

# Determination of stellar physical parameters using SPECFLOW

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Astronomers : Agnès Lèbre - Ana Palacios

Engineers : Aurélien Emeras - Patrick Maeght - Michèle Sanguillon

**Goal :** First evaluation of physical properties of the stars HD232862 (case #1) and VEGA (case #2)

**Software to launch :** SPECFLOW

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## Case #1

- Step 1. Go to <http://specflow.oreme.org/> and click to the « RESET » button to clear the previous requests and results.
- Step 2. Click on the « Stellar Parameters » tab to retrieve the stellar parameters of the star.

The screen is divided in two regions : the **QUERY** zone and the **RESULTS** zone. In the **QUERY** zone, give the star ID : HD232862. Select « All » catalogues registered in Vizier. Then, click on the « Get Parameters » button. In the **RESULTS** zone on the right, a summary of the result of query on the SIMBAD and VizieR services is displayed. When available, the Simbad query gives indications on the metallicity (meta.main : None), the class of the object (src.calss : \*\*), on the RA (pos.eq.ra;meta.main : 0.59333275) and DEC (pos.eq.dec;meta.main : +50.855156) coordinates, the rotation velocity (PHYS.VELOC.ROTAT : None), the radial velocity (spect.dopplerVeloc.opt : -1.80) and the spectral type (src.spType : G8II). From the Vizier query, the average values of several physical quantities obtained from all the catalogs in Vizier containing information on HD 232862 are displayed. For this specific object the only value obtained concerns the effective temperature (phys.temperature.effective : 4900.0). The detailed result of query for the Vizier service can be seen by clicking on the « Show details » button in the **QUERY** zone of the screen on the left.

- Step 3. Click on the « Observed Spectra » tab to choose an observed spectrum in the TBLegacy database. In the **QUERY** zone, click on « Search » to check the database. The list of the spectra matching the coordinates is returned in the **RESULTS** zone on the right. The data including a label « *int\_Normal\_I* » in their name correspond to the total non-polarized intensity. Select the *hd232862\_narval\_26sep08\_int\_Normal\_I\_001\_tbl.fits* by dragging and dropping it in the cart.
- Step 4. Click on the « Synthetic Spectra » tab to choose a synthetic spectrum. In the **QUERY** zone, click once on « + » to increase the interval of selection

(4410 to 5390). Replace « None » by 3 for the min (upper field) and max (lower field) of the gravity (logg) and -0.5 and 0 for the min and max of metallicity. Then click on « Search ». In the **RESULTS** zone, a list of 6 spectra is displayed on the right, corresponding to the data in POLLUX matching the query.

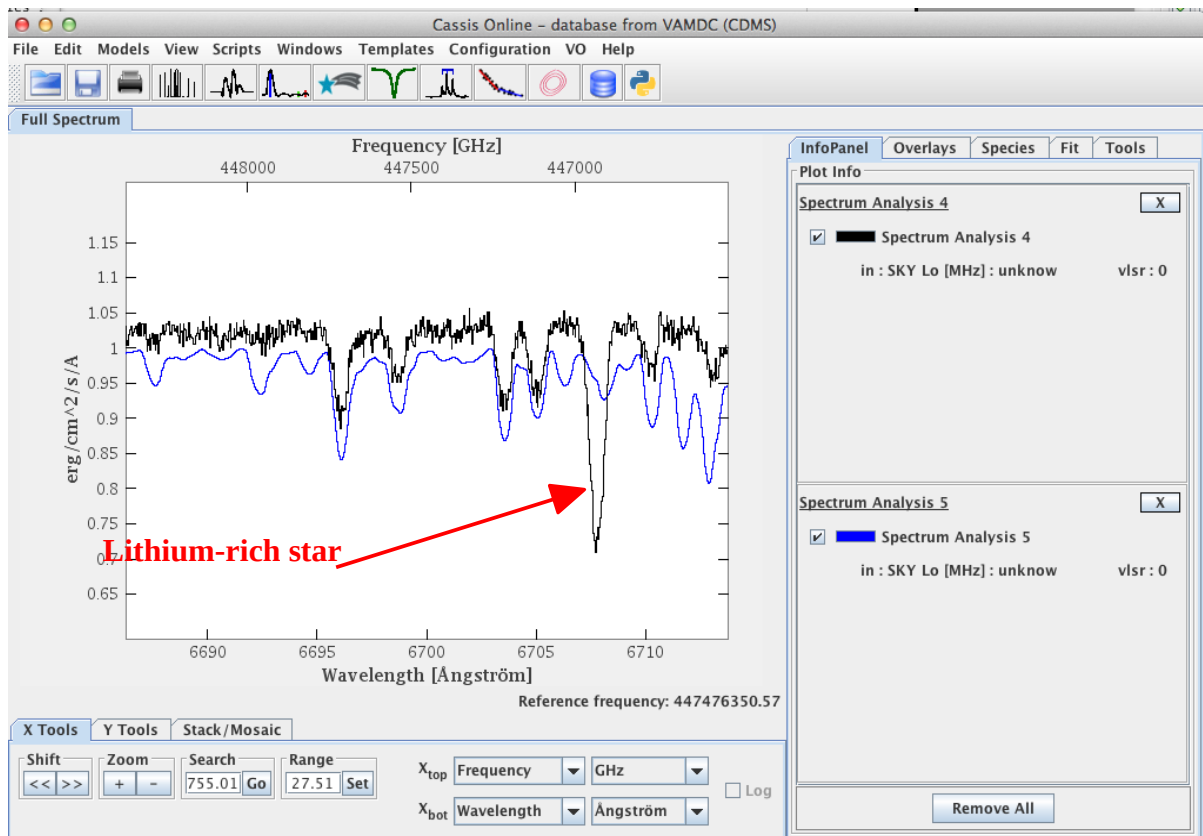
Select

*NORMFLUX\_M\_s5000g3.0z0.0t1.0\_a0.00c0.00n0.00o0.00r0.00s0.00\_VIS.FITS* by dragging and dropping it in the cart.

- Step 5. Click on the « Convolution » tab to convolve a first portion of the synthetic spectrum in the region of the lithium line at 6707 Å. Give the following values in the **QUERY** zone
  - central wavelength : 6700
  - macroturbulence : 2
  - rotational velocity : 20.5
  - instrumental profile : 105 (mÅ)

Click on the « Process » button to convolve. In the **RESULTS** zone, select the convolved spectrum (*CONV\_M\_s5000g3.0z0.0t1.0\_a0.00c0.00n0.00o0.00r0.00s0.00\_VIS.FITS*) by dragging and dropping it in the cart.

- Step 6. Launch CASSIS VO tool by clicking on the corresponding button. You will be asked to confirm to open it, to accept the risks and to execute it. It can be a bit long... Two windows (console java cassis tools) and will be displayed. A hub icon (yellow and black) may appear in your browser icons. The hub may also appear in another window.
- Step 7. Open the cart by clicking on it. Check the central wavelength displayed above is correct. Select the « FLUX\_NOR » column of the observed spectrum and the « normalizedconvolvedflux » column of the convolved one. Then click on the VO button (the green one in the middle of the window) to broadcast the files to the VO tools. If it is your first transfer, you will be asked to confirm the SPECFLOW connection to the HUB. Do it !
- Step 8. In the CASSIS software, for each file, select the « Spectrum Analysis » model. Cassis opens a new window where you have to click on the « Display » button. The spectra are displayed (the first spectrum / observed one with a black line and the second / the convolved one - with a blue line).
- Step 9. In Cassis, zoom on the 2 spectra around 6707 Å . At this wavelength, you can see a lithium line in the observed spectrum that is not present in the convolved one. This fact indicates that the star is lithium-rich, contrary to what is predicted for a standard object with the considered temperature, gravity and metallicity corresponding to the selected synthetic spectrum.



- Step 10. Return to SPECFLOW and click on the « Convolution » tab to convolve a second portion of the synthetic spectrum around the **infrared calcium triplet**. Choose the CaII IR line to convolve around 8590 Å. Give the following values :

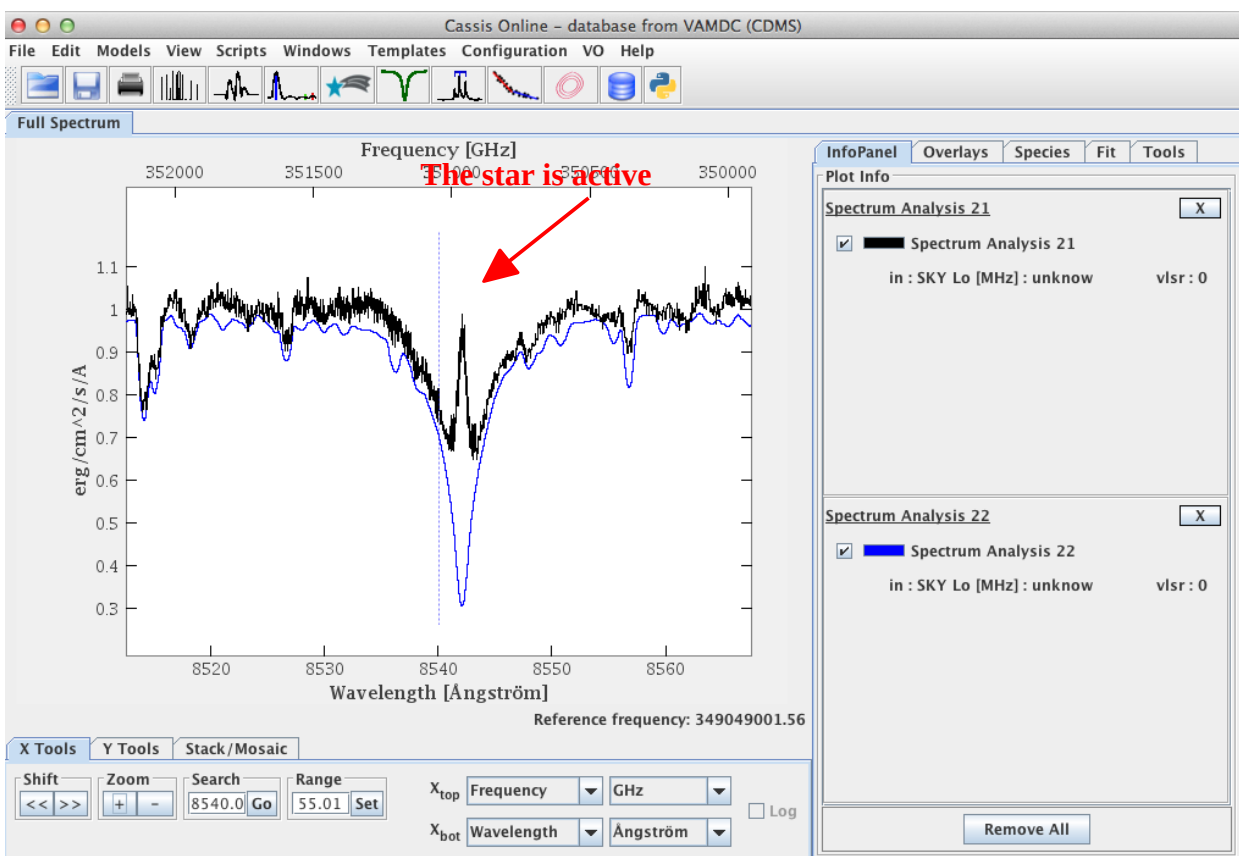
- macroturbulence : 2
- rotational velocity : 20.5
- instrumental profile : 105

Click on the « Process » button to convolve. Select on the right part the convolved spectrum (*CONV\_T2R20.5G105mA\_L8590\_W200\_S-1.80\_M\_s5000g3.0z0.0t1.0\_a0.00c0.00n0.00o0.00r0.00s0.00\_VIS.spec.FITS*) by dragging and dropping it in the cart.

- Step 11. Open the cart by clicking on it. Check the central wavelength displayed above is set to 8590 and the width to 200. Select the « FLUX\_NOR » column of the observed spectrum and the « normalizedconvolvedflux » column of the convolved one. Then click on the VO button (the green one in the middle of the window) to broadcast the files to the VO tools. In the CASSIS software, select the « Spectrum Analysis » model. Cassis opens a new window where you have to click on the « Display » button. The spectra are displayed (the first spectrum / observed one with a black line and the second / the convolved one - with a blue line). **If you did not close the Cassis display windows, the new portion of spectrum will appear in the same**

window in which the lithium line region was displayed. Uncheck the previous files in the Cassis window to center the graph back on the CaII region. The observed and convolved spectra may then appear in different colours (red and green). The observed spectrum is always the less smooth one.

- Step 14. In Cassis, zoom the plot around 8540 Å. You can see that the width of the calcium line in the observed spectrum is matched by that in the theoretical convolved spectrum, indicating that the line broadening is well accounted for with the chosen parameters. You can also see that the core of the line strongly differs, with an emission line appearing in the core of the observed the calcium line that is not present in the theoretical spectrum. This indicates that HD 232862 is an active star, probably magnetic.



## Case #2

- Step 1. Go to <http://specflow.oreme.org/> and click to the « RESET » button to clear the previous requests and results.

- Step 2. Click on the « Stellar Parameters » tab to retrieve the stellar parameters of the star. In the **QUERY** zone on the left, give the star ID : VEGA. Select « All » catalogues registered in Vizier. Then, click on the « Get Parameters » button. In the **RESULTS** zone, on the right, the results of query of the Simbad and Vizier service are displayed. For the Simbad query, indications on the metallicity (meta.main : None), the class of the object (src.class : PulsV\*delSct), on the RA (pos.eq.ra;meta.main : 0.59333275) and DEC (pos.eq.dec;meta.main : +50.855156) coordinates, the rotation velocity (PHYS.VELOC.ROTAT : 24), the radial velocity (spect.dopplerVeloc.opt : -20.60) and the spectral type(src.spType : A0Va) are given. From the Vizier query, the average values of several physical quantities obtained from all the catalogs in Vizier containing information on Vega are displayed : effective temperatures (phys.temperature.effective : 8266.6), gravity (phys.gravity : 3.77), the metallicity (phys.abund.Fe : -0.65), the microturbulence velocity (phys.veloc.microTurb : 2.0). The SIMBAD values prevail over the Vizier ones, so that only the Simbad value for the rotational velocity will be retained for the convolution.
- Step 3. Click on the « Show details » in the **QUERY** zone on the left to check the values found in the **VizieR** catalogues. Here, you can unselect the catalogues with suspicious values (the mean is automatically recalculated) . Uncheck the I/305 lines :
  - I/305 0.53 4.0 -0.50 None : The effective temperature equal to 0.53 is likely the log value of an effective temperature
  - I/305 None None - ? None : The ? indicates that the value could not be read
- Step 4. Click on the « Observed Spectra » tab to choose an observed spectrum in the TBLegacy database. Click on « Search » to check the database. The list of spectra matching the coordinates appears in the **RESULTS** zone on the right. Select the *vega\_narval\_15jul10\_int\_Fast\_I\_001\_tbl.fits* by dragging and dropping it in the cart.
- Step 5. Click on the «Synthetic Spectra » tab to choose a synthetic spectrum. Refine the range of parameters as follows (the min and max values are to be entered in the upper field and lower field respectively) :
  - effective temperature (Teff) : from 8200 to 8300 (K),
  - gravity (logg) : from 3.4 to 4 .,
  - metallicity : from -1 to -0.5.
  - microturbulence (vturb) : from 2.0 to 2.0

Then click on « Search ». 24 files are displayed in the **RESULTS** zone. Select the file *NORMFLUX\_A\_p8200g4.0z-1.0t2.0\_a0.00c0.00n0.00o0.00r0.00s0.00\_VIS.spec.FITS* by dragging and

dropping it in the cart.

- Step 6. Click on the « Convolution » tab to convolve a portion of the synthetic spectrum around 8525Å. In the QUERY zone on the left, keep the following values : 8525 to the central wavelength, 100 to the width, 24 to the rotational velocity and -20.6 to the radial velocity. Add the following values : 2 to the macroturbulence and 102 to the instrumental profile. Click on the « Process » button to convolve. Select on the right part the convolved spectrum (*CONV\_T2R24G102mA\_L8525\_W100\_S-20.60\_A\_p8200g4.0z-1.0t2.0\_a0.00c0.00n0.00o0.00r0.00s0.00\_VIS.spec.FITS*) by dragging and dropping it in the cart.
- Step 6. Launch CASSIS VO tool by clicking on the corresponding button. You will be asked to confirm to open it, to accept the risks and to execute it. It can be a bit long... Two windows (console java cassis tools) and will be displayed. A hub icon (yellow and black) can be appear in your browser icons. The hub may also appear in a third Cassis window : let it be !
- Step 7. Open the cart by clicking on it. Check the central wavelength displayed above is correct. Select the « FLUX\_NOR » column of the observed spectrum. Then click on the VO button (the green one in the middle of the window) to broadcast the file in the VO tools. If it is your first transfer, you will be asked to confirm the SPECFLOW connection to the HUB. Do it ! In the CASSIS software, select the « Spectrum Analysis » model. Cassis opens a new window where you have to click on the « Display » button. The observed spectrum is displayed (black line)
- Step 8. In the cart, select the « normalizedconvolvedflux » column of the convolved spectrum and click on the VO button (the green one in the middle of the window) to broadcast the file in the VO tools. In the CASSIS software, select the « Spectrum Analysis » model. Cassis opens a new window where you have to click on the « Display » button. The convolved spectrum is displayed (blue line).
- Step 9. Zoom on the 2 spectra. You can see that the width of the CaII IR triplet lines is well matched by the convolved theoretical spectrum.

