Data processing of ESPRESSO data: FAQs

Paola Popesso - 2026-07-28 - Comments (0) - data processing FAQ for each instrument

Data processing of ESPRESSO data: Frequently asked questions

- **I can run the whole pipeline and produce end products, but I can not do so in interactive mode. Am I doing something wrong, or is there a way to get it to run interactively?**

Answer: The GlobalPlotInteractivityScience reflex parameter should be already set by default to true. This is to allow reflex interactively, that means some python based GUI will pop up at the end of the science data reduction step (espdr_sci_red recipe). Those GUI will present you with some images and spectra (see reflex tutorial page 41, fig 6.4.14) through which you should be able to asses the quality of your data and eventually change some parameters (see upper right hand side tabs). If you change parameters you then need to press the "Re run Recipe" button, which will re-run the recipe and then pop-up again the same GUI with updated results.

- **Is there a way to manually set the parameters of the CCF computation? In particular, what is the default range of radial velocity values that is being searched? And how can I change these?**

Answer: On the science recipe interactive GUI there are three parameters under the RV button, that concern the CCF computation:

--rv_center : Guess RV. [0.0]

--rv_range : Range for the RV table. [20.0]

--rv_step : Step used in the RV table. [0.5]

The units are km/s.

- **I've had some trouble extracting a good RV value through Esoreflex for some spectra. A quick look at the CCF shows no line, or a line with different properties than expected, while a quick glance at the spectrum suggests it looks reasonable. Any idea what is going on here and how to**

fix this?

Answer: Please check rv_centre, rv_range, and rv_step parameters. In particular, if the RV of the star is outside the -20+20 km/s boundary, as happens with so many stars, the CCF computation will not show the average line of the spectrum. Following this, the pipeline cannot find the "true" minimum/maximum, and just picks the minimum value in the range. rv_range has to be large enough for the pipeline to be able to locate the minimum/maximum that corresponds to the center of the line.

- **Is a rv_step of 0.5 too wide for a precise RV extraction? What would a good step size be?**

Answer: The choice of the rv_step default is a compromise between precision and speed. The recommendation is to use a good guess for rv_center, select the right rv_range to include the whole line, and change rv_step to optimise results, considering the trade-off between precision and efficiency. 0.5 km/s is the size of an ESPRESSO pixel when measured in RV. Using a step larger than this value is equivalent to using fewer pixels to sample the FWHM of the line; on the other hand, using a smaller pixel can lead to a gain in RV precision, but it will depend on the specific case.

- **What is the list of supported stellar types?**

Answer: The supported spectral templates include F9, G2, G8, G9, K2, K6, M2.

If the input is not one of these spectral types, the pipeline will use the default, which is G2.

- **Do I need to specify anywhere the binning mode and source on fibre B when running EsoReflex?**

Answer: These parameters are read by the pipeline from the fits header of the data.

- **Are there any other settings than rv_center, rv_range, rv_step to pay attention to, or to change, when running EsoReflex to achieve the highest possible precision of RV?**

Answer: Instead of using the standard masks provided by the pipeline (for spectral types F9, G2, G8, G9, K2, K6, M2), you can also provide your own mask for the CCF computation. You should also consider the specifications of the observing mode being used.

- **I found that I obtain very different RV values for different spectral templates/masks of the order of several hundred m/s. Is this normal?**

Answer: This is normal. The instrumental offset is of this order of magnitude. The RV calculation is a precise -- not accurate -- measurement and as such comparing the absolute results with different masks does not make physical sense. A mask comparison should not be confused with a measurement of the accuracy of ESPRESSO (it is not).

- **Should I expect the FWHM of the cross-correlation function (CCF) of ESPRESSO to be smaller than that of HARPS on the same target, due to ESPRESSO's higher resolution?**

Answer: The FWHM of the individual lines measured by ESPRESSO is smaller than that of HARPS, as expected due to the instrument's higher resolution. However, the HARPS and ESPRESSO pipelines use different algorithms with different line weighting schemes for the computation of the CCF's FWHM. These differences make the HARPS data reduced with the HARPS pipeline to have smaller FWHM than the ESPRESSO data of the same target processed with the ESPRESSO pipeline.

- **The esprd_sci_red recipe crashes, but all the input files and parameters seem ok. What happened?**

Answer: There have been reported few cases in which the science pipeline crashes with no apparent reason, providing the following error message:

10:00:07 [WARNING] espdr_correct_flux: [tid=000] ESC[31mFlux correction not performed: no flux template available for spectral type F5ESC[0m

10:00:07 [INFO] : [tid=000] Computing CCF for fibre A sky_sub for size_y = 170 ...

10:00:47 [ERROR] espdr_sci_red: [tid=000] espdr_compute_CCF failed for sky_sub: Access beyond boundaries

10:00:47 [ERROR] cpl_errorstate_dump: [tid=000] Lost 11192 CPL error(s)

10:00:47 [ERROR] cpl_errorstate_dump_one_level: [tid=000] [11193/11212] 'Access beyond boundaries' (11) at cpl_image_get:cpl_image_io.c:747

To our best knowledge, the problem is associated to the presence of cosmic rays on some raw calibrations (category: WAVE, FP,FP), which led to a product that caused the failure in the science recipe. Future versions of the pipeline will be able to identify such issues and flag them appropriately.

To overcome the issue, two solutions are currently available:

- Remove the cosmic ray from the faulty calibrations with external tools before starting the data reduction.

- Replace the calibrations with those from a previous or followingday. It might be worth replacing all the calibrations (all WAVE,ORDERDEF, and FLAT types), even if not all are affected by cosmic rays, to avoid fibre misalignment between calibrations from different days.

- **What do I have to take care of if I want to compute the radial velocity of the same target over a certain period of time? And which precision can I expect?**

Answer: When computing the radial velocity of the same target over a certain period of time, it is important to use the same template (mask_table_id) to remove systematic effects between measurements at different epochs. All calibration and science must be reduced with the same version of the ESPRESSO pipeline; downloaded master calibrations from the ESO archive have not always been processed with the latest pipeline release. With high SNR data, one can expect a relative precision of 50 cm/s. It is, however, recommended to use the interactive features of the ESPRESSO-DAS workflow in order to improve the precision.

- **Why does espdr_orderdef report that fewer orders were found than expected?**

Answer: If espdr_orderdef reports, for example,

[WARNING] espdr_orderdef: For fiber A and ext 0 the number of orders found (89) differs from the nominal number (90)

The most likely cause is an incorrectly associated master bias. In particular, combining bias frames from different observing days into a single master bias can introduce residuals that cause orders near the detector edges to be poorly illuminated. As a result, order_def may fail to detect one or more orders.

To avoid this, use only the calibration frames closest in time to the science observations, following the ESPRESSO calibration association rules. Use the 10 closest bias frames and the corresponding 5–10 dark frames.

We recommend using EDPS for the data reduction (https://www.eso.org/sci/software/edps.html), as it automatically applies these association rules and creates separate master biases for different calibration groups. If SOF files are prepared manually and fed into esorex, make sure that calibration frames from different observing days are not incorrectly combined.