

Tarantula Survey Reduction Notes

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These notes summarise the processing of the Medusa data for the VLT-FLAMES Tarantula Survey (VFTS). If you plan to use these data we suggest you read through the following; full observational details are given by Evans et al. (2011)¹.

File Nomenclature

Each spectrum is named using a common format. For example: 'LR03_01_a_A_082.fits' is e.g.:

- LR03 FLAMES grating and wavelength setting [LR02/LR03/HR15N]
- 01 Observing Block (OB = an epoch) for this setting in this field configuration [01-06]
- a Order within OB, comprised of back-to-back pairs and mostly named 'a' or 'b'².
- A FLAMES field, each of which comprises a different fibre configuration [A-I]
- 082 Object number, as used in the 2011 overview paper [001-893]

General comments

- The reduced spectra were summed extractions with v.2.8.7 of the ESO Common Pipeline Library FLAMES reduction routines.
- All spectra were corrected to the **heliocentric frame** (using *rvcorrect* and *dopcor* in IRAF).
- There is some curvature at a given wavelength across the CCD. The pipeline automatically truncates to a common point at the blue end of each setting but not the red. For consistency all spectra were also truncated to a common point in the red (a matter of pixels rather than Ångstroms).

Data product description

Various stages of the reduction process were included as fits extensions. It is expected that most users will only use the spectra within the primary extension [0], but those wishing to recreate the original reduced data, can do so by addition of extensions [1] and [2]. The contents of each extension are:

Ext.[0] Final data product

This is the same as [1] but pairs of exposures are passed through a cosmic clipping routine which employs principles of a similar routine written by Ian Howarth for cleaning 2dF spectra:

- Exposures were taken in consecutive pairs ('a' & 'b', or 'c' & 'd' if repeated) within the OBs. [Except for LR02_06 for Field B as the first execution of the OB was aborted, leaving one exposure mapped (out of sequence) to LR02_06_c_B_xxx.fits].
- For each spectrum the ratio of the two exposures was calculated.
- A boxcar 4-sigma clip, on 100 wavelength bins, was performed on the *ratio* value, i.e. any unexpected and significant deviations in the ratio were found – these would indicate a feature present in one observation, but not the other. Since the exposures are consecutive, it is safe to assume that such a transient feature is a cosmic ray.
- The offending region is then clipped out and replaced with the value from its sister exposure, appropriately scaled by the ratio of the surrounding region.

Ext.[1] Sky subtracted, extracted spectrum: Sky-subtracted object spectrum, without cosmic removal. Inspect this if you have any concerns regarding cosmics.

Ext.[2] Median sky spectrum: Median sky spectrum for this OB, after rejection of contaminated sky fibres (noted in the *BAD_SKYS* keyword). This was subtracted from all other fibres in that observation. All fields have ≥ 12 sky fibres used for the median calculation.

¹ <http://adsabs.harvard.edu/abs/2011A&A...530A.108E>

² In some instances pairs were repeated due to, e.g., poor seeing, so some are labelled 'c' or 'd'.

Ext.[3] Error spectrum: An error spectrum is produced by the pipeline for each fibre as part of the reduction process which, for each wavelength bin, records the statistical error arising from the different stages in the reduction, e.g., bias level, detector gain, read-out noise. The error spectrum is combined with the error of the subtracted sky spectrum to yield an overall error spectrum for each fibre.

Ext.[4] Fibre look-up table: Mapping of the Medusa fibre number to the original object identifiers used in target selection. Both this and the *ORIG-ID* header keyword are for traceability of the observations through the processing/remapping to object numbers etc.

Additional header keywords of note:

VHELIO: Heliocentric correction applied to the spectra by *dopcor*.
BAD_SKYS: Sky fibres not included in median sky creation due to contamination/cross-talk.
MED_SKY: The median value of the Sky Spectrum used for this observation, for use as a quick estimate of the magnitude of the Sky Spectrum.
VERSION: Data release number (2.0 = data release used in VFTS papers).
S_to_N: Signal-to-noise estimated from the median of the object spectrum divided by the median of the error spectrum (i.e. Ext.[0]/Ext.[3]).
ORIG-ID: Original target identifier for observations.

Known issues/possible problems:

- Cross-talk between fibres: Cross-contamination between fibres is generally minimal, but inspection of the reduced spectra revealed a number of fibres that were contaminated by bright emission lines in WR or slash stars and, in a couple of cases, by supergiants with bright continua (harder to quantify). We inspected the adjacent spectra to all 'bright' spectra (counts>10,000) from the OB taken with the best seeing for each field/wavelength setting. In some instances the contaminated fibres were sky fibres (included in '*BAD_SKYS*'), and four stars were removed from the survey due to such cross-contamination. A further ~20 stars have some element of cross-contamination – typically an artificial 'bump' at 4686Å from strong emission in slash stars. These stars are noted as such in Table 5 of Evans et al. (2011), but we comment that in the course of analysis of the VFTS spectra we have noted several others (with weaker contamination) – this is probably the cause if you notice broad/weak 'emission' near 4686Å.
- The Sky Spectrum was not modified to remove known nebula lines.
- The cosmic clipping generally does a good job, but sometimes does not fully remove broader cosmic features. This can occasionally result in some odd-looking, semi-removed features remaining – if in doubt, simply compare the spectra with those in Ext.[1].