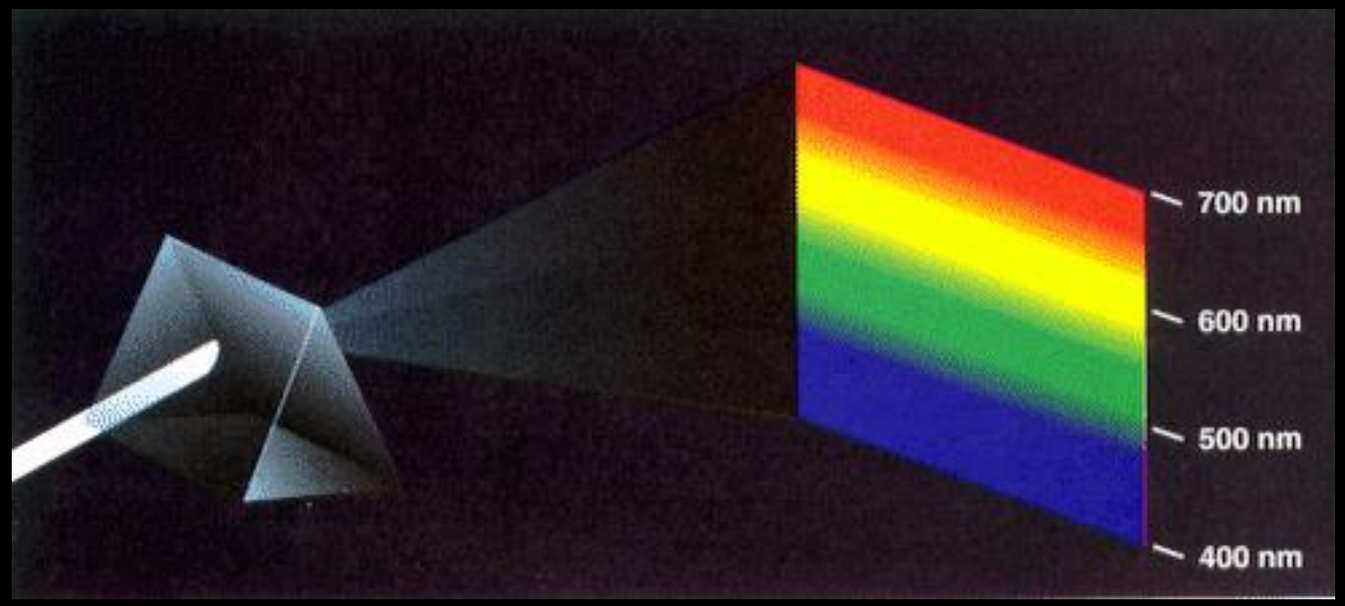
AMATEUR SPECTROSCOPY



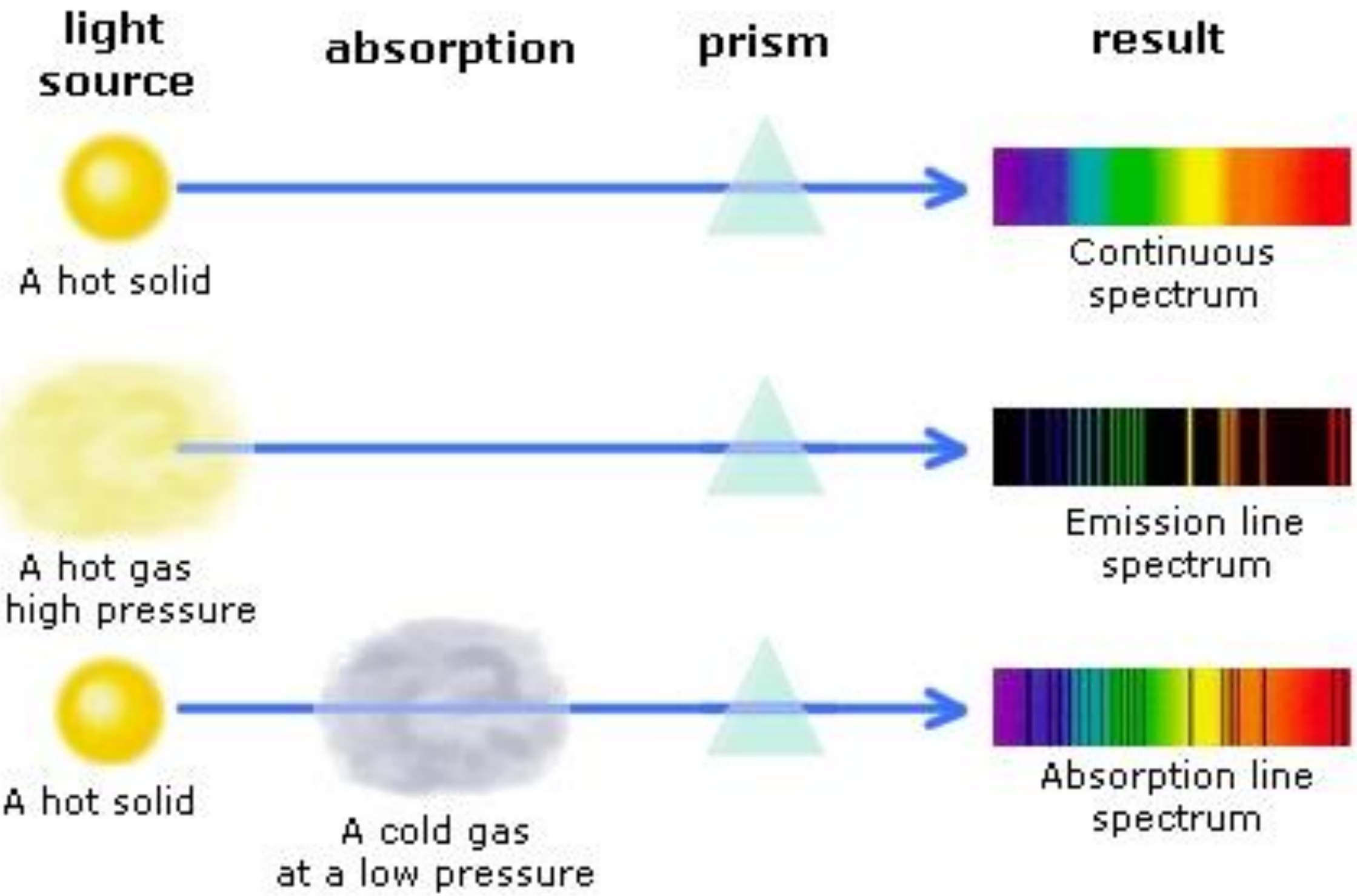
Percy Jacobs
Pretoria ASSA Centre
2017

Spectroscopy is the study of the different wavelengths/frequencies of light we see from an object. It is a measure of the quantity of each colour of light (or more specifically, the amount of each wavelength of light). It is a powerful tool in astronomy. In fact, most of what we know in astronomy is a result of spectroscopy.

It can reveal;

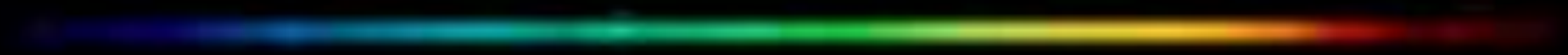
- Composition of the object (surface conditions),
- Temperature,
- Red or blue shift,
- Speed of shift,
- Distance,
- and more

Spectroscopy is done at all wavelengths of the electromagnetic spectrum, from radio waves to gamma rays; but here we will focus on optical light.


light source
absorption
prism
result
A hot solid
Continuous spectrum
A hot gas at high pressure
Emission line spectrum
A hot solid
A cold gas at a low pressure
Absorption line spectrum

ETA CARINAE

every 5.5 yr
during periastron:

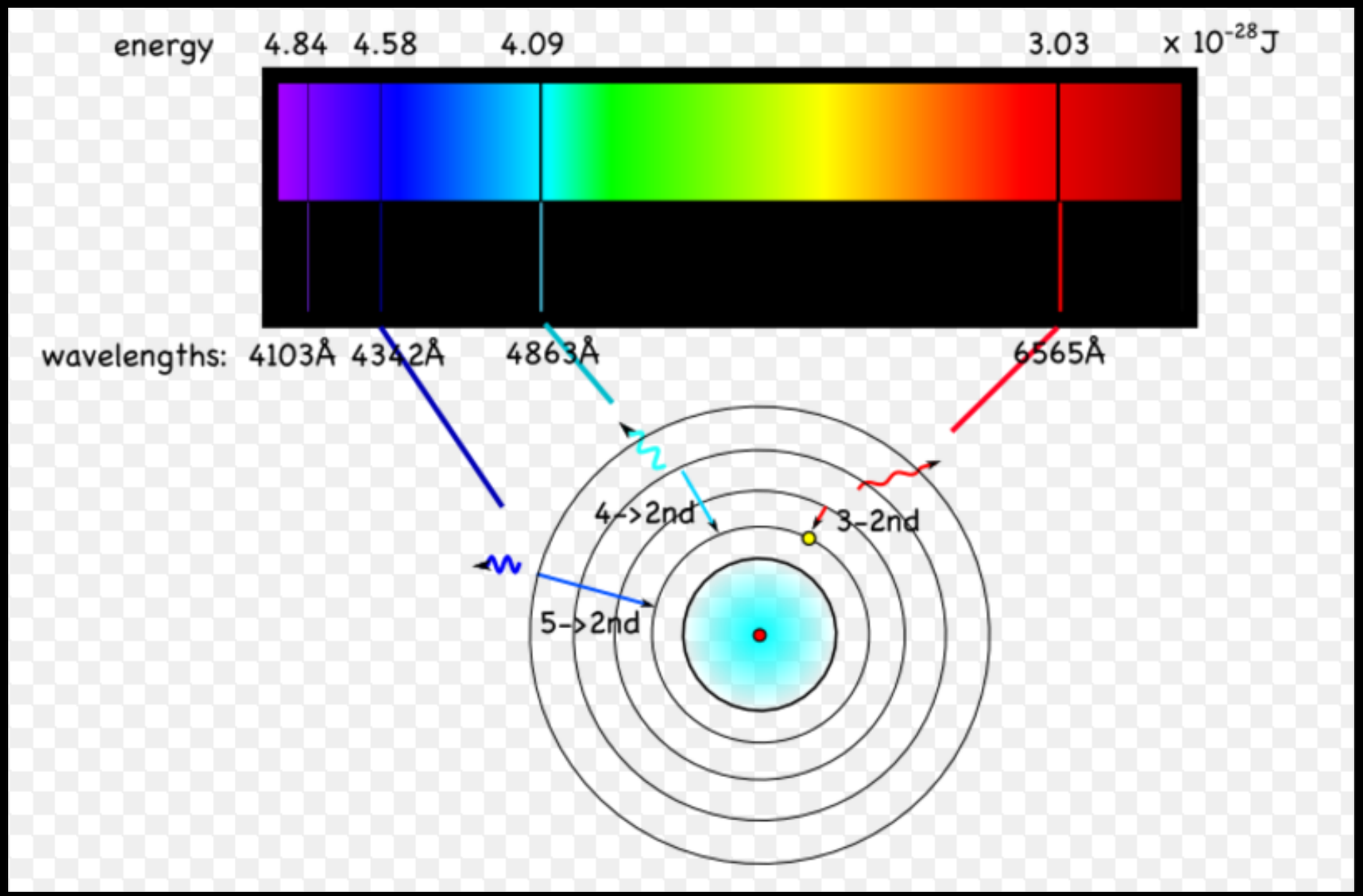


other times:

Hγ ? Hβ Hα

434Nm 486Nm 656Nm


Hδ
410 nm
Hγ
434 nm
Hβ
486 nm
Hα
656 nm


energy
4.84
4.58
4.09
3.03
x 10^-28 J
wavelengths:
4103Å
4342Å
4863Å
6565Å
4->2nd
3->2nd
5->2nd

Author's equipment:

6" reflector / Newtonian

Rainbow Optics Transmission Grating (200l/mm),

Canon 650D DSLR,

Tracking equatorial mount

Camera & Mount connected and driven from laptop

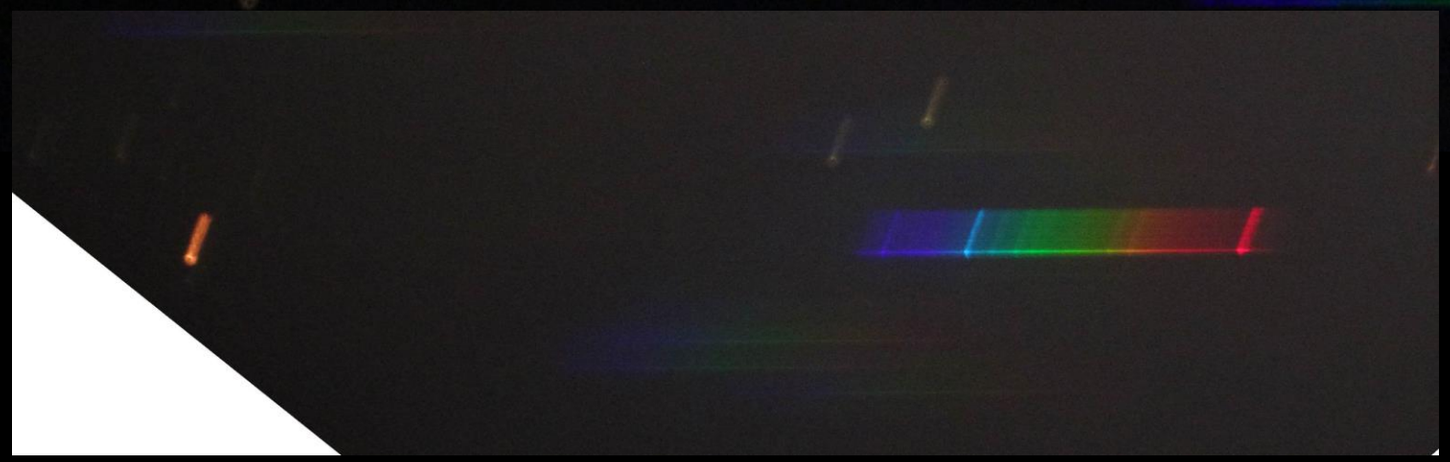
Sample Spectra taken by the author

Std star
ALTAIR

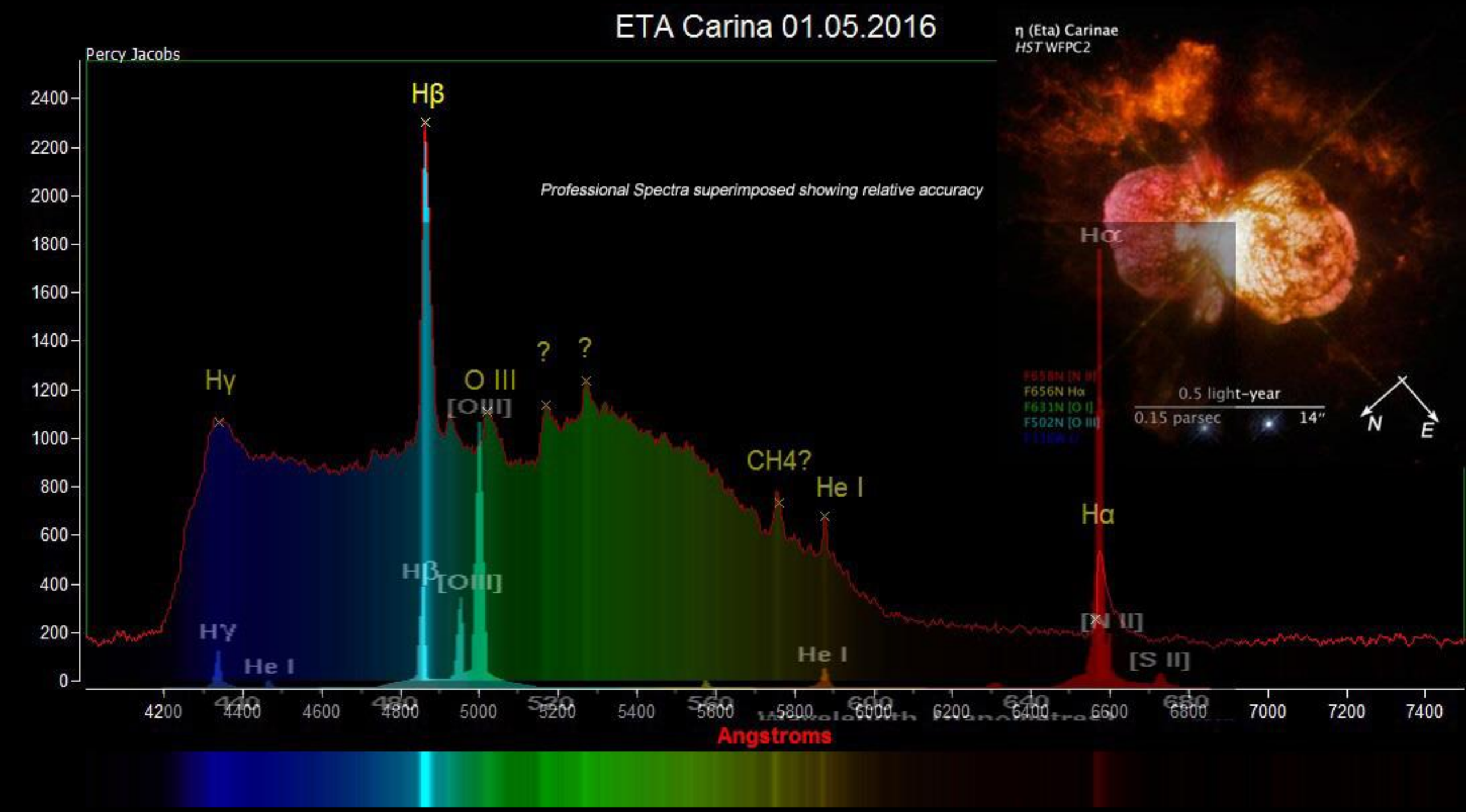
1st Target
Saturn
Nebula
NGC 7009

2nd Target
Variable
Star T Ind

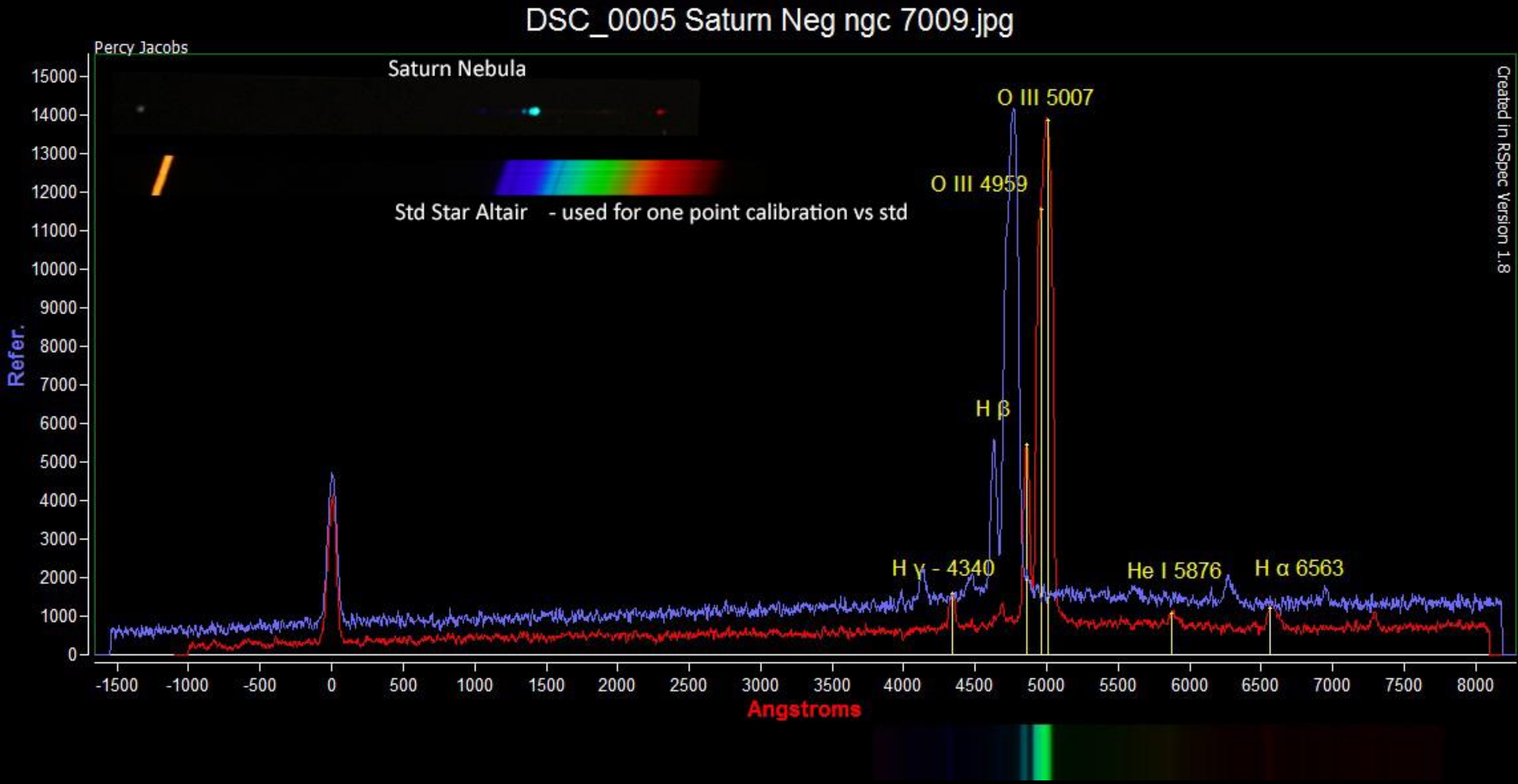
3rd Target
ETA Carina



Professional spectra “superimposed” – note the accuracy!



Demonstrating a “blue-shift” movement. Spectra calibrated at “rest” wavelength vs calibration against a std star



So, to get a resolution of R ~600 (10 A°), we need to use a "slit" spectroscope.

Cheapest one on the market, is the Alpy 600 @ ~R24,000

Alpy 600

Spectroscope wide range
PF0035

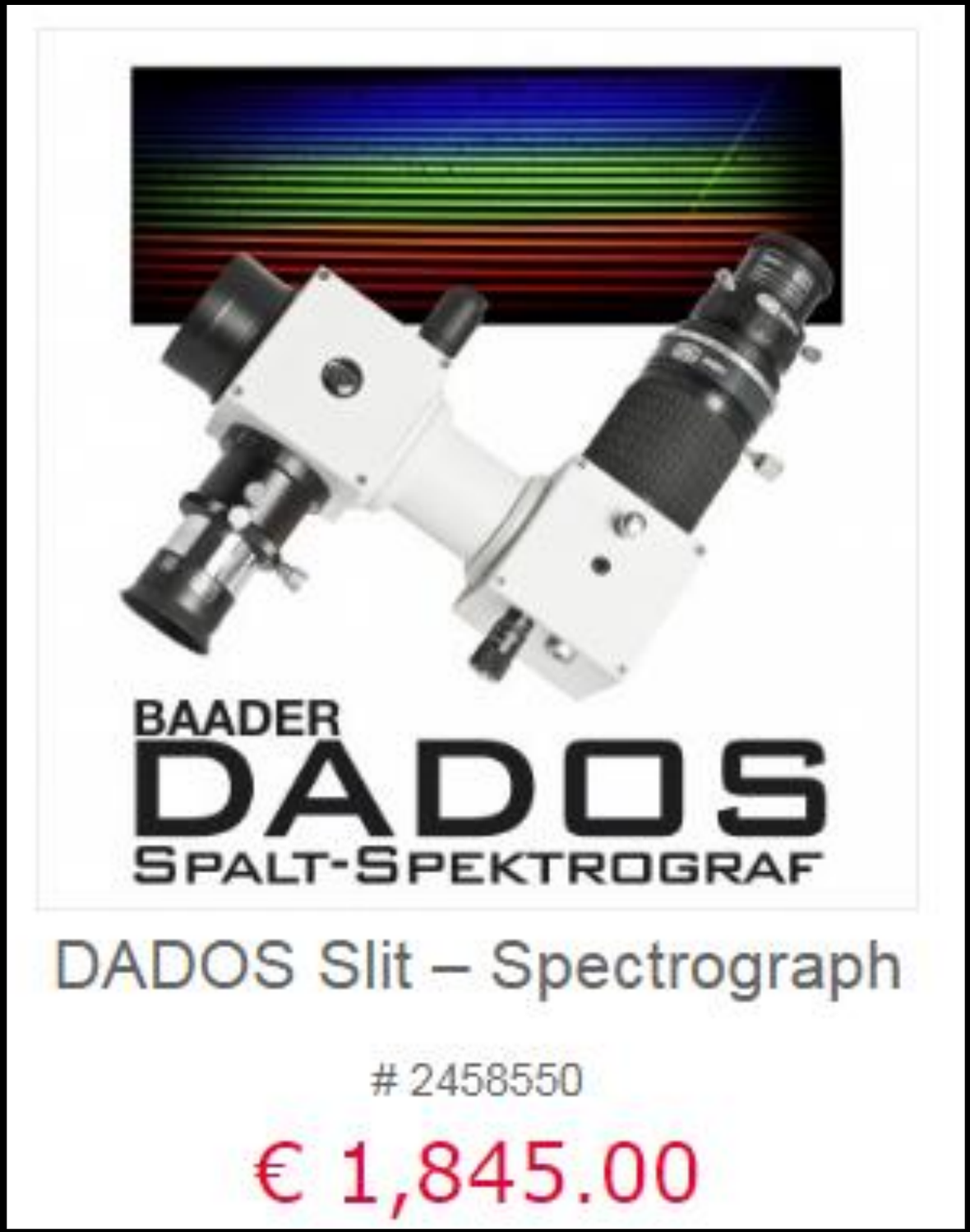
732.00 € incl VAT

Alpy guiding module

Compulsory on the telescope
PF0036

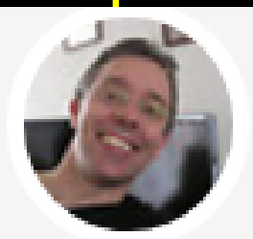
828.00 € incl VAT

Next cheapest on the market, the DADOS, @ ~R30,000



So, to get a resolution of R ~900 or 1,500 (5 to 1 A°), you can build your own “slit” spectroscope for about R10,000 or as low as R5,000. **Very similar to the DADOS design**

Compliments of



Spectrograph / Spectroscope (LOWSPEC)

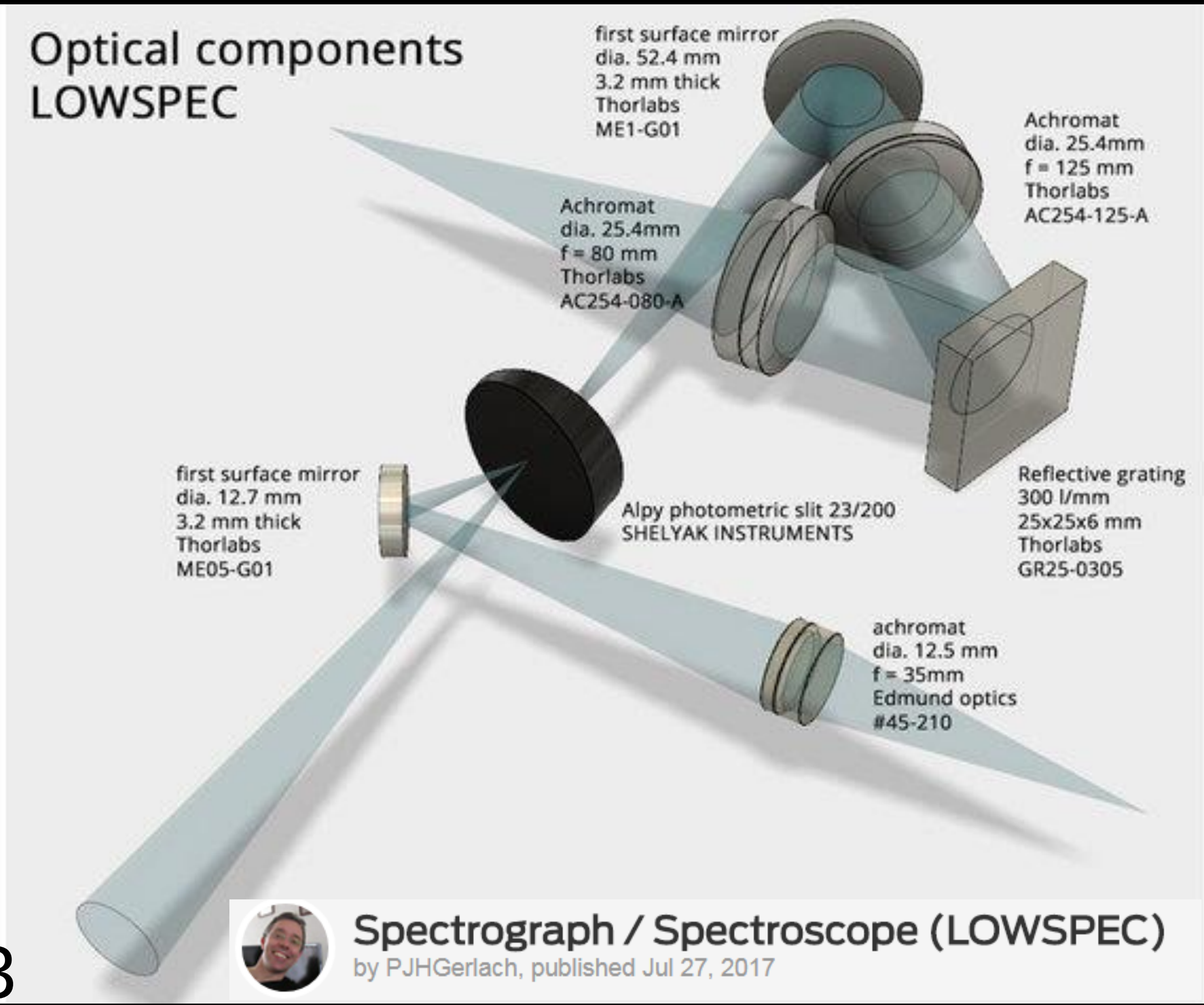
by PJHGerlach, published Jul 27, 2017

https://www.thingiverse.com/thing:2455390

Costs

1. 3D Printing
2. Mirrors, lenses, grating
3. Slit
4. Hardware – screws, bolts, etc
5. Courier costs
6. Vat on import

Optical components LOWSPEC



Spectrograph / Spectroscope (LOWSPEC)

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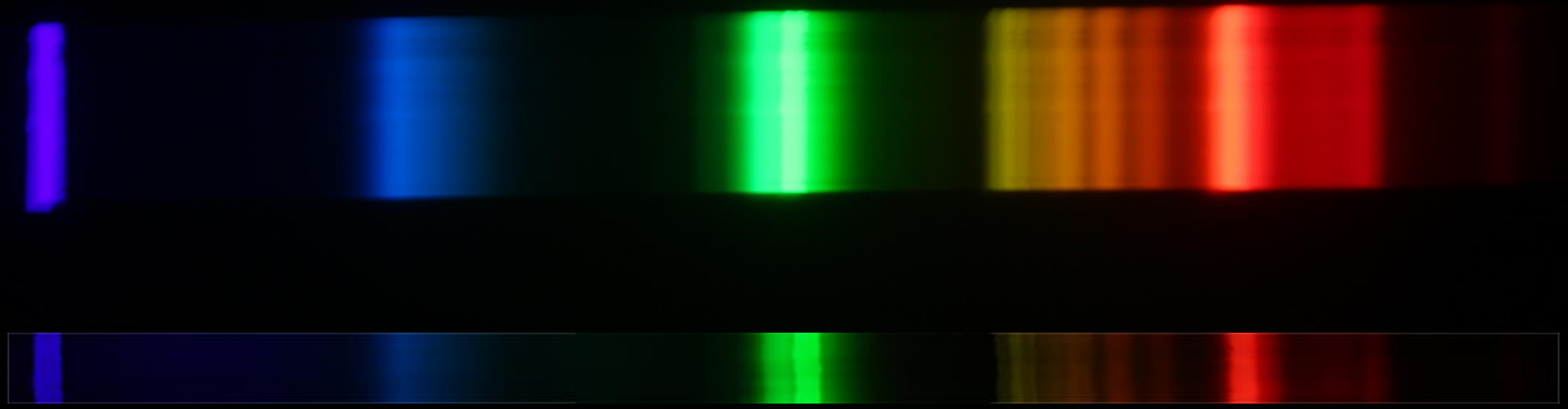
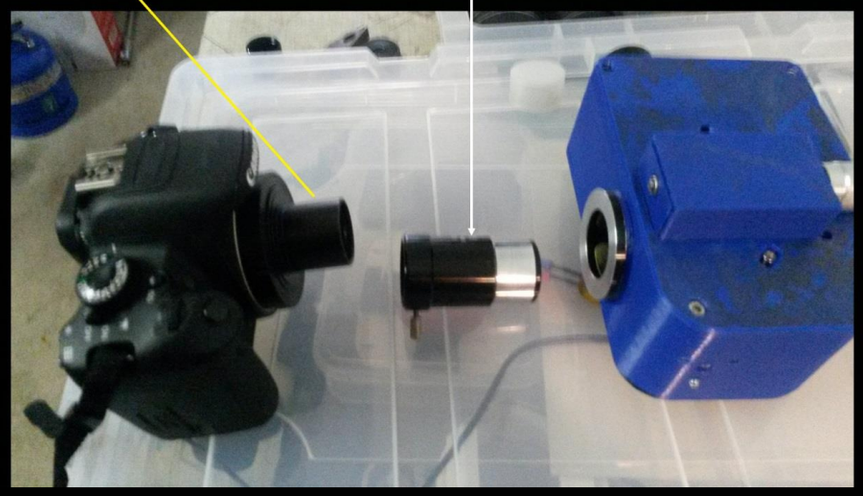
Spectra of std household white fluorescent light – showing the “neon” emission lines

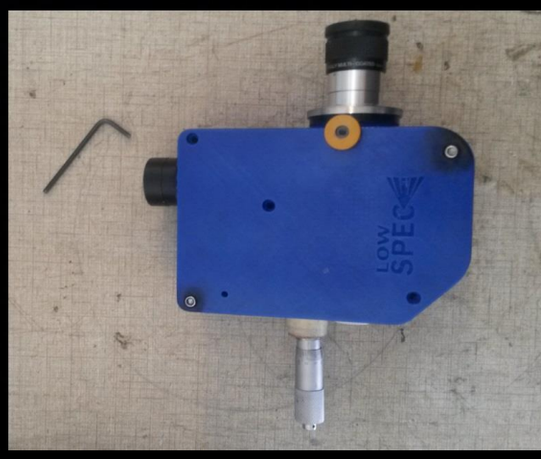


Spectra of std household fluorescent light
Complete spectrum fits onto a Canon 650D ccd chip
Spectroscope has a 600l/mm grating
Adaptions to get this spectra to fit onto the chip - 2x's barlow lens, achromat lens approx. 80mm,
Setup by Percy Jacobs

Achromat fitted inside camera noise piece - recessed 10mm inside

Barlow lens





Books

Spectroscopy: The Key to the Stars – Keith Robinson
Astronomical Spectroscopy for Amateurs – Ken M. Harrison
Astronomical Spectrography for Amateurs – EAS Publication Series – J.P. Rozelot, C. Neiner
Spectroscopic Atlas for Amateur Astronomers (no longer a free pdf download – now buy on-line through Cambridge University Press) - Version 5.0 04/2014 (if you send me an email, I can send you a pdf copy of Version 4)

Software

Tom Field - RSpec **– http://www.rspec-astro.com** (most preferred – software comes with video tutorials that can be down loaded)
BASS Project (Basic Astronomical Spectroscopy Software by John Paraskeva – 2nd choice - http://www.aesesas.com/mediapool/142/1423849/data/DOCUMENTOS/BASS_Project_1_.pdf
Visual Spec – http://www.astrosurf.com/vdesnoux
Christian Buil - http://www.astrosurf.com/~buil

Gratings

Rainbow Optics: manufacturer of the Star Spectroscope 200 l/mm grating - http://www.starspectroscope.com/
Paton Hawksley Star Analyser 100 (SA-100) - http://www.rspec-astro.com/star-analyser/

Groups

Astronomical Spectroscopy for Amateurs
https://groups.yahoo.com/neo/groups/RSpec_Real_Time_Spectroscopy/info

Basic Astronomical Spectroscopy Software
https://uk.groups.yahoo.com/neo/groups/astrobodger/info

Ken M. Harrison – very specialised in amateur spectroscopy and willing to help – ex member of the Durban ASSA group – you can contact him via the above “yahoo” group or direct on kenm.Harrison@gmail.com

Robin Leadbeater - THREE HILLS OBSERVATORY - (Formerly "ROBIN'S ASTRONOMY PAGE")
http://www.threehillsobservatory.co.uk/astro/astro.htm

A Good List of Links
http://www.stargazing.net/david/spectroscopy/links.html

Astronomical Society of Southern Africa
http://assa.saao.ac.za/sections/photometry-spectroscopy/spectroscopy/