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Fringing in IRS High Resolution Spectra

P. Morris, SSC – (modified and shortened by B. Brandl)

Fringing properties overview

Testdata have been analyzed by means of Fourier transforms of SH and LH spectra extracted from differenced LUX images obtained in either SRS mode (Feb-Mar and April 2000) or RAW mode (December 2000). SRS mode aliveness data obtained on 15 December 2000 are also included. The extraction is not ideal as it does not take order curvature or line tilt into account, resulting in some reduction of spectral resolution and S/N ratios. Ideally the analysis is revisited later when calibration files containing 2-D wavelength calibration and tracings of each echelle order (i.e., the “wavesamp” files used in the IRS pipeline) are derived and validated.

In summary, recent testdata are dominated by a single range of periods. For LH, the peak period occurs near 3.2 cm^{-1} , but drifts monotonically with increasing echelle order from 3.01 to 3.30 cm^{-1} . This period is likely associated with the detector, corresponding to a Si gap width of about $0.44 - 0.48 \text{ mm}$. In SH, the period is reasonably constant 2.33 cm^{-1} for a corresponding Si gap of 0.63 mm . A second set of periods is present, centered in LH near 1.16 cm^{-1} (roughly constant with order) and 0.65 cm^{-1} in SH. Gap widths¹ are 1.25 and 2.25 mm . In SH, the period drifts very smoothly from 0.45 to 0.89 cm^{-1} with increasing echelle order.

The amplitudes of the fringing associated with these periods are very low, 1-6% in LH (peaking in orders 17 and 18), and $< 0.5\%$ in SH. These are surprisingly low in comparison to transmission data of the pass filters as measured by D. Watson, but f-cone effects and loss of spectral resolution (thus amplitudes) in the December testdata should be considered. The peak-peak amplitudes² of these fringes range from 3-5% of the continuum for SH, and from 6-16% in LH. The behavior of LH is somewhat erratic with regards to amplitude, not monotonic with echelle order. See Figure 3 - Figure 5.

¹ Calculated assuming an Si index of refraction of 3.42 and normal incidence of light.

² It must be remembered that data of December (and thereafter) are acquired under conditions of a low, unconstrained f-number (f/8?) and that the light source fully fills the IRS slits, in contrast with February-March 2000 test conditions of partial extension and f/11 light.

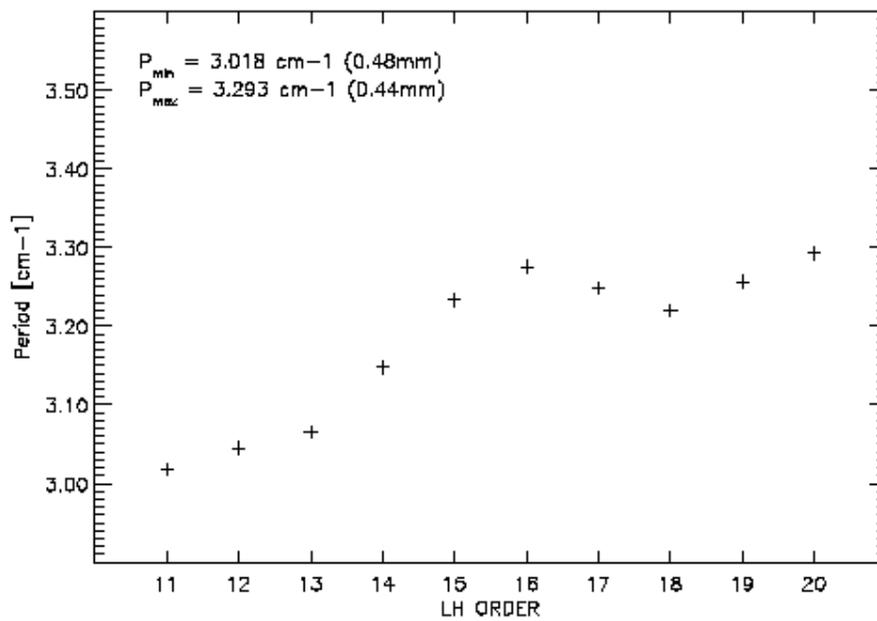
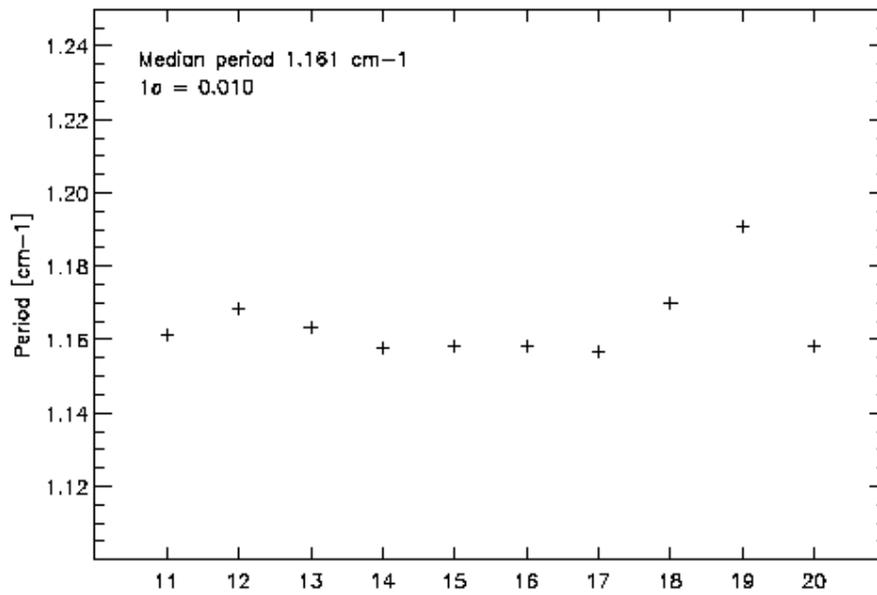


Figure 1: The two leading periods in LH by echelle order (15 Dec 00 aliveness).

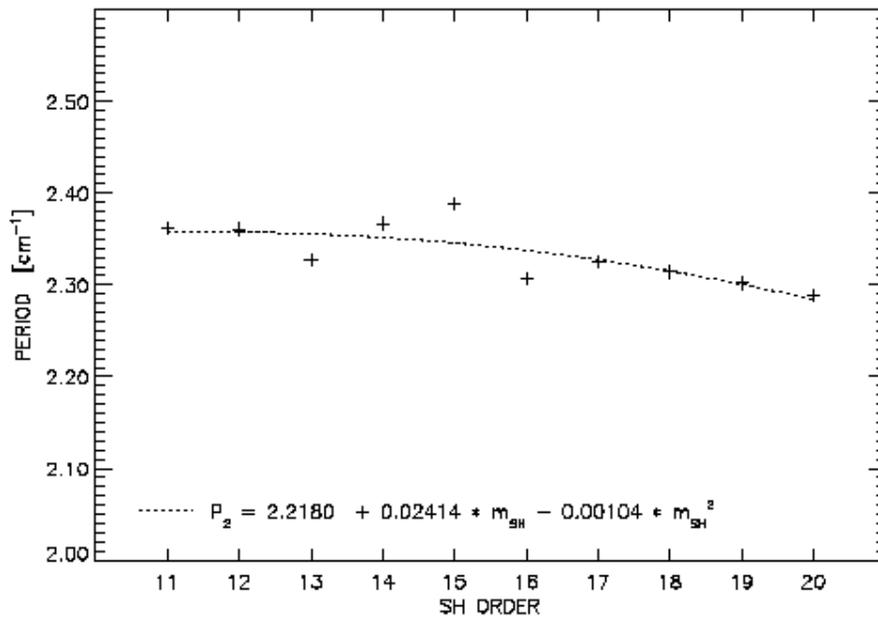
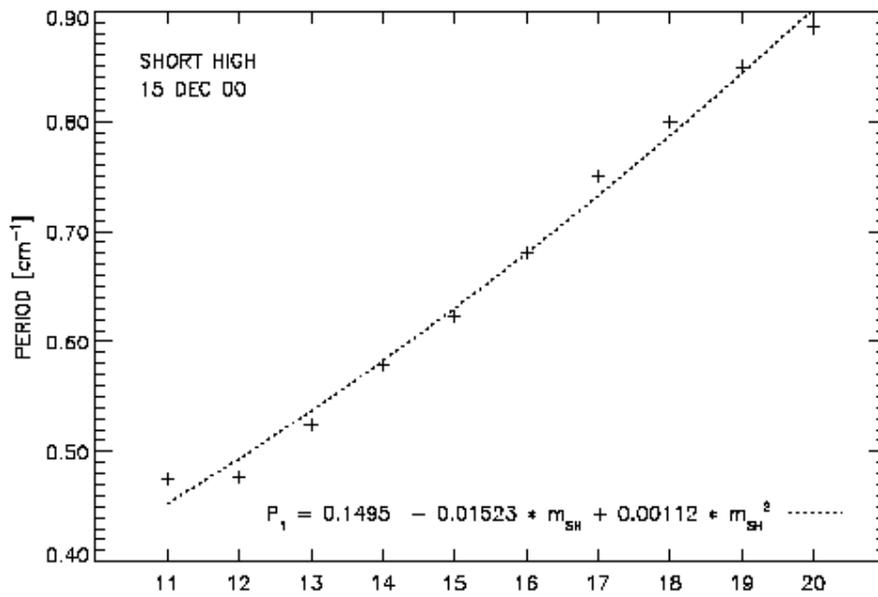


Figure 2: Principal periods in SH by echelle order (15 Dec 00 aliveness).

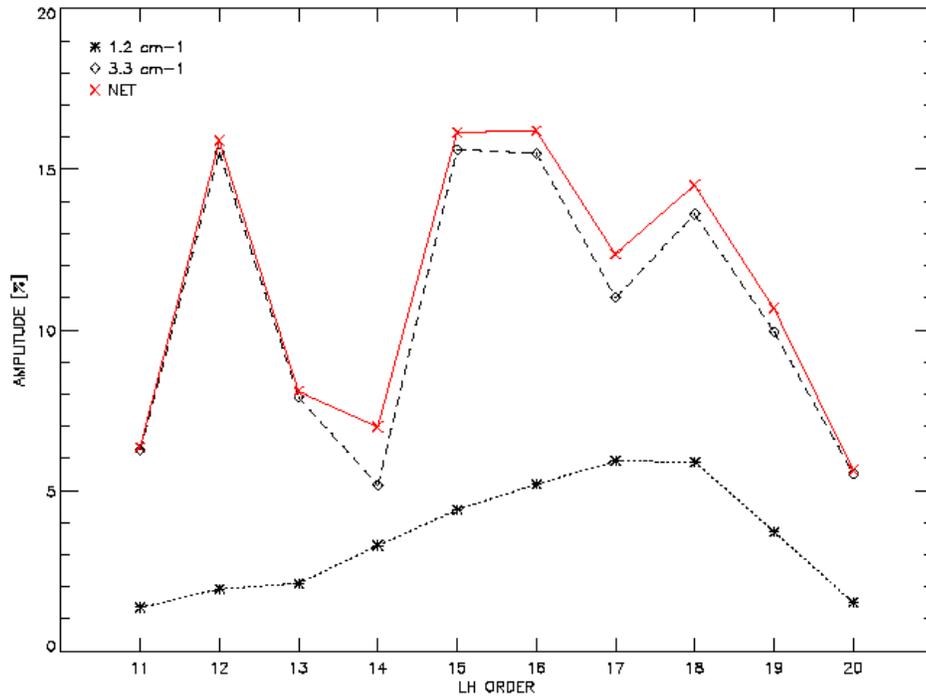


Figure 3: Fringe amplitudes in LH by order (15 Dec 00 aliveness). Peak-peak amplitudes are determined as the $1-\sigma$ spread about unity of the fringed / defringed spectrum. See Figure 4 for an example.

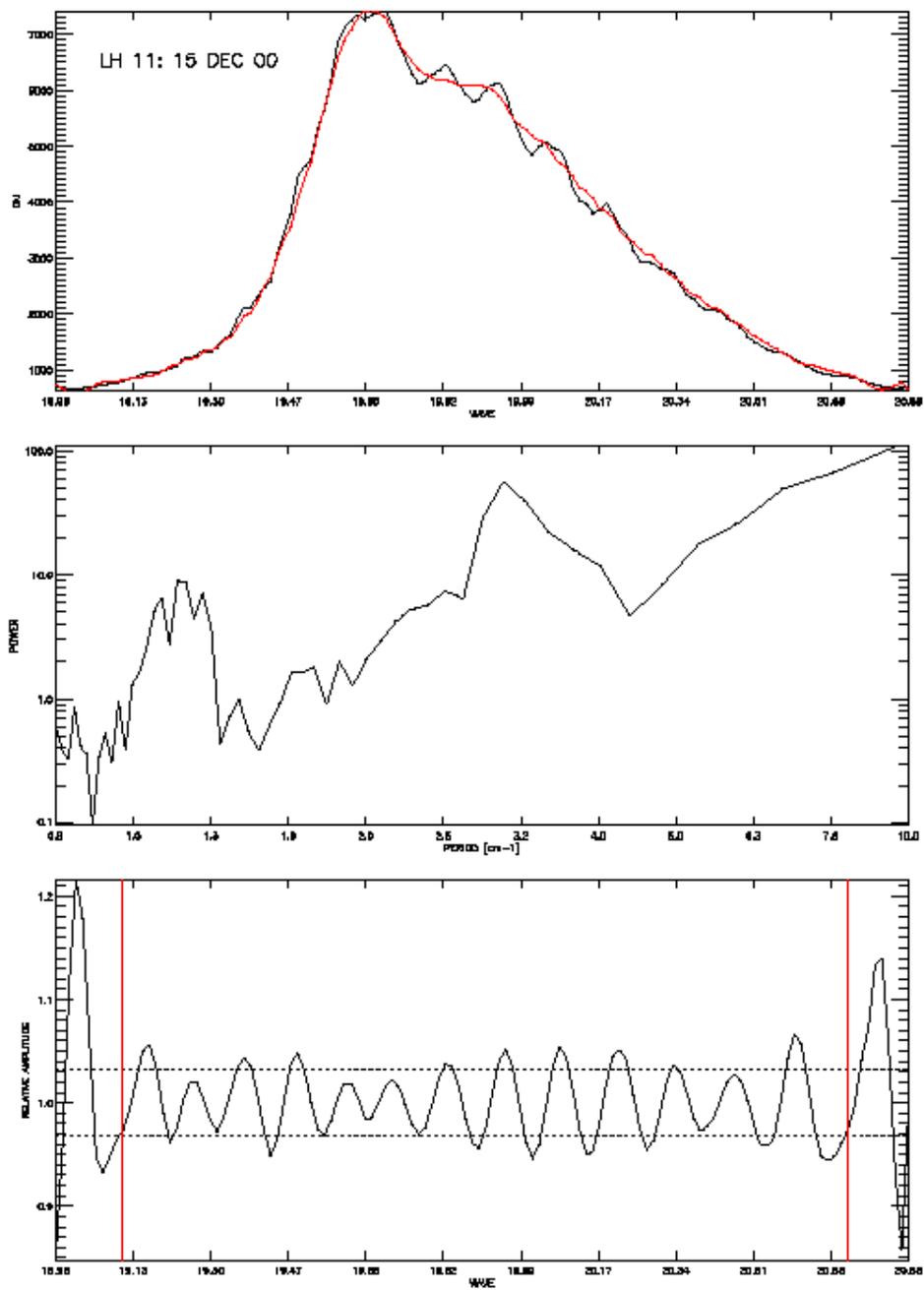


Figure 4: LH order 11 (15 Dec 00 aliveness). Upper: Extracted spectrum (black) and defringed (red). Middle: Power spectrum of LH11. Lower: Ratio of fringed and defringed spectra. Amplitudes shown in Figure 3 are generally determined from the inner 110 pixels of each extracted spectrum, avoiding the edges where residual effects from defringing may occur.

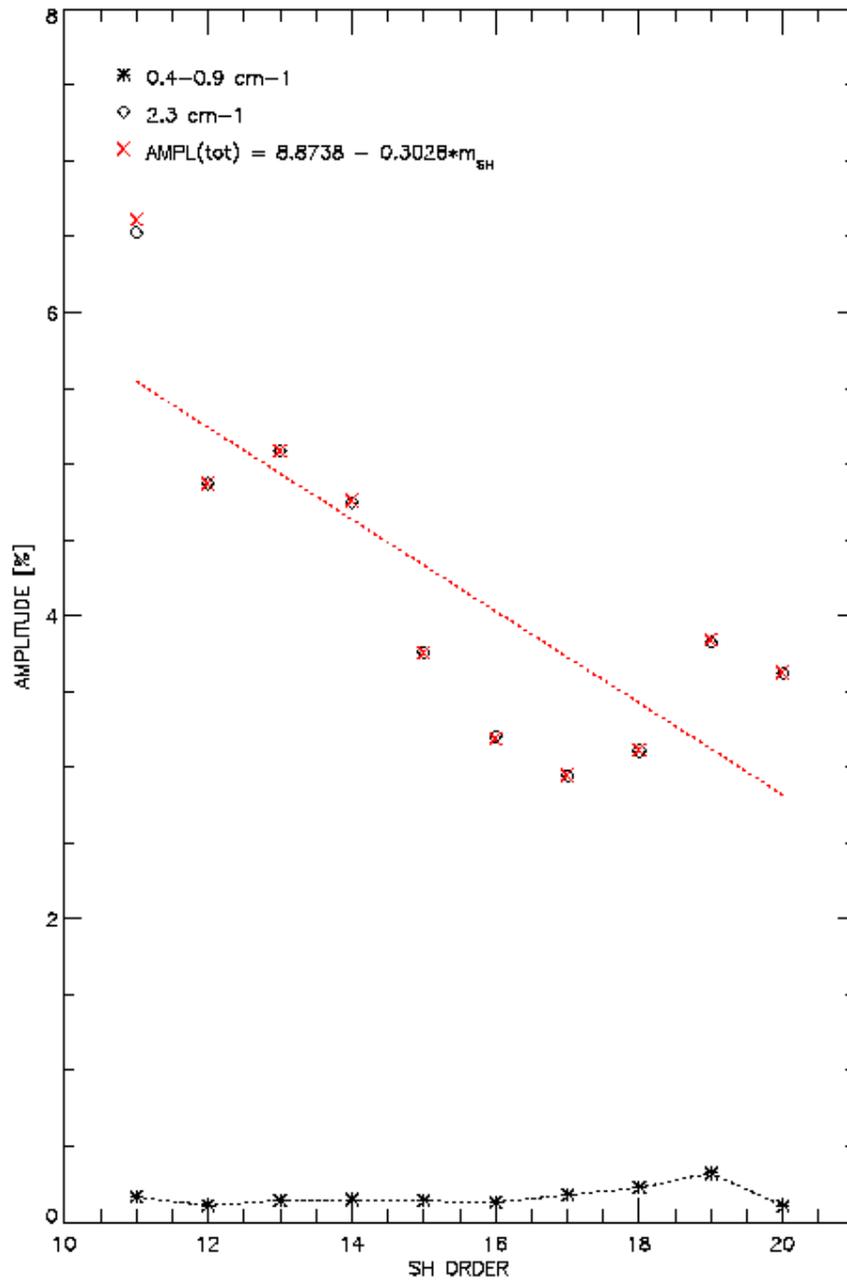


Figure 5: SH amplitudes by order (15 Dec 00 aliveness). The linear fit to the net amplitudes is not particularly believable, but a general decrease in amplitude with order is evident.