Spurious Spectral Features seen in band 2C

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Chapter 1

Introduction

This note describes spurious features seen in band 2C (7 to 12 microns) that should not be mistaken for actual spectral features from the object of interest. It is based on a small sample of observations, and its conclusions should be treated as preliminary at this stage.

Band 2C features are a collection of ubiquitous spectral 'lines' in emission and absorption seen between 7 and 12 microns (SWS Band 2C). An example of these features is shown in Figure 1.1. In this figure, we show the normalized flux of an AOT1 speed 1. Also plotted in this figure is the Relative Spectral Response Function (RSRF) of Band2c.

The features occur at:

9.35 microns in absorption with a FWHM: 0.3 microns

10.05 microns in emission with a FWHM: 0.1 microns

11.05 microns in emission with a FWHM: 0.1 microns

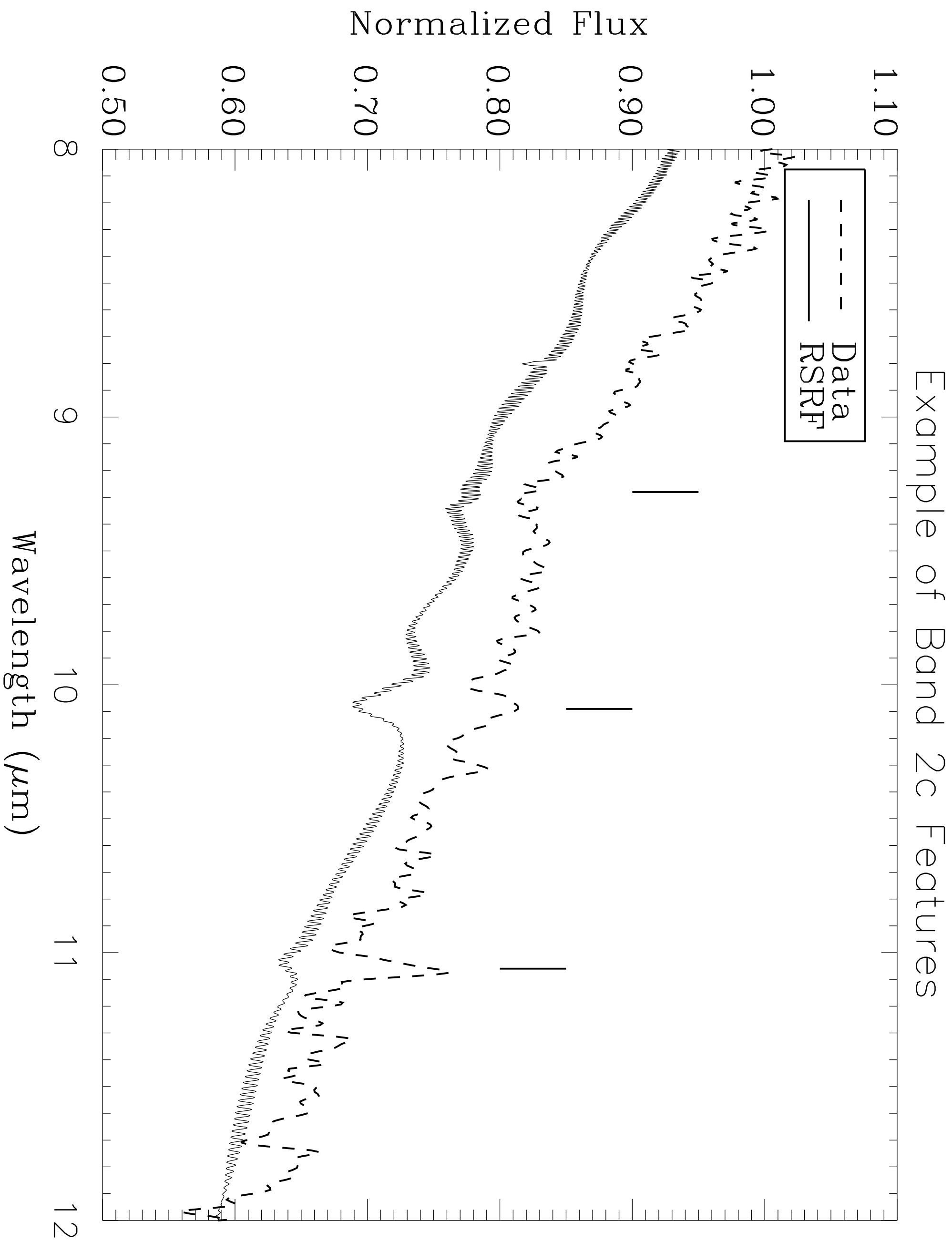

Figure 1.1: SWS spectrum showing spurious features

Chapter 2

Data

Forty-three Band 2C spectra were collected from 9 observers in order to find trends in the strength of the features. The spectra are from both carbon and oxygen rich objects which are, in turn, stellar and nebular in origin. Since a rather broad wavelength range is required, only data from AOT SWS01 observations was used. This does not preclude the features being present in the data from other AOTs.

Table 2.1 shows a summary of the 43 sources in our sample with at least one feature. The peak wavelengths, FWHM and Percent of continuum levels ("% Cont", negative meaning absorption, positive emission) are median values in the sample. Also listed are the minimum and maximum values for each parameter that were seen in the dataset. Some of the spread is due to noisy data and the difficulty of measuring the continuum and width of a line.

Feature	#	Peak Waveln.	(Min,	Max)	Median FWHM	(Min,	Max)	% Cont	(Min,	Max)
9.35	36	9.26	(9.2 ,	9.4)	0.295	(0.029,	0.482)	-7	(-14,	1)
10.05	30	10.07	(9.96,	10.10)	0.094	(0.017,	0.280)	3	(-5,	11)
11.05	37	11.05	(11.01,	11.11)	0.090	(0.050,	0.180)	6	(4,	15)

Table 2.1: Sources With Features

The summary for the absence of features is shown in Table 2.2. We have listed the number of sources that do NOT show a feature and the continuum level where we expect the feature to be. In general the absence of a feature correlates with the continuum strength. Of the sources that do not show one of of the features, at least 2/3 of these have continua below 100 Jy. Again, this may be an indication of the difficulty in measuring the features.

Feature	Number	Median Cont (Jy)	(Min,	Max)
9.35	7	63	(20,	4200)
10.05	13	46	(14,	430)
11.05	6	18	(12,	115)

Table 2.2: Sources Without Features

The remaining sources that have high continua but do not show a feature remain a puzzle. Of the high continuum sources (>100 Jy), 2 do not show the 9.35 micron feature, 3 do not show the 10.05 and 1 does not show the 11.05 feature.

Since we did not specifically ask for sources that did not show any features, we cannot draw any conclusions about these sources.

Chapter 3

Results

From the 43 sources we find the following:

- For the 9.35 micron feature, there is a spread of between 1% to 14% in the strength of the feature peak relative to the continuum.
- For the 10 and 11 micron features, the peak is roughly 5% of the continuum in all but one source greater than 100 Jy.
- There are no apparent trends with Galactic or Ecliptic latitude or longitudes.
- The equivalent widths of the features show similar trends as the peak fluxes but are more scattered.
- There are 'features' present in the Band 2C Relative Spectral Response Function (RSRF) at or near the positions of the observed features.
- There is one measurement of the 9.35 micron feature in emission (1260 Jy continuum) and one high SN measurement of the 10.05 feature in absorption (316 micron continuum).
- The features are not always present in the spectra.
- We do not have a large database of counter-examples.

Chapter 4

Discussion

There are a number of arguments why these features are not astronomical:

- The strength of the features is roughly a constant multiple of the continuum. This strongly suggests that the features are introduced in the Relative Spectral Response Function (RSRF).
- The features appear in all types of sources without any correlation to position on the sky.
- The features appear at wavelengths where the RSRF has significant changes. See Figure 1.1.
- Finally, the RSRF was determined from very strong signals. In the presence of the band 2 memory effects, strong signals can influence the contrast in any measurement including the RSRF measurement itself.

However, the absence of features in some spectra clouds the problem greatly. If these features are introduced in the RSRF, then we must explain what is happening in the sources without the features. Again there are a number of possibilities:

- The spectra are too noisy to measure the features well. This is likely the cause of the variation of the equivalent widths. An example of this problem is seen for the 10 micron feature in Figure 1.1. Due to noise, the continuum beneath the feature is highly uncertain. This would result in a poor determination of the line strength.
- Different data reduction techniques hide the features. SWS_REBIN, an SWS IA tool, can have a significant effect on the features depending on the resolution and method used for computing the rebin.
- In some sources the features may be real. If the features are very strong they could be astronomical. However, until there is a resolution to this issue, they should always be suspect.

Chapter 5

Conclusions

From the small number of observations studied the preliminary conclusions on these spectral features are that they appear in all types of objects and are a constant fraction of the source continuum, roughly 5%. At this time, the best explanation is that the features are introduced by the RSRF and are not astronomical in origin.

While only AOT 1's have been checked, these features have been seen in the data from other grating AOT's.

These conclusions should be viewed as preliminary until the SWS IDT can carry out a more complete investigation.