Near-infrared Corrections

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LWS spectra of stars that are bright in the near-IR sometimes contain features which resemble broad spectral features, but which do not occur at the same wavelength in detectors which cover the same range. These 'false strong features' appearing at $\sim$53 μm and $\sim$103 μm (see Figure 1).

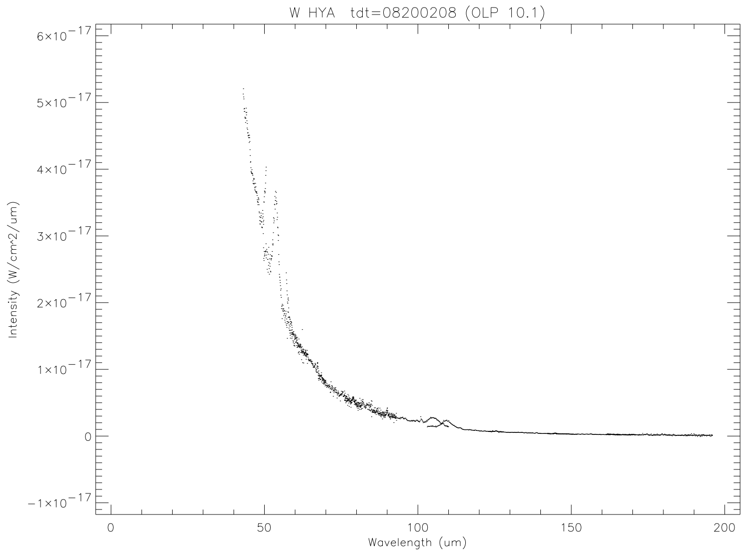

Figure 1. A typical nirleak LWS spectra: W Hya (TDT 08200208)

The origin of these features is believed to be a near-infrared leak in the blocking filters located in front of the detectors. This supposition is supported by a statistical test, which showed a correlation between these features and the J, H, and K bands. The strength of these features is best correlated with the strength of the sources in the H-band (1.6 μm). In a small sample of post-main-sequence stars observed in the Core Programme, all those which had H-band emission brighter than about 2.2 magnitudes (around 140Jy) were seen to exhibit these spurious features.

Follow-up observations of one of the affected sources gave results consistent with a near-IR leak as the origin of the features. The spurious features are now known to be reproducible, in terms of wavelength, shape and FWHM from one source to another and for repeated observations of the same source. This means that a template profile can be created which observers can fit to their data and use to remove the spurious features. To first order the profile is Gaussian for each of the three most-affected detectors: SW2, LW1 and LW2. The short-wavelength wing of a similar feature also affects the longest-wavelengths of detector SW1's range, while the long-wavelength wing of a spurious feature affects the shortest wavelengths of detector SW3's range.

Based on the small number of affected sources in the Core Programme, we can offer the following estimates:

- The spurious features become noticeable when [H] is brighter than 2.2 magnitudes, and the ratio of flux densities $F(1.6\mu m)/F(60\mu m) \geq 4$.
- A zero-magnitude source at H(roughly $F(1.6\mu m) = 1050$ Jy) gives a feature with peak flux 1.5 10^{-18} W cm$^{-2}\mu$m in detector SW2.

The method to remove the 'false features' is based on the power law assumption of the continuum and the gaussian template profiles. The estimated continuum ($F_{\lambda,\mathrm{c}}$) underneath the feature is assumed to have the form of a power law

$$F_{\lambda,\mathrm{c}} \propto \lambda^{-\beta} \quad \text{where } \beta \text{ is the continuum spectral index,}$$

and the fitted features are from the best estimated central wavelength and FWHM of the gaussian template profiles. Figure 2 shows a 'false feature' (solid line), which is due to the NIR leak problem, on the spectrum of W Hya in the range of detector SW2. The fitted spectrum (with diamond symbol) lies on the top of the original spectrum. We can see that it fits very well. The 'removed false spectrum' (solid line) lies just underneath the 'false feature' along with the fitted continuum (dashed line).

These features, which are shown on the LWS spectra of 44 sources in the sample, have been removed (see Figure 3).

References

Gry C., Swinyard B., Harwood A. et al., The ISO Handbook volume III: LWS, The Long Wavelength Spectrometer, esa SP-1262, version 2.1, August 2003.

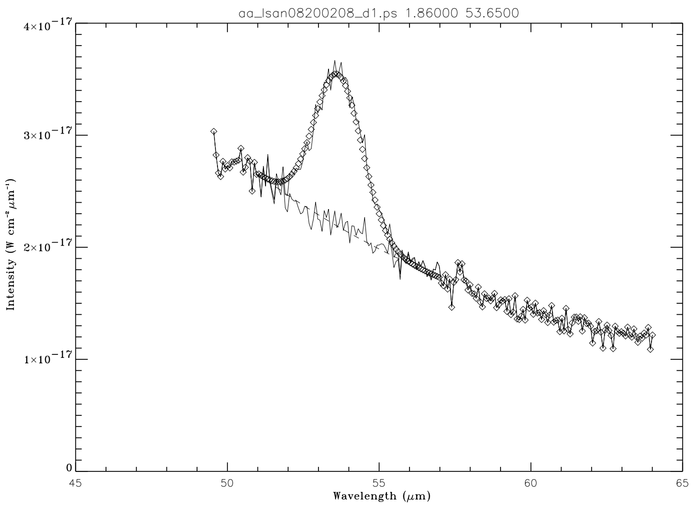

Figure 2. NIR-leak infrared correction

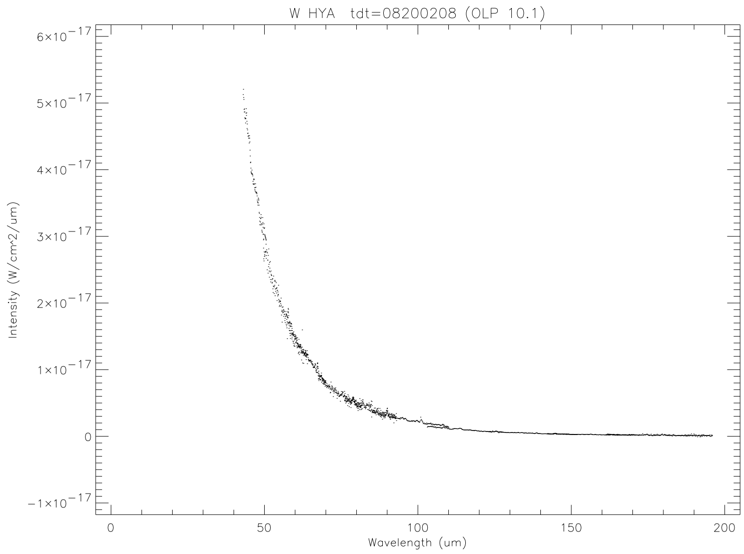

Figure 3. A typical nirleak-corrected LWS spectra: W Hya (TDT 08200208)