A COMPARISON BETWEEN SWS GRATING AND FABRY-PÉROT LINE FLUXES

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ABSTRACT

We present a comparison between line fluxes observed with the grating and the Fabry-Pérot of the SWS instrument (AOT2 and AOT7 observing modes, respectively). The agreement between the AOT2 and AOT7 line fluxes is within 60% but for one case. In half of the cases studied, the AOT2 and AOT7 determined line fluxes are consistent up to a 90% level. The main reasons for the discrepancies found between FP and grating line fluxes are the uncertainty in the continuum determination, wrong fringe removal due to a shift with respect to the applied RSRF, and/or low S/N in the AOT7 observations. This is an update of the paper published in the Proceedings of the First ISO Workshop on Analytical Spectroscopy (ESA SP-419).

Key words: infrared instrumentation; spectroscopy.

1. INTRODUCTION

The SWS instrument consists of two grating spectrometers covering the wavelength range 2.38-12 μm (SW) and 12-45.2 μm (LW), respectively, with a resolution between 1000 and 2000. The resolution is increased to approximately 30,000 by inserting Fabry-Pérot filters that collimate the radiation returning from the LW grating. For each grating spectrometer, the output spectral image is re-imaged into two detector arrays (12 elements). The FP output is directed to one of the FP arrays of two detectors each, depending on the wavelength. The SWS observing mode AOT2 has been designed to obtain optimum observations of single lines by using the grating, while AOT7 is the corresponding mode for maximum resolution observations with the Fabry-Pérot filters (see de Graauw et al. 1996 for a description of the instrument and its observing modes).

The purpose of this work is to compare the fluxes of lines observed with both modes to check for consistency, and to analyze the factors that affect line flux determination in each case.

2. DATA SELECTION AND PROCESSING

Several observations of three sources have been selected for the comparison. Most of the lines are strong enough for a good S/N in the grating mode. The data have been reduced using SWS IA (i.e., Lahuis et al. 1998), with the Cal-G files included in OLP V6.11. In addition to the standard pipeline processing, further data reduction steps have been applied. In particular, for the AOT2 observations: At SPD level, interactive dark current subtraction, applying sigma clipping to dark currents and discarding glitched data; after deriving the Auto Analysis Result (AAR) product, bad detectors (31 in one of the observations and 36 in the others) have been discarded; flatfielding of the twelve detector signals in each corresponding band; application of sigma clipping and rebin the spectrum to the maximum resolution of the AOT band; application of defringing methods when necessary. For the AOT7: At SPD level, interactive removal of glitched points and tails in dark currents and signal; interactive dark current subtraction; after deriving the AAR, application of sigma clipping and rebin to resolution 30000. Note that only detectors 49 or 51 have been considered, depending on the line wavelength.

3. RESULTS

Table 1 shows the line fluxes calculated of each observation by fitting a Gaussian to the line profiles. If a single line in an AOT2 observation corresponds to a blend of lines resolved when observing with the higher resolution of the AOT7 (e.g. the 25.062 μm line in NML Cyg), the AOT7 flux given is the total flux of these lines. In the column before last the AOT7 to AOT2 line flux ratios are shown. Since the continuum level maybe different in the AOT2 and AOT7 observations of a particular line, the last column lists the AOT7 to AOT2 equivalent width ratios (when the continuum is significant with respect to the line). Figure 1 shows the AOT2 and AOT7 observed lines considered in this study.

Table 1.

Source	line μm	Grating AOT band	FP AOT band	AOT2 flux W cm^{-2}	AOT7 flux W cm^{-2}	AOT7/AOT2 line fluxes	AOT7/AOT2 EW
NML Cyg	20.658	3D	5D	7.36E-19	9.80E-19	1.33	1.45
	25.062	3D	5D	9.68E-19	1.95E-18	2.01*	1.59
NGC 6543	15.555	3A	5B	5.64E-17	5.94E-17	1.05	-
	18.713	3C	5C	1.36E-17	1.40E-17	1.03	-
	21.829	3D	5D	4.47E-19	3.09E-19	0.69**	-
NGC 7027	13.521	3A	5B	4.87E-18	2.11E-18	0.43	1.00
	18.713	3C	5C	9.47E-18	1.02E-17	1.08*	-
	24.317	3D	5D	4.75E-17	2.28E-17	0.48	1.06
	34.815	4	6	1.28E-18	7.70E-19	0.6*	1.16
	35.349	4	6	2.58E-19	2.66E-19	1.03	1.47
	36.013	4	6	4.71E-18	4.25E-18	0.9	1.01

* Difficult to determine the continuum level in the AOT7
**Very low S/N for the FP

4. CONCLUSIONS

The agreement between grating and FP line fluxes is within 60%. A low S/N ratio, uncertainty in determining the continuum level in the FP observation, and wrong fringe removal due to a shift with respect to the applied RSRF are the main reasons for the discrepancies found between AOT2 and AOT7 line fluxes. On the other hand, in five out of eleven cases studied, the AOT2 and AOT7 line fluxes are consistent up to a 90% level. When equivalent widths are considered, the discrepancy is smaller than for the line fluxes in three cases (NML Cyg at 25.062 μm, NGC7027 at 24.317 and 34.815 μm), in which the continuum levels in the AOT2 and AOT7 observations differ in 26%, 50% and 43%, respectively.

Since the continuum in an AOT7 may be very noisy, it is recommended to request a wavelength range broad enough around the line to reduce the error in its determination.

REFERENCES

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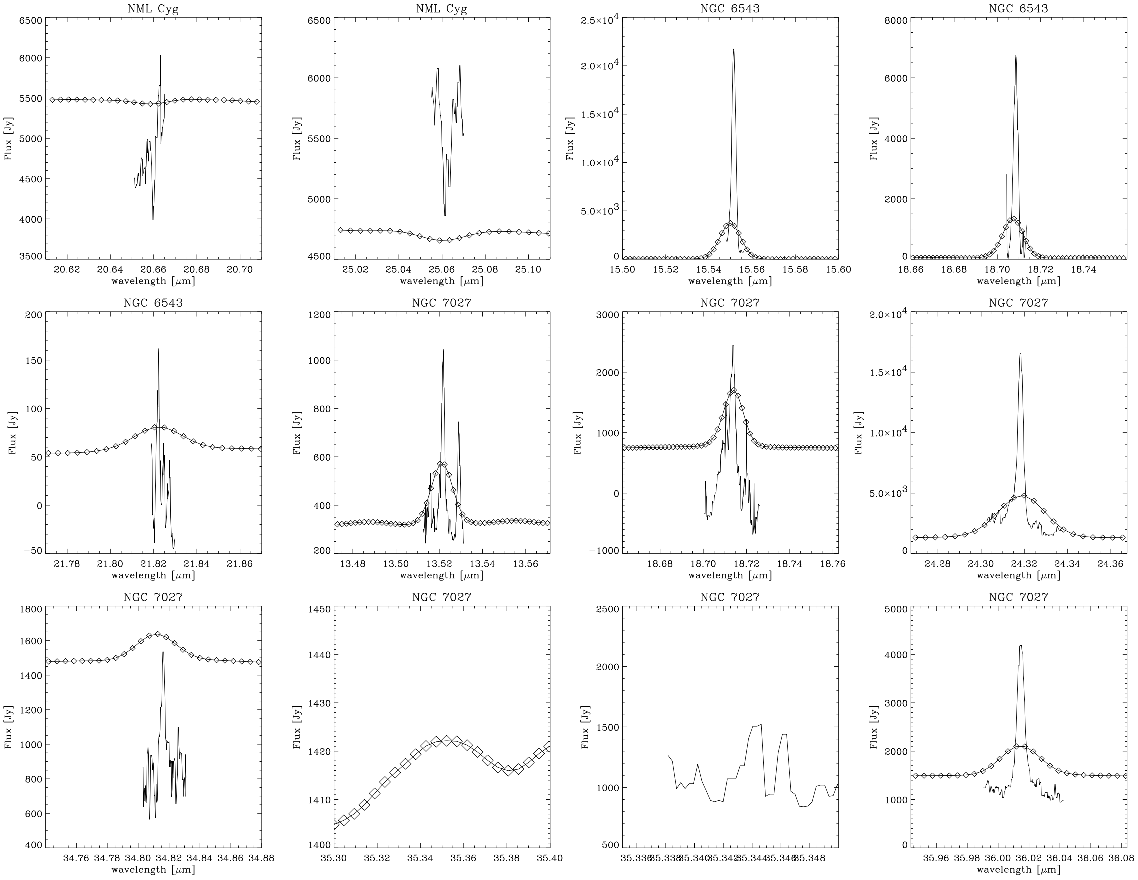

Figure 1. AOT2 (diamonds line) and AOT7 (solid line) observations of the lines considered in this comparison. For the 35.349 μm line, the AOT2 and AOT7 observations are plotted separately for clarity (very narrow FP line).