataloguing of double and multiple star systems with common proper motion (OAG *Garraf Common Proper Motion Wide Pairs Survey 2009-2020+*) and revision of neglected double stars (*Neglected Double Stars 2015+*).

Observations made at OAG are sent via SFTP to the SVO server on a monthly basis, distributed in folders corresponding to one observing night each. Each folder includes all spectroscopic images with its corresponding text files. Due to the educational nature of the project, no short listing based on quality is performed as the main point is to present the totality of the observational material as is. The analysis of images captured under less favourable conditions has a very practical value, revealing the observational limits of Earth's atmosphere. Observational conditions can vary during the observing session, so a randomly chosen image is not necessarily representative of the quality of all images taken that night, changes can happen in minutes. Only nights with extremely bad observing conditions have been discarded as observing sessions in SASDABA. In the case of stars observed during a single night, the data is included if the quality meets a minimal established standard. Additional observations can be used to replace such defective data if quality improves. Nevertheless, as already remarked, it is not SASDABA's purpose to offer an idealized selection, but a real night-observing experience. It is on the user side to determine which images are used.

Maintaining SASDABA implies a continuous expansion of its contents, as well error proofing and further adapting to the user's needs. User's suggestions are always welcome. The project has an estimated duration of four years, being a critical factor for its completion the acquisition of data from the Southern hemisphere, either through specific expeditions or by remote means. The practical limit of the OAG/VNG observatory (Vilanovai la Geltrú-Barcelona) is DEC=-15˚, and that of OAG/OAPG (Parc del Garraf, Olivella-Barcelona) and OAG/NVP (Navalperal de Pinares-Ávila) stations is about DEC=-35˚.

3. File and data retrieval

SASDABA provides the following information for each catalogued star:

- Common name of the star
- Henry Draper Catalogue number or alternative
- Bayer designation
- Flamsteed designation
- Link to SIMBAD database (CDS, Strasburg)
- Equatorial coordinates 2000,0:RA/DEC (sexagesimal degrees)
- Equatorial coordinates 2000,0:RA / DEC (hh mm ss / ˚ ‘“)
- Observer code
- Apparent visual magnitude
- Spectral classification

643 results found

Search selected objects

Select	Search	Name	HD Name	Bayer id	Flamsteed id	SIMBAD	RA (degree)	Dec (degree)	RA	Dec	V	Spec. Type
☐	View observations	-	HD225003	c Psc	32 Psc	view	0.62376	8.48546	00 02 29.702	+08 29 07.67	5.690	F1V C 2006AJ....132..161G
☐	View observations	Sirrah	HD358	del Peg	21 And	view	2.09692	29.09043	00:08:23.25	+29:05:25.5	2.06	B8IV-VHgMn
☐	View observations	Caph	HD432	bet Cas	11 Cas	view	2.29452	59.14978	00:09:10.68	+59:08:59.2	2.27	F2III
☐	View observations	Algenib	HD886	gam Peg	88 Peg	view	3.30896	15.18359	00:13:14.15	+15:11:00.9	2.84	B2IV
☐	View observations	-	HD1280	tet And	24 And	view	4.27291	38.68164	00 17 05.499	+38 40 53.89	4.61	A2V C ~
☐	View observations	-	HD1404	sig And	25 And	view	4.58191	36.78523	00:18:19.65	+36:47:06.8	4.52	A2V
☐	View observations	-	HD1635	d Psc	41 Psc	view	5.14942	8.19027	00 20 35.861	+08 11 24.98	5.370	K2.5III C 1989ApJS...71..245K
☐	View observations	-	HD1671	rho And	27 And	view	5.28029	37.96860	00:21:07.26	+37:58:06.9	5.18	F5IV-V
☐	View observations	-	HD1967	-	-	view	6.00811	38.57704	00:24:01.94	+38:34:37.3	7.39	S5-7/4-5e
☐	View observations	-	HD2411	-	47 Psc	view	7.01213	17.89312	00:28:02.91	+17:53:35.2	5.06	M3III
☐	View observations	-	HD2772	lam Cas	14 Cas	view	7.94316	54.52228	00:31:46.35	+54:31:20.2	-	B8Vn
☐	View observations	-	HD2905	kap Cas	15 Cas	view	8.24996	62.93178	00:32:59.99	+62:55:54.4	4.16	B1Ia
☐	View observations	-	HD3369	pi. And	29 And	view	9.22021	33.71934	00:36:52.84	+33:43:09.6	4.36	B5V
☐	View observations	Fulu	HD3360	zet Cas	17 Cas	view	9.24285	53.89691	00:36:58.28	+53:53:48.8	3.66	B2IV
☐	View observations	-	HD3546	eps And	30 And	view	9.63895	29.31176	00:38:33.34	+29:18:42.3	4.38	G7IIIFe-3CH1
☐	View observations	-	HD3627	del And	31 And	view	9.83198	30.86102	00:39:19.67	+30:51:39.6	3.28	K3III-IIIbCN0.5
☐	View observations	Schedar	HD3712	alf Cas	18 Cas	view	10.12684	56.53733	00:40:30.44	+56:32:14.3	2.23	K0-IIIa
☐	View observations	-	HD3901	ksi Cas	19 Cas	view	10.51622	50.51252	00:42:03.89	+50:30:45.0	4.81	B2V
☐	View observations	-	HD4058	pi. Cas	20 Cas	view	10.86695	47.02455	00:43:28.06	+47:01:28.3	4.949	A5V
☐	View observations	-	HD4656	del Psc	63 Psc	view	12.17060	7.58508	00:48:40.94	+07:35:06.2	4.44	K5-III
☐	View observations	-	HD4636	nu. Cas	25 Cas	view	12.20840	50.96817	00 48 50.017	+50 58 05.40	4.891	B9III C ~
☐	View observations	Achird	HD4614A	eta Cas A	24 Cas	view	12.27621	57.81519	00:49:06.29	+57:48:54.6	3.44	F9V+M0-V

Fig.2: “Objetc List” / SASDABA

The user can choose between:

1) Obtaining a complete updated list of all stars included in the catalogue (*Object List*)
2) Selecting by date of observation (*by Date*)
3) Selecting by HD designation (*by Name*)
4) Directly selecting any AVI, TXT (or any other format to be considered)

Users familiarised with star designations and catalogues will have no difficulties selecting and finding the desired object. There is no limit to the number of image .AVI and data .TXT files that can be retrieved. Both types of files are necessary for a correct interpretation of the observation, because the observing parameters allow to evaluate if the observation is valid.The.TXT files are those generated automatically by the image capturing system.

Users can search stars by any of their designations. Bright stars have corresponding common names, Greek letter names and historical numberings. Bayer’s (*Uranometria*1603) and Flamsteed (*Atlas Coelestis*1729*)* designations can differ, so the most systematic way to identify a star is by its number in the Henry Draper Catalogue (1890-1949). SASDABA is sorted in ascending RA order, referenced to equinox 2000,0. This usually coincides with sorting by HD number, although close to RA= 00h / 24h it can vary because the original HD Catalogue was referenced to the equinox of 1900,0. In case of doubt, HD numbers is the accepted identification in international databases. Some stars in SASDABA do not have HD number, so several alternatives are offered to the users.

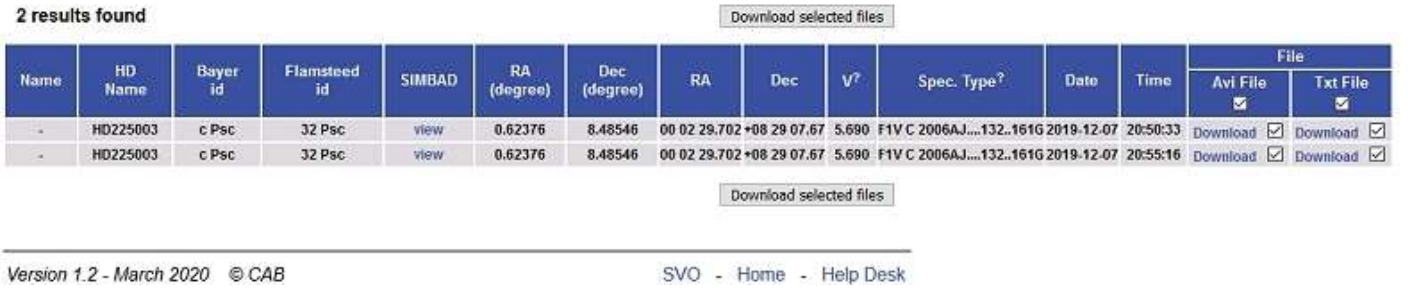
All stars in SASDABA are bright (magnitude < 6) so a very convenient reference is the *Yale Bright Star Catalogue 5th Edition (1991)* (BSC_5) where all fundamental data of bright stars can be found. To supplement and compare information the user can consult the online site ALADIN SKY ATLAS, with access to all international databases SIMBAD(from the Centre de Données Astronomiques de Strasbourg). For ease of use, SASDABA provides a link to SIMBAD. Additionally, the OAGwebsite has a section, continuously updated, where appropriate links can be investigated by those interested in getting started with practical spectroscopy.

1289 results found

Download selected files

Name	HD Name	Bayer id	Flamsteed id	SIMBAD	RA (degree)	Dec (degree)	RA	Dec	V?	Spec. Type?	Date	Time	File	
													Avi File	Txt File
Tabit	HD30652	pi.03 Ori	1 Ori	view	72.46005	6.96127	04:49:50.41	+06:57:40.5	3.190	F6V	2018-01-29	20:46:17	Download	Download
Tabit	HD30652	pi.03 Ori	1 Ori	view	72.46005	6.96127	04:49:50.41	+06:57:40.5	3.190	F6V	2018-01-29	20:33:32	Download	Download
Tabit	HD30652	pi.03 Ori	1 Ori	view	72.46005	6.96127	04:49:50.41	+06:57:40.5	3.190	F6V	2018-01-29	20:37:30	Download	Download
Tabit	HD30652	pi.03 Ori	1 Ori	view	72.46005	6.96127	04:49:50.41	+06:57:40.5	3.190	F6V	2018-01-29	21:04:16	Download	Download
Pollux	HD62509	bet Gem	78 Gem	view	116.32896	28.02620	07:45:18.94	+28:01:34.3	1.14	K0IIIb	2018-01-29	21:20:18	Download	Download
Pollux	HD62509	bet Gem	78 Gem	view	116.32896	28.02620	07:45:18.94	+28:01:34.3	1.14	K0IIIb	2018-01-29	21:22:41	Download	Download
Castor AB	HD60178J	alf Gem	66 Gem	view	113.64947	31.88828	07:34:35.87	+31:53:17.8	1.58	A1V+A2Vm	2018-01-29	21:34:44	Download	Download
Tabit	HD30652	pi.03 Ori	1 Ori	view	72.46005	6.96127	04:49:50.41	+06:57:40.5	3.190	F6V	2018-01-29	20:37:05	Download	Download
Tabit	HD30652	pi.03 Ori	1 Ori	view	72.46005	6.96127	04:49:50.41	+06:57:40.5	3.190	F6V	2018-01-29	21:03:00	Download	Download
Tabit	HD30652	pi.03 Ori	1 Ori	view	72.46005	6.96127	04:49:50.41	+06:57:40.5	3.190	F6V	2018-01-29	20:34:35	Download	Download
Tabit	HD30652	pi.03 Ori	1 Ori	view	72.46005	6.96127	04:49:50.41	+06:57:40.5	3.190	F6V	2018-01-29	20:40:39	Download	Download
Castor AB	HD60178J	alf Gem	66 Gem	view	113.64947	31.88828	07:34:35.87	+31:53:17.8	1.58	A1V+A2Vm	2018-01-29	21:35:48	Download	Download

Fig.3: “Select Search Objects” / SASDABA



2 results found

Download selected files

Name	HD Name	Bayer id	Flamsteed id	SIMBAD	RA (degree)	Dec (degree)	RA	Dec	V?	Spec. Type?	Date	Time	File	
													Avi File	Txt File
-	HD225003	c Psc	32 Psc	view	0.62376	8.48546	00 02 29.702	+08 29 07.67	5.690	F1V C 2006AJ....132..161G	2019-12-07	20:50:33	Download	Download
-	HD225003	c Psc	32 Psc	view	0.62376	8.48546	00 02 29.702	+08 29 07.67	5.690	F1V C 2006AJ....132..161G	2019-12-07	20:55:16	Download	Download

Download selected files

Version 1.2 - March 2020 © CAB

SVO - Home - Help Desk

Fig.4: “View Observations” / SASDABA

4. Direct, unfiltered star selection

The “Object List” displays the spectral classification of all stars regardless of any filter or selection criteria. This classification (which follows the MKK system) does not follow from the SASDABA observations, but corresponds to the databases presently accepted by the scientific community. Let us suppose that a student wants to write a final assignment about some spectral classes. Retrieving the spectrum of each star, those that apply can be easily selected.

The appropriate software can then be used to browse the corresponding images to check if their quality meets the requirements. Lastly, the selected images can be analysed with another tool that produces the desired results.

An important point is that the original spectroscopic images have no direct visual resemblance with the final results after processing and analysing them. An original file of images (video frames) can appear too faint or underexposed if visualized in a standard graphical software. Before discarding it, though, it is advisable to apply an appropriate stacking and processing procedure (using for example, *Registax* 6.0 or similar), which very often reveals very clear spectral lines in the final image. Obviously a good original image requires less processing work than a poorer one. For example, following the classic Harvard photographic plates taskforce, some spectroscopic plates were of a lesser quality, but that did not prevent their inclusion in the catalogue nor their subsequent analysis.

It is very interesting to track the development process of the methods and techniques that concluded in the publication of the *Henry Draper Catalogue*, especially its first edition in 1890 containing over 10.000 stars.Time, equipment and technology apart, the *modus operandi* remains very similar.

The next step is obtaining the *normalised spectrum*, which is usually definitive for the desired level of classification. This is not a direct procedure because it requires a multistep approach with specific software (like *RSpec*), but it can be done quite swiftly with some practice. It is planned to include in the OAG website several libraries of normalized spectra from SASDABA to allow the user to compare them with their own results. With normalised spectra the user can address measuring wavelengths, line intensity, identification of chemical elements, emission line variation, etc.

5. Equipment

Spectroscopic images are obtained with a diffraction grating *Star Analyser of 100 L /mm* (another available grating has 200 L/mm) to which a prism of 3,8˚(made by *Paton Hawksley Education Ltd* (UK)) can be attached. The main instrument is a Schmidt-Cassegrain telescope, Celestron-11 Fastar with an aperture of 288mm and focal length F/10. The AVI images are captured with a CMOS camera model ZWO-ASI-174MM attached to a multipurpose *Rotarion Wheel*device designed by *AstronScientific* (Spain), allowing several instrument configuration.

Wide-field images (approx. 2.5 sq. deg.) centered in the target star are provided as supplementary material. They are captured by an *ATIK-16 IC* CCD installed on a small 50mm F/4 *Omegon* refractor piggybacked to the main instrument. These images are a by product of SASDABA, and are not included in the online databases. They form an archive of stellar fields around the main object, and provide astrometric and photometric measurements, object identification and supplementary basic cartography that could be useful for publications.

The equatorial mount is an Skywatcher EQ-6GoTo-Pro model installed in an iron column, secured into a solid cement base equipped with leveling systems . All the setup is covered by a sliding roof. TheOAG/VNG observatory is located at Vilanova i la Geltrú (01˚43’57.6”E / 41º13’27”8N) some 40km South of Barcelona, (Spain). Camera control is achieved with the following software: *FireCapture* (Torsten Edelmann 2009+) for the CMOS ZWO-ASI-174MM camera and *Artemis* for the CCD ATIK 16-IC camera. An additional CCD camera SBIG ST-7E controled with *CCDSoft* is also available for different applications. The spectroscopic images are treated with *Registax* 6.0 (Cor Berrevoets 2011+). *RSpec* 1.9.0.30 (Tom Field 2015+) is used to obtain the spectra and their analysis. The RSpec tutorials are attached to SASDABA interface with permission of author.

For field observations a portable 200mm F/10 Schmidt-Cassegrain Meade LX-90_UHTC telescope with a Celestron focal reducer to F/6,3 is available. This should be the instrument to use in southern expeditions.

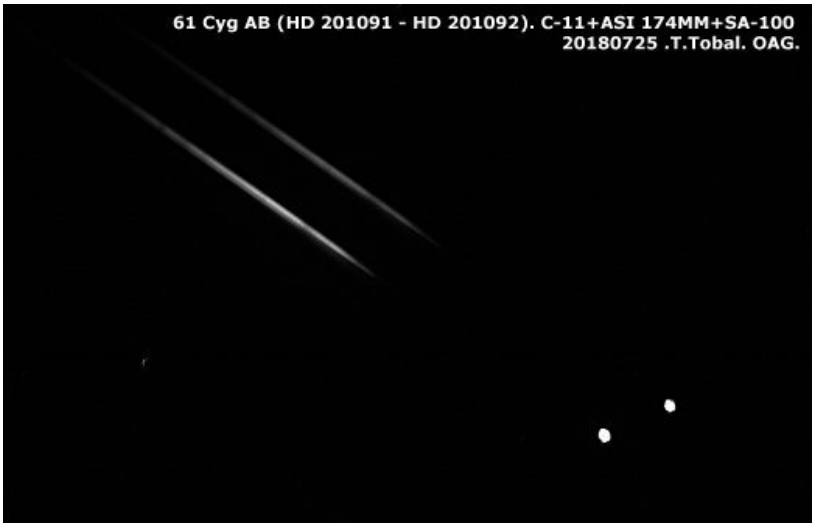
6. Methodology

The approach and method for this project are largely inspired by the classical works gathered in Henry Draper Memorial (Harvard College Observatory, 1886+) and published in several volumes of the series Annals of the Astronomical Observatory of Harvard College (1885-1950). The detailed approach and development of the spectroscopic program can be read in the OAG web site. For a description of the evolution of Henry Draper Memorial, "The evolution of Henry Draper Memorial (Dorrit Hoffleitt, 1991) or "The Glass Universe" (Dava Sobel, 2017) can be consulted. There are many works regarding spectroscopy that deal with this part of the history of astronomy.

A remarkable characteristic of SASDABA is the uniformity of methods and techniques, to make easier the comparison between the different spectral types. The standard values are of the order of 20 Å/pyx for dispersion and 40 Å -60 Å for the spectral resolution as a function of the wavelength. This low dispersion is very useful to learn the basic classification, without considering very specific particularities of the different spectral classes. As a comparison, it is worth reminding that the scale used in the elaboration of the spectral classification in Harvard's catalogues was of the 125 Å/mm order. The range of selected wavelength with the instruments falls in the 3800Å-8000Å interval.

The instruments and selected method for this project allow the spectral classification of all bright stars up to the 6th visual magnitude, in a similar way that it was used in the general classifications by Harvard astronomers. The images are obtained with expositions in the millisecond to second order, and the duration of the video-recordings is between 30 and 90 seconds. This allows us to get several tens or hundreds of frames. For an observer with some experience, it is relatively easy to detect the approximate spectral class of the star by direct examination of the screen.

Nonetheless, a further analysis using the specific software is imperative for any classification work meeting the standard requirements. It is also possible to obtain spectroscopic images of weaker stars, given that the practical operative limit for the instruments described is around the 7th visual magnitude for the CMOS camera. Spectroscopic observations for weak stars can be obtained with more sensitive CCD cameras and more sophisticated stacking techniques.



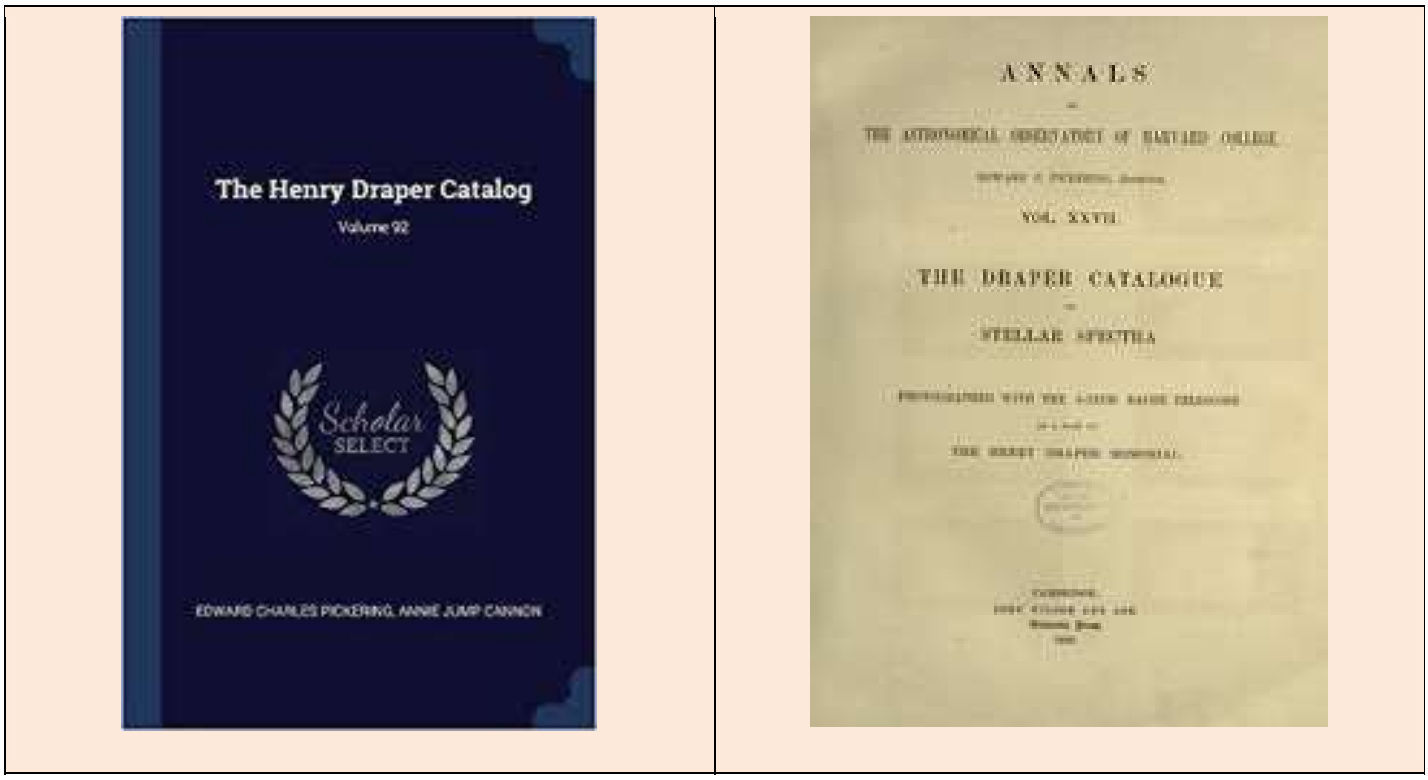


Fig. 5: Publications from Henry Draper Catalogue. Facsimiles and originals

7. Observational criteria in star selection

The stars gathered in SASDABA are all mapped and with a unique ID in the Photographic Atlas Charts (MzPAC), part of A Field Guide of Stars and Planets by D.H.Menzel (1964+). Otherstars have also been included, such as the brightest stars from the Coma Berenices, Hyades, Pleiades or Praesepe open clusters. Later revisions of SASDABA will be able to complete this selection. For variable stars, the maximum is close to 6th magnitude, and the lowest are of the 12th or 13th magnitude. The project will complete the variable stars closer to the maximum (i.e. 6th magnitude) as much as possible.

The number of stars for each photographic chart varies according to the richness of the stellar background, around 20 stars near to the celestial poles and some 80 in the central regions of the Milky Way. Hence, to complete all the observations for one photographic chart takes between 2 and 5 sessions lasting 1 to 4 hours each. In July 2020, of 54 charts from the Photographic Atlas Charts, 22 in total have already been 100% completed, 15 more show partial data from 01% to 99%, and there are no observations yet for the remaining 17 charts. The first stage aims to complete the observations for all stars between DEC = + 90º to -15º, second stage between DEC = -15º to -35º, and third stage between DEC = -35º to -90º.

8. The observation sessions

The observation sessions for each night are prepared from the MzPAC. This photographic atlas, masterfully conceived by its author (D.H. Menzel was director of Harvard College Observatory in 1952 and 1954-1956), is a selection of 54 charts in double showing (positive/negative) coming from the vast collection of plates obtained in Harvard observatories and stations. They cover both Northern and Southern Hemispheres, overlapping each other. The denomination for stars, clusters, nebulae and galaxies has been included. Current atlases, both printed and digital, have vastly improved this kind of mid XXth century mapping, but the distribution of celestial regions it offers is still very useful as a reference to collect data.

The Digital Access to a Sky Century @ Harvard (DASCH) project, developed at Harvard College (USA) allows access to the digitalised original plates from the Photographic Atlas Charts. The author made the wise decision tospecifythe ID number to each plate, so it is possible to find them in the digitalised archive of more than 500,000 DASCH plates. This is a historical factor very attractive to SASDABA, establishing a modest historical link between both projects. As an auxiliary tool for the identification and data extraction for each star, the program *Cartes du Ciel* 4.2.1 (Patrick Chevalley 2011+) is used. With this program, we have updated information for the star being observed. This also allows correcting any identification problem or ambiguities, having already been detected some of them in the reference MzPAC charts. The region of the sky to be observed is determined with the same order as the mapping established in the MzPAC (charts 1 to 54), as well as the possibilities of observation by date and time of the session. The order of centring the stars in the telescope is from West to East and from South to North, to facilitate the extension of the observations according to the visibility of the objects.

The session starts with the introduction of the coordinates for the first star in the control console of the telescope and then the corresponding page of the manual registry of observations is made available. Once the equipment has been set up, one proceeds to get the spectroscopic images. Besides the automatic register, the main parameters of the camera are manually recorded (gain, exposition, gamma, length of the video), as well as notes regarding the seeing conditions and any other remarkable factor. Manual notes may include indications of any weather condition changes, the need to improve the focus, or automatic changes of meridian that reorient the instrument.

The logbooks are a fundamental tool to correct errors or information lost in the digital files. Not only do manual registers record the observation and analysis of the spectra, but also they leave proof of anything regarding the SASDABA project. With this material it will be possible, in the future, to know and rewrite the detailed history from the beginning to its conclusion. As an example, it is worth noting that the digitalisation of the detailed logbooks has played a very important part of DASCH to provide value to the manual registers through time. To control the stars observed and to avoid unforeseen repetitions, several working copies of the 54 charts of the MzPAC have been made.

Moreover, all charts have been scanned in JPEG and PDF formats. Each star observed is marked in the charts in a way that it is very useful to know the work that has already been done. The fact that the charts overlap helps to program the different sessions, linking stellar fields in a way so the telescope doesn’t have to do big moves during the night. In general a 15 to 25 stars are selected per observation session.

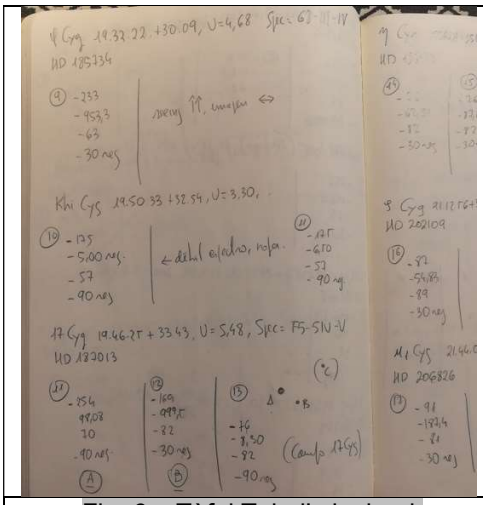


Fig. 6a: Tòfol Tobal's logbook

CHRONOLOGICAL DEVELOPMENT : 2018-2020

LOOGBOOK_Vol_N°4_20200314 - XXXXXX_Abstract

Loogbook number	Epoch	Task	Description (BS = Bright Stars)
	Year 2020		
Vol_N°4	20200314	Observations with CMOS camera	BS in Cnc, Gem CCD WF images
Vol_N°4	20200315	Observations with CMOS camera OAG-SVO_SASDABA Project	BS in Cnc CCD WF images Update files Data Base & SASDABA interface
Vol_N°4	20200320	Observations with CMOS camera	BS in CVn, UMa, Com CCD WF images Menzel's PCA n°6 is completed.
Vol_N°4	20200321	Observations with CMOS camera	BS in Leo, LMi, UMa CCD WF images
Vol_N°4	20200321	RSpec learning-37+Registax 6.0	Analysis of R Lyr

Fig. 6b: Summary transcript available on OAG web site

Folder N°	Epoch	.avi +.txt .fit +.txt	Data GB	Observer / Telescope + Grating + CMOS Camera
Year 2018				
001	20180129	66	0,970	TOB / C-11" f/10 +SA-100+ ASI-174MM
002	20180130	60	2,190	TOB / C-11" f/10 +SA-100+ ASI-174MM
003	20180831	10	0,263	TOB / C-11" f/10 +SA-100+ ASI-174MM
004	20180202	34	0,557	TOB / C-11" f/10 +SA-100+ ASI-174MM
005	20180210	22	0,561	TOB / C-11" f/10 +SA-100+ ASI-174MM
006	20180215	20	0,627	TOB / C-11" f/10 +SA-100+ ASI-174MM
007	20180725	14	0,379	TOB / C-11" f/10 +SA-100+ ASI-174MM
008	20180726	50	0,309	TOB / C-11" f/10 +SA-100+ ASI-174MM
009	20180801	37	1,090	TOB / C-11" f/10 +SA-100+ ASI-174MM
010	20180821	22	0,098	TOB / C-11" f/10 +SA-100+ ASI-174MM
011	20180822	30	0,139	TOB / C-11" f/10 +SA-100+ ASI-174MM
Year 2019				
012	20190224	28	0,316	TOB / C-11" f/10 +SA-100+ ASI-174MM
013	20190226	14	0,041	TOB / C-11" f/10 +SA-100+ ASI-174MM
014	20190302	2	0,015	TOB / C-11" f/10 +SA-100+ ASI-174MM

Fig. 6c: Recording data Index available on OAG web site

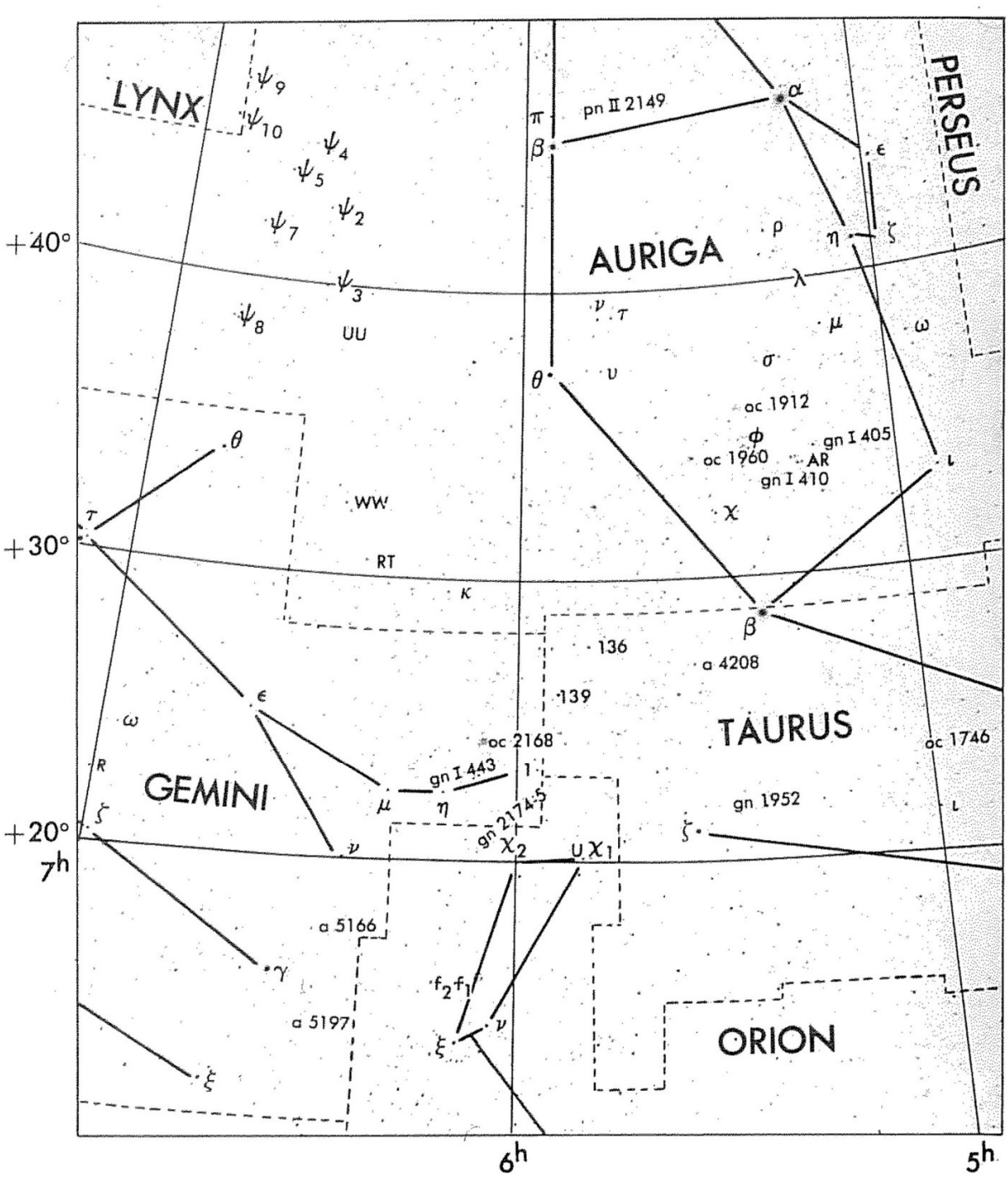


Fig 7: Scanned copy of the original Chart #13 MzPAC (DASCH #33902)

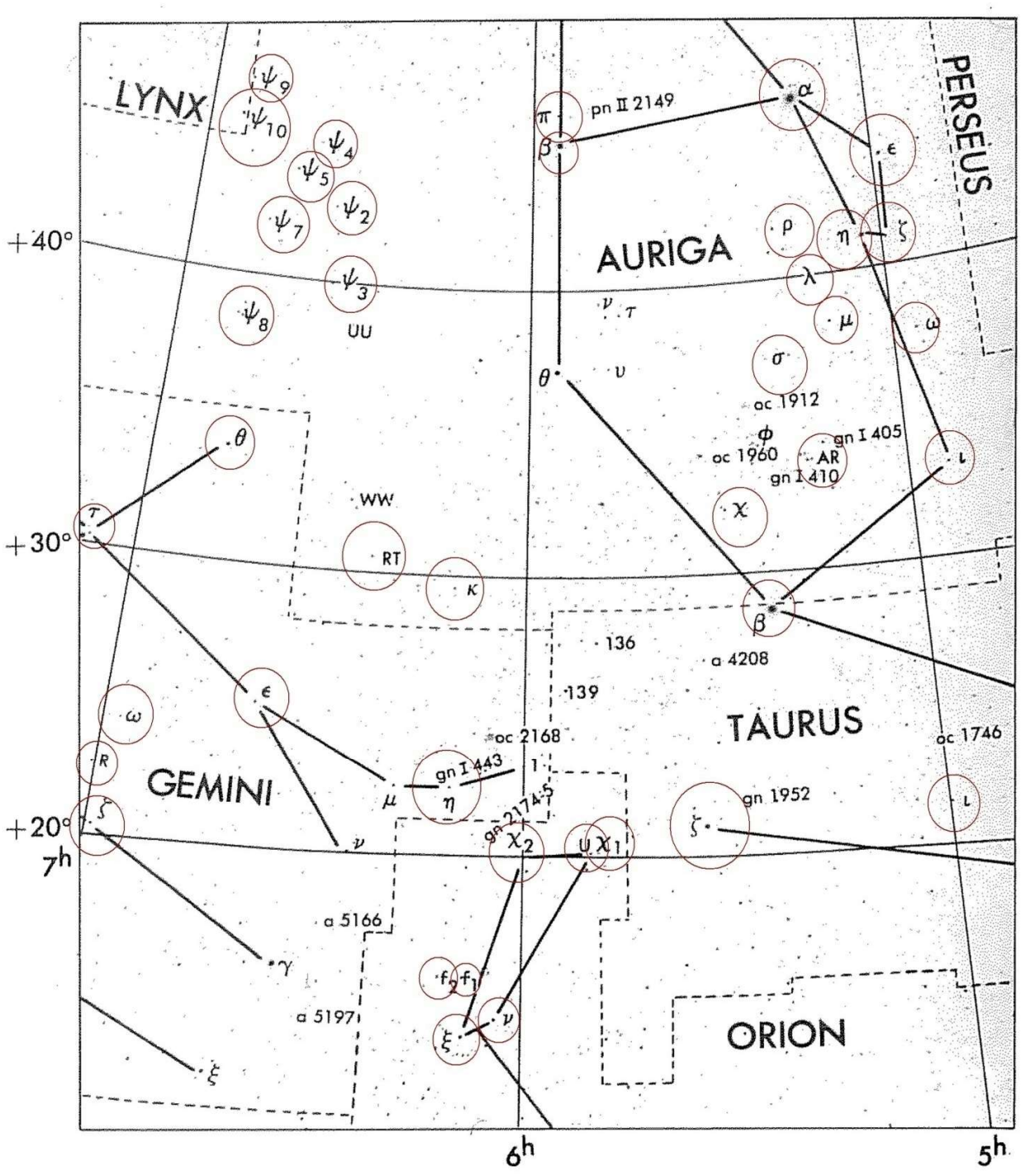


Fig.8: Scanned copy of the original MzPAC Chart #13 (DASCH #33902) with the observed stars and those that are not yet.

9. OAG *Field Guide of Bright Star Spectra*

OAG Field Guide of Bright Star Spectra is meant to be an Atlas/Field Guide focused in spectral classification (in process). Its goal is to provide a basic visual guide for SASDABA users. This guide keeps the original division into sky sectors from A Field Guide of Stars and Planets. Charts are made with *Cartes du Ciel* software, giving the basic colour of each star included in SASDABA and some of the weaker ones that can be useful as a reference or to widen observations. *Cartes du Ciel* shows the approximate colour for each star included in the HD Catalogue and it is easy to establish a simple relationship. It is evident that the colour from the Key Chart is only an approximation of the spectrum, because it doesn't make any difference between giant and dwarf stars. *Cartes du Ciel* provides a graphic level of information similar to that provided by the first edition of the HD Catalogue (for instance, A1, F5, B2), but it doesn't show the current MK classification (or MKK sometimes) due to Morgan, Keenan and Kellnan (1943) and later extensions of several sources.

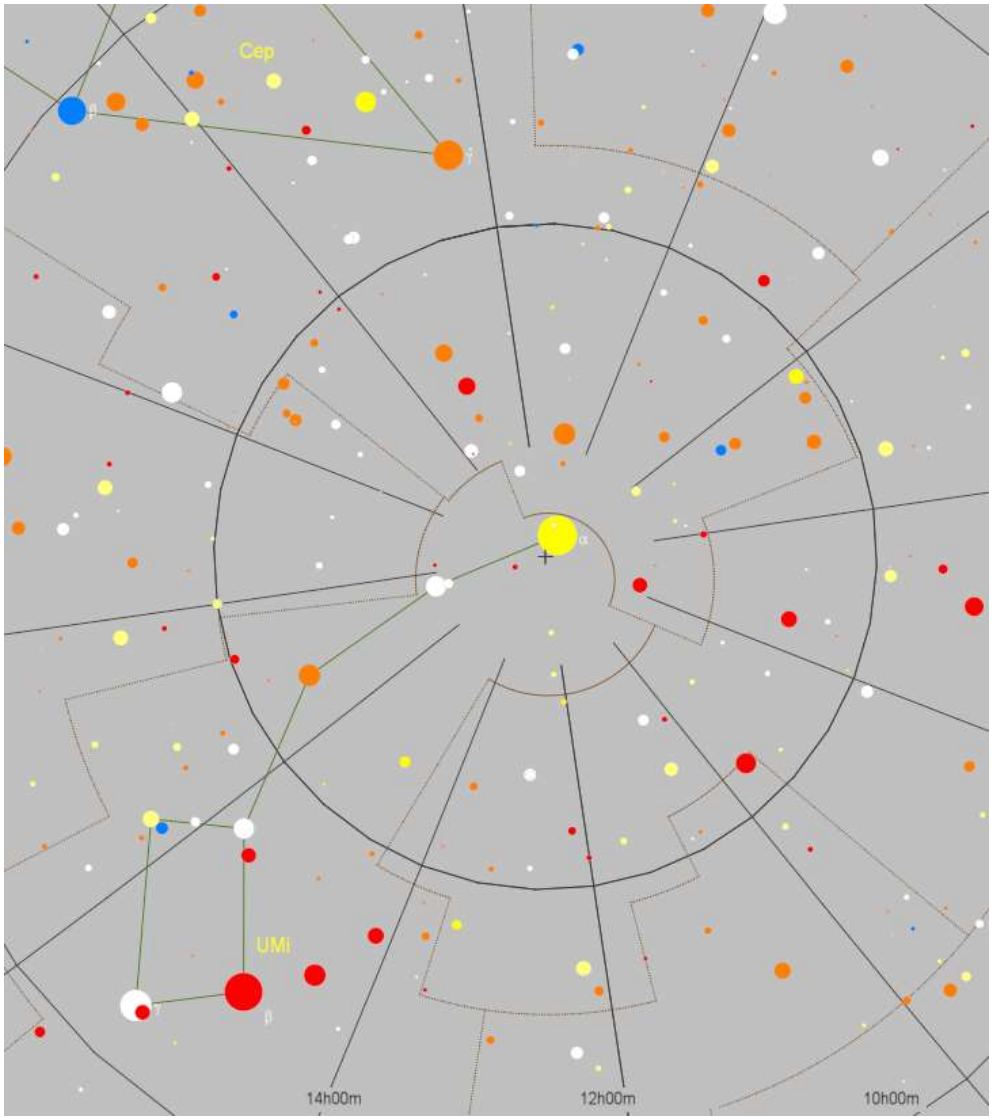


Fig. 9: Key chart with star colours / spectra made from Cartes du Ciel

Let's assume that a student wants to get images from the Ursa Minor constellation (fig.9), willing to get several different spectral types. OAG Field Guide of Bright Star Spectra will allow them to reach quickly that area in the sky and detect the colours of the stars of the region. Then, they will be able to make a first selection, recording the designations of the chosen stars, go to SASDABA and, in Object List, check if the star has already been registered during the project previously. When the project is finished all the selected stars will be included in SASDABA.

In summary, the process is the following:

1. Find the region of the sky in OAG Field Guide of Bright Star Spectra
2. From the colour of the star, select the candidates according to the study criterion
3. Record the stars designations
4. Find the stars in Object List in SASDABA
5. Complete the record for the spectral classification
6. Download the matching files
7. Analysis and data process with specialised software

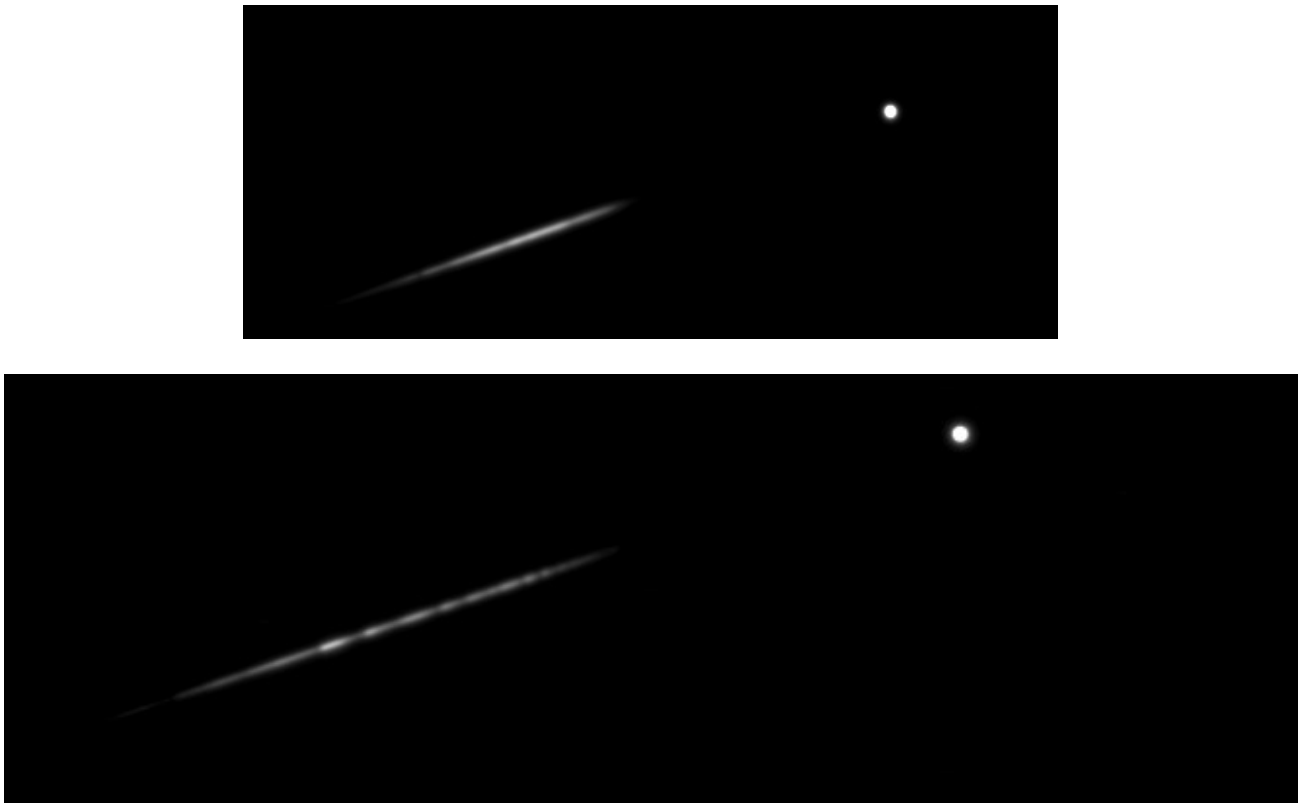


Fig.10: Spectroscopic images already treated (Registax 6.0) from the downloadable files in SASDABA. Top: HD_80493_Alpha_Lyn (K6-III). Bottom: HD_175865_R_Lyr (M5-III). The spectral differences are already visible with a visual examination of the final images. Observations by T. Tobal with the equipment described in this document.

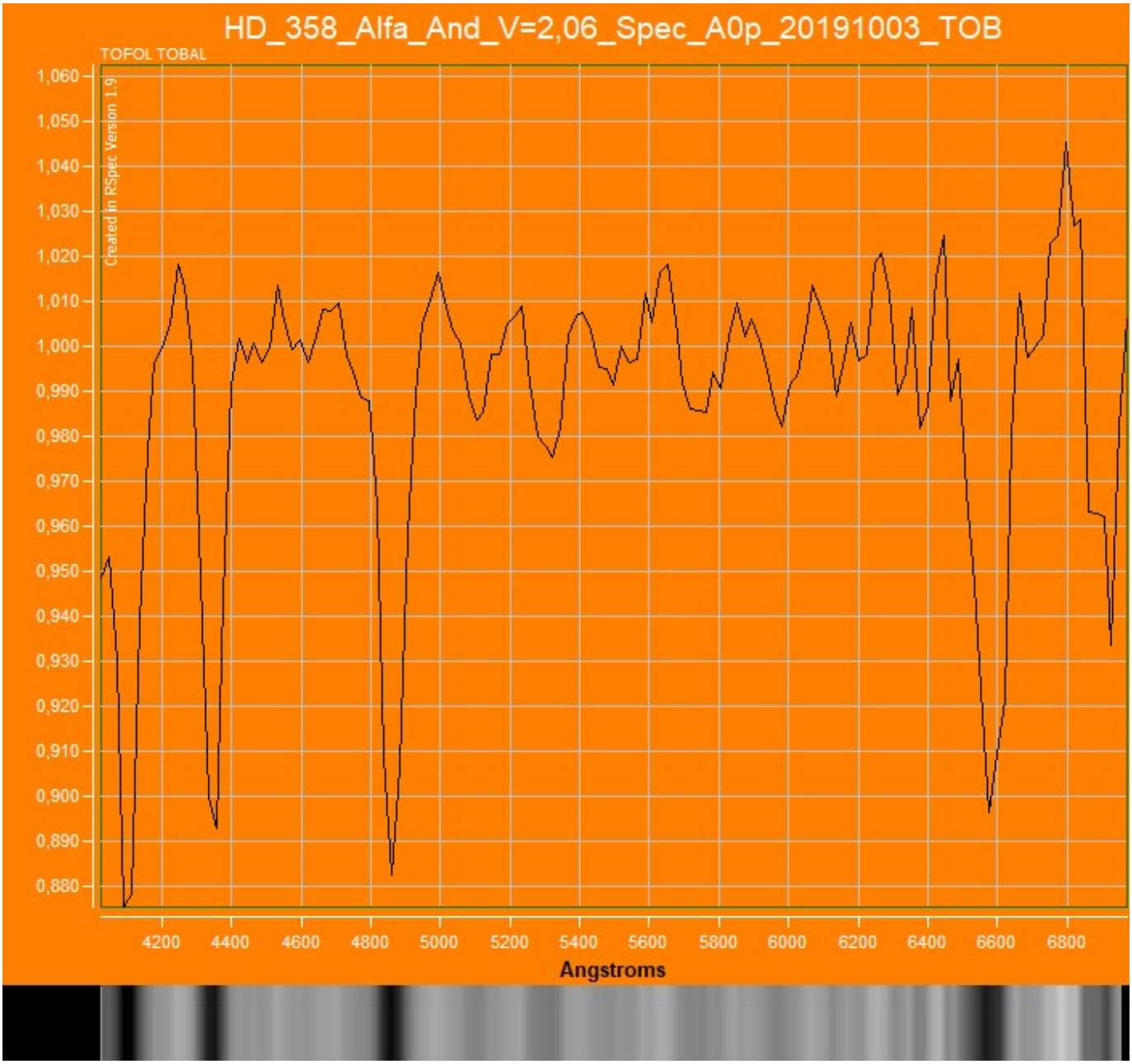
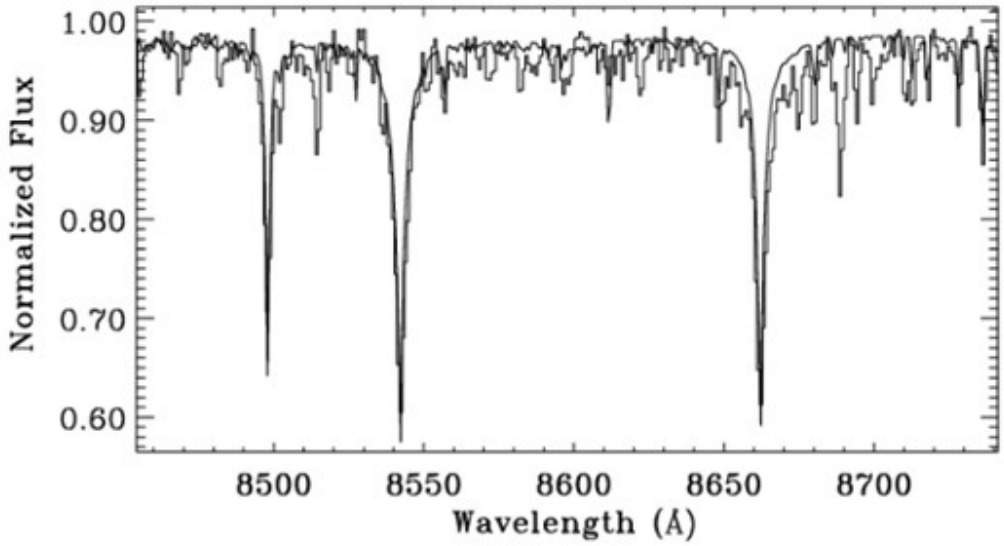
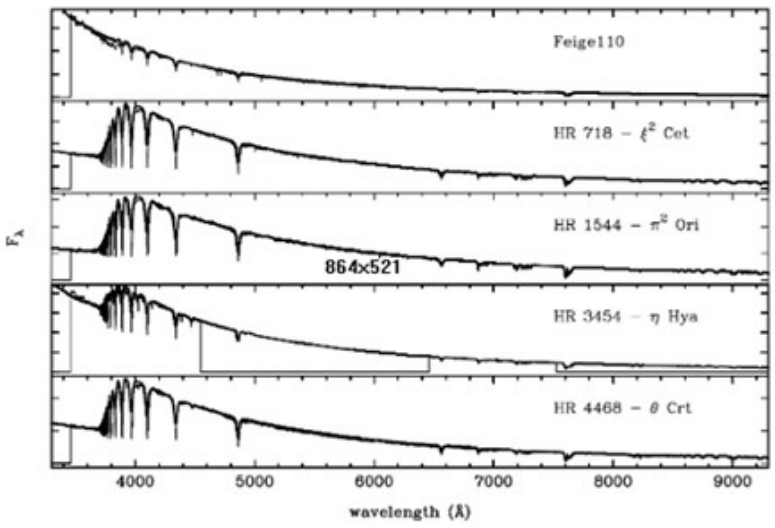


Fig. 11: Spectrum of HD_358_Alpha_And with RSpec. Note the intense lines for hydrogen. Example of work to get a normal spectrum (N=1) with RSpec software. This is one of the possible graphs. Video files that must be treated by each user.

NOTE: Spectrum with continuum normalised to 1.
Source: Observational astrophysics (Notes by Joan Fabregat-UV)

The calibration process in flow is complex and imposes severe restrictions when planning the observations and their later treatment. Sometimes this effort is not necessary because we can get the relevant astrophysical information from analysis of the spectral lines, ignoring the form for the continuum. In this case, to delete the equipment continuum, without physical relevance, we apply a technique called “continuum rectification”. To apply this technique, we adjust by square minima an analytical function to the spectral continuum. Usually, we use a polynomial of a low degree, between 2 and 5. Then, we divide the spectrum by the adjustment function, getting the “modified spectrum”, a spectrum whose continuum is a horizontal line with value equal to 1. The modified spectrum is very useful to compare the relative depth of the spectral lines between them, what is a fundamental criterion in the technique of spectral.





Spectrum of several stars, where we can identify the spectral continuum, the spectral lines and Balmer’s discontinuity in 365 nm.

PhAtCh N°	AR/DEC CENTER OF PLATE*	Harvard Plate n°	Harvard Plate Epoch	Harvard Plate Exp (min)	Survey	n° stars*	Bright Stars in...
01	XX +90	39209	19450913	90	100%	17	Cam-Cep-UMi
02	00+60	38571	19440820	87	100%	49	And-Cas-Cep-Lac
03	03+60	39974	19461120	102	100%	33	And-Cam-Cas-Per
04	06+60	32373	19341004	80	100%	22	Aur-Cam--Lyn
05	09+60	38865	19450211	85	100%	22	Dra-Lyn-UMa
06	12+60	39480	19460202	91	100%	14	CVn-Dra-UMa
07	15+60	38419	19440518	90	100%	29	Boo-Dra-Her-UMa-UMi
08	18+60	38416	19440518	92	100%	33	Cyg-Dra-Lyr-Her-UMi
09	21+60	38570	19440820	89	100%	61	Cep-Cyg-Dra-Lac
10	00+30	40874	19480912	120	100%	35	And-Lac-Psc
11	02+30	32372	19341004	87	100%	56	And-Ari-Tri-Per-Psc
12	04+30	39477	19460202	96	100%	60+	Ari-Aur-Ori-Per-Tau + Pleiades + Hyades
13	06+30	33902	19371109	87	80%		Aur-Gem--Ori-Tau
14	08+30	38955	19450405	115	90%		Aur-Cnc-Gem-Lyn
15	10+30	40034	19461230	111	100%	37	Cnc-LMi-Lyn-UMa
16	12+30	32615	19350402	101	100%	17+	CVn-Com-Leo-LMi-UMa + Mel 111

Fig.12: Extract of the STATUS table of the development of SASDABA from the OAG website (linked to DASCH)

Test image of open cluster IC 4651 with T-17"+SA-200

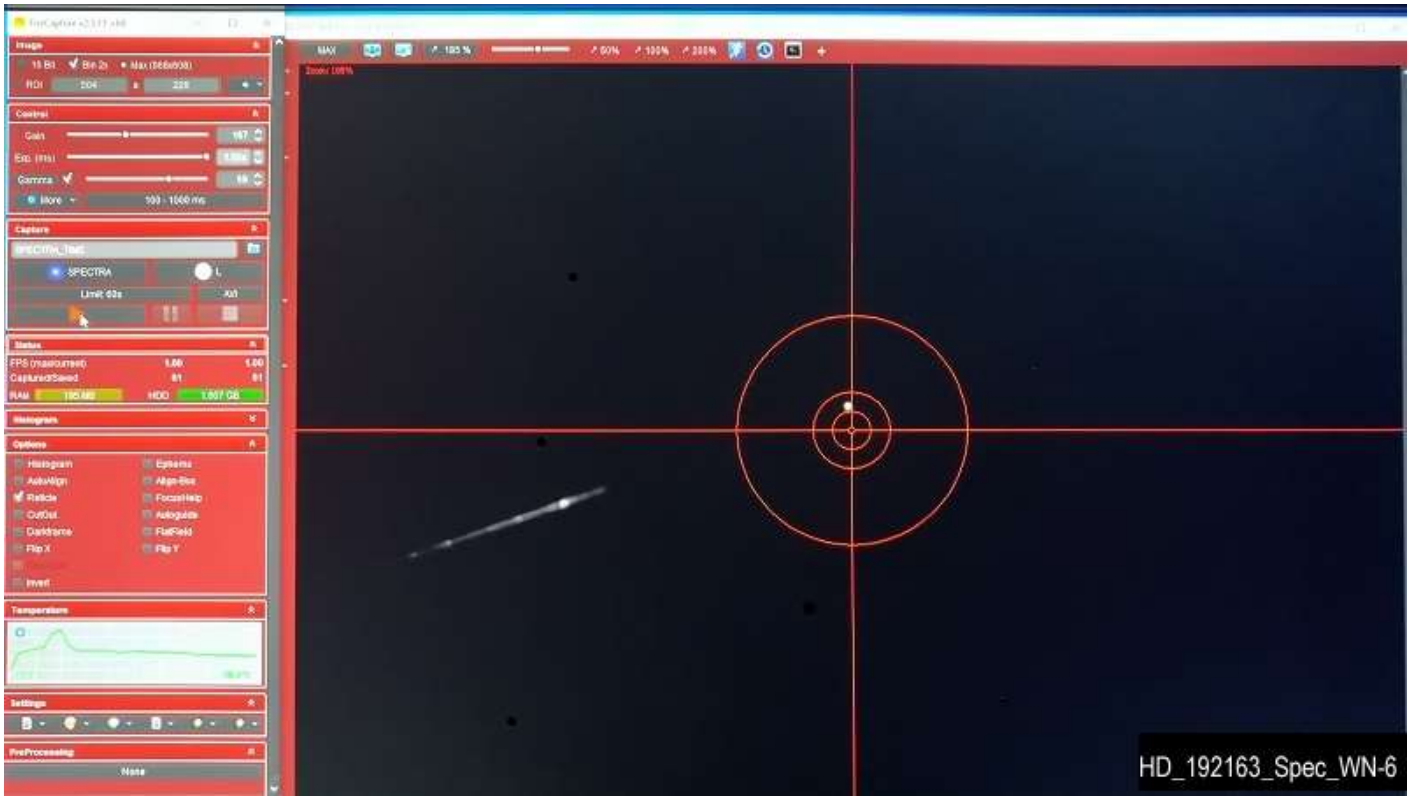
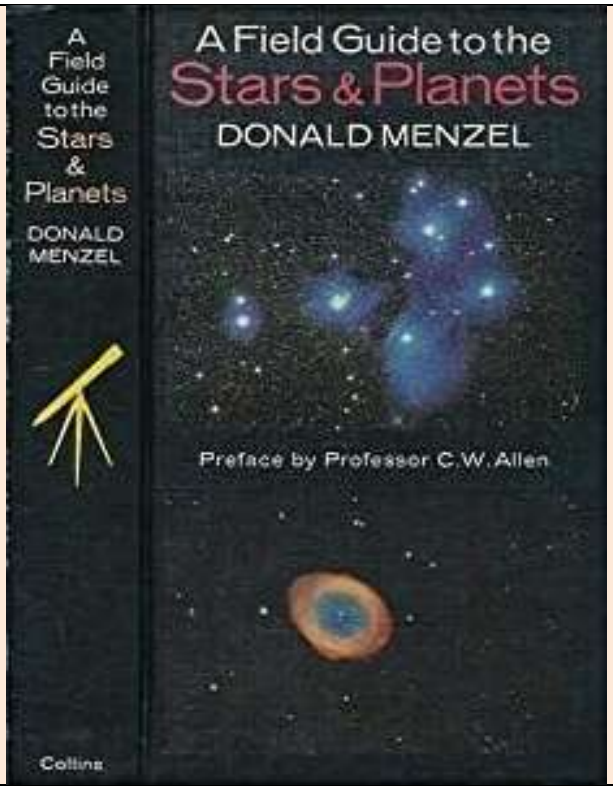
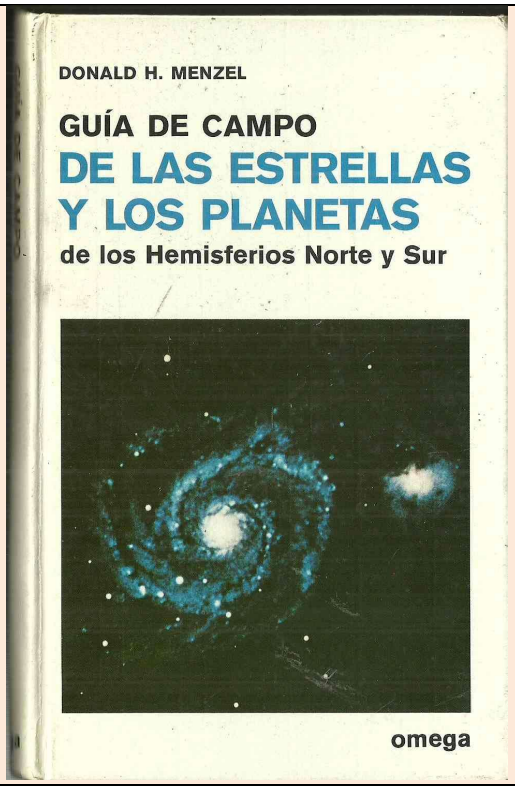


Fig.13. Example of video capture. Observe the emission lines in the spectra of HD 192163

	
D.H.Menzel's Guide. Collins English edition 1973	D.H.Menzel Guide. Omega Spanish edition 1982

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by T.Tobal

Translated from Spanish by J.Cairol & R.Hernández