LWS L03 release note

Dear LWS observer,

The last LWS observing mode has now been released for observations. The Fabry Perot wavelength range AOT (L03) has been tested using observations of the Galactic Centre, and was found to be working properly. Therefore other observations using the L03 AOT can now also be scheduled.

We would like to ask all L03 observers to carefully read the advice on the use of L03 as given in a note that was sent out by the ISO helpdesk on March 11, 1997, and which can also be found on the World Wide Web at http://isowww.estec.esa.nl/notes/lws_0397.html.

In short L03 should only be used to identify lines and determine reasonably accurate (20%) line fluxes for sources with smooth continuum and narrow lines (less than 5 FP resolution elements). In all other cases L03 might be used, if no other observing mode is possible. However, there will be great difficulty in the interpretation of the data in those cases. If a measurement of the continuum is also needed for the scientific goals of the proposal, a full grating scan should be made using the L01 AOT.

Please contact the helpdesk (email: helpdesk@iso.vilspa.esa.es) for any changes necessary to your observations, or to release the programme as is.

Best regards,
ISO helpdesk.

LWS Observations affected by the LWS wheel problem

In the course of November last year, a problem was discovered with the positioning of the LWS interchange wheel. Following this, LWS operations were suspended, as a precautionary measure. The problem has been solved and as of 31 January of this year LWS operations were fully resumed.

The LWS instrument team has examined the potential impact on all observations and determined during which observations the wheel was not positioned correctly. There are three different cases that can be distinguished:

- Observations with the grating, during which the wheel was only slightly misplaced (less than 7°). In this case there is no effect on the observation.

- Observations with the grating, during which the wheel was significantly misplaced (more than 7°). In this case there is some vignetting of the LWS beam due to the wheel misplacement. The impact is, at this stage, not considered so significant that the observation would qualify for rescheduling.

- Observations with the FP, during which the wheel was misplaced. Since the FPs were calibrated with the wheel in the correct position, any misplacement of the wheel will put an uncalibrated part of the FP etalon meshes in the beam. Therefore any observation in this category has been recommended for rescheduling by the Project Scientist.

The tables below give the observations falling in categories 2 and 3. Table 1 lists the observations (TDT, Observer ID, Proposal ID, AOT and Target) for all observations in category 2, together with the amount of obscuration due to vignetting that was calculated for this observation. Table 2 lists all the observations in category 3 (TDT, Observer ID, Proposal ID, AOT and Target) that have been recommended for rescheduling.

ISO Science Operations and LWS Instrument Team
02/04/97

Table 1. Grating observations with the wheel misplaced.

TDT	ObsID	PropID	AOT	Target	Obscuration %
30800602	VBUJARRA	PPNA	L02	R Sct	7
30800603	VBUJARRA	PPNA	L02	R Sct	7
30800938	KERIKSSO	PROP_394	L02	V Aql	7
32301004	SCOLGAN	NARROWLN	L02	G36.3+0.7	3
32301005	SCOLGAN	NARROWLN	L02	OFFG36.3	3
32301108	DENGELS	JUNGEPPN	L01	OH 37.1-0.8 OFF	3
32301404	MVOGEL	SYMBPHYS	L01	PU Vul	3
32301405	MVOGEL	SYMBPHYS	L01	PU Vul BG	3
35400552	HSMITH	GALXISM	L02	NGC 5195	6
35400708	JSTUTZKI	PDRDENS	L01	S106	7
35501620	VBUJARRA	PPNA	L02	M1-92	11
35501621	VBUJARRA	PPNA	L02	M1-92 OFF	11
37600944	GVDSTEEN	CNO_ABUN	L01	NGC 6891	1

Table 2. FP observations that have been recommended for rescheduling.

TDT	ObsID	PropID	AOT	Target
32301236	JCERNICH	CERNI_1	L04	W51 IRS2
32301237	JCERNICH	CERNI_1	L04	W51 IRS2
33101903	ABAUDRY	PROP_OH1	L04	G10.6-0.4
35102433	JCERNICH	CERNI_3	L04	NGC7027
35201408	EVDISHOE	MOLSPEC	L04	GL 2591 NIRS01
35400703	JSTUTZKI	PDRDENS	L04	S106
35500318	EVDISHOE	MOLSPEC	L04	DR21 FIR1
35501622	VBUJARRA	PPNA	L04	M1-92
36303850	VBUJARRA	PPNA	L04	IRAS19500-17
36303851	VBUJARRA	PPNA	L04	IRAS19500-17OFF

LWS Note: FP AOTs L03 and L04

Dear LWS observer,

This note is intended to give the observers using the LWS Fabry Perots some additional information on the use of the FP AOTs L03 and L04. The line scanning AOT (L04) has been commissioned and is available for use. The range scanning AOT (L03) is in the process of being released, but with detailed caveats on when its use is suitable. During recent detailed analysis of the grating calibration observations, anomalies in its behavior were discovered, which impact in particular the accuracy of the fluxes for the L03 AOT.

Observers using or intending to use the range scanning mode (L03) should review their observations in the view of the recommendations below and contact the ISO helpdesk if they need assistance in modifying their programme.

The problem and consequences

The origin of the problem lies in the accuracy with which the grating can be set to the correct position, coupled with an uncertainty of the spectral profile of the grating over a sufficiently wide range of wavelengths. The effect of this on the FP AOTs is as follows:

L04: For each line an attempt is made to set the grating so that its response peaks at the wavelength of the line. After the grating has been set, the FP is scanned over the line. An uncertainty in the setting of the grating will lead to an uncertainty in the peak strength of the line as well as some distortion of the line (since it is assumed in the processing that the grating was actually put in the correct position). If the true grating position can be reconstructed accurately, it should be possible to correct for both these effects.

L03: The original intention of this AOT was to reconstruct a range of the continuum at high resolution as well as the lines within this range. The grating is set at a number of standard positions (0.25 grating spectral elements apart for FPL and 0.5 grating spectral elements apart for FPS; to reduce the distance between these standard settings much below this would require an inordinate amount of time in overheads). The FPs are than scanned over a wavelength range larger than the distance between the grating settings to provide overlap between the scans. If we then are to reproduce the continuum and match it between adjacent grating positions, we must accurately know (a) the wavelength setting of the grating and (b) the grating profile out to beyond its half-power point. We do not yet know (b) with sufficient accuracy, and, in the light of the discussion above, (a) is currently impossible (but may be possible later).

More information on the anomalies with the grating setting will be provided in a later note and on the World Wide Web.

Advice on the use of L03

Circumstances in which to use L03:

L03 can be confidently used in the following circumstances: a) you believe your source consists of lines which are no more than about 5 FP resolution elements wide (so that the whole line is well within a single FP scan), sitting on a continuum which is smooth on the scale of a grating resolution element, and
b) you want merely to identify spectral lines, and assign a reasonably accurate (about 20% relative) flux to them.

If you want in addition to have a measure of the continuum, youo should also make an L01 scan of the same spectral region. Note that features in the continuum that are unresolved by the grating but resolved by the FP will distort the estimate of the line strength.

Circumstances in which the use of L03 is not recommended:

We do not recommend the use of L03 if:
a) you want to obtain a high resolution measure of the continuum as well as of the lines, or
b) you believe your spectrum consists of lines which are more than 5 FP spectral elements wide, or
c) you believe that your continuum has significant structure on the scale of a grating resolution element, or
d) you are interested in broad "features" in the spectrum.

If there is no other way to make your observation, then L03 may be used, but there will be great difficulty in interpreting the resulting data. On a best efforts basis, the LWS team is happy to help you with this.

Best regards,
ISO helpdesk and LWS Instrument team.

LWS Note to observers (31/01/97)

Dear LWS Observer:

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. (see section 7.3 of the LWS ISO Data User's Manual IDUM (Web address: ftp://ftp.estec.esa.nl/pub/iso/doc/lws/idum/lws_idum.ps). 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 (1.6μm). 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 ($\sim$ 140 Jy) 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. There are no in-flight changes which can be made to the LWS configuration on order to prevent near-IR radiation affecting the spectra, so the features must be removed "after the fact" from the spectra.

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. A more sophisticated profile has yet to be derived, but 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. The best estimates of central wavelength and FWHM of the gaussians are tabulated below.

Using these parameters, it has proved possible to effectively remove the spurious features and to detect narrow emission lines that were undetectable before removal of the spurious features.

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

1)The spurious features become noticeable when [H] is brighter than 2.2 magnitudes, and the ratio of flux densities F(1.6μm)/F(60μm) $\geq\sim$ 4

Detector	Peak WL (μm)	FWHM (μm)
SW2	53.60	1.86
LW1	105.08	4.30
LW2	109.39	3.91
SW1	≥ 51	~ 2?
SW3	≤ 57	~ 2?

2)A zero-magnitude source at H (roughly F(1.6)=1050Jy) gives a feature with peak flux 1.5e-18 $Wm^{-2}\mu m^{-1}$ in detector SW2.

Studies of the properties and techniques for removal of the spurious features have now advanced sufficiently that we recommend observers to unblock their observations of sources that are bright in the near-IR.

Best regards,
ISO Science Operations Team and LWS Instrument Team
(Roger Sylvester and Mike Barlow)

LWS note for observers (18/10/96)

Dear LWS Observer,

LWS spectra sometimes contain features which resemble broad spectral features, but which do not occur at the same wavelength in detectors which cover the same range. (see section 7.3 of the LWS ISO Data User's Manual [IDUM]). The origin of these features was originally thought to be straylight, but is now believed to be a near-infrared leak in the blocking filters located in front of the detectors. This supposition is based on a statistical test, which showed a correlation between these features and all bands longwards of I. The strength of these features is best correlated with the strength of the sources in the H-band (1.6μm). In a small sample of post-main-sequence stars observed in the Core Programme, all those which had H-band emission stronger than about 2.2 magnitudes ($\sim$ 140 Jy) were seen to exhibit these spurious features.

Methods for measuring the contribution from these spurious features are being investigated. Until these are in place, it will be extremely difficult, if not impossible, to remove these features from strongly affected observations and we recommend that such observations be temporarily suspended. The criterion for which observations to suspend would ideally be based on the relative strength of the source at H and in the LWS wavelength range (e.g., at 60μm) but at the moment we cannot quantify the problem this precisely. Therefore, in the interim we suggest you request your observations be BLOCKED if the sources are expected to be stronger than about 2.5 mag at H.

"Blocking" is the method used to temporarily inhibit scheduling of an observation – it is accomplished by setting the fixed time flag to "Y" and adding the text "Do not schedule". You may request this as an update to your programme. To make an update:

You should contact the ISO helpdesk at helpdesk@iso.vilspa.esa.es (or IPAC at iso@ipac.caltech.edu if you have been doing your PGA work there) and give explicit instructions for changes to made on your behalf, or request remote access to PGA or schedule a visit (PDEC will be unavailable for visits during October and November due to the Supplemental Call Review Process). When the changes are completed you will be sent a final PH report for confirmation – you MUST respond to the PH Report with a request to re-release your observing proposal. This procedure is necessary to verify that the correct version of your programme is loaded into the active Mission Database!

LWS Note, 23 July 1996

Dear ISO Observer:

During the course of routine observing with LWS, some observing strategies have been identified which facilitate optimal reduction of the data. These suggestions reflect the current LWS consortium practice and encompass all LWS observing modes; you may wish to consider incorporating them in an update to your observing program. Updates will affect any observations in your program which have not yet been scheduled. Instructions on making updates can be found at the end of this note.

A brief summary of the recommendations is in the table below. A detailed discussion follows.

Recommendation	Applicable to	Procedure/Comments
1) Make enough independent scans to de-glitch the data	All LWS Observations ($\leq 10^4$ Jy)	Fast scan = "Y" and Tint $\geq$ 2.4s $\rightarrow$ 6 scans. For $\geq\sim 10^4$ Jy see point 3).
2) Measure fringing so data can be de-fringed	All Obs. except point sources on axis (w/in $\sim$ 5")	Do a sufficiently wide and deep LWS01 range scan within or in addition to the primary observation.
3) Avoid excessive non-linearity	ESSENTIAL for Sources $\geq\sim 10^4$ Jy	Tint $\leq$ 0.7s. Forces 1/4s integration ramps.
4) Use sufficient scan width to cover wings of FP spectral elements ($\pm$5 res. elements)	F-P Obs	NSPEL=5. 2 more elements will be added automatically NOTE that tis means all LWS04 observing times will increase.
5) Re-consider the spacing of well-sampled maps.	Mapping	Sample assuming a SMALLER beam with beam-width $\sim$ 80"

In detail:

1) Use at least 6 scans.

Previously, fast scanning was recommended to minimise the low-frequency end of 1/f noise. It is now even more important to avoid correlated contamination os successive spectral samples after a particle hit. The recommendation to use 6 (rather than the previous 4) scans is to ensure that sufficient uncontaminated samples are available at each spectral point to allow median filtering. For 1/2s integration ramps, used for all but very bright sources (see point 3), this implies Tint per sample must be at least 2.4s.

2) Characterise fringing with a grating range scan.

Some examples of severe fringing are available on the WWW:
http://isowww.estec.esa.nl/images/fringes.gif

LWS spectra of off-axis point sources or of extended sources show a modulation of the spectrum referred to as fringing. In wave-number space, these fringes are cosinusoidal with a fixed phase and a constant period of $3.6 cm^{-1}$, independent of the detector channel. It is therefore supposed that they arise from within the instrument and are caused by the interference of two beams arriving at the detectors along paths which have a fixed difference in length. In wavelength space, the interval between successive peaks varies from about 1 micron at the shortest wavelength to about 10μm at the longest; at the shortest wavelengths this is comparable to the grating resolution element, complicating detection of lines.

If the interpretation of the origin of the fringes is correct, their effects are present in both grating and Fabry-Perot spectra of extended or off-axis sources. Note that different parts of a source may have different degrees of fringing. For example, the spectrum arising from a point source will not itself be fringed, even if it lies within a field of extended emission. The resultant overall spectrum, however, will exhibit fringes.

If you are CERTAIN that your source is point-like, well isolated and its IR position is known to within 5", you may not need to take action. In most cases, however, you will want to de-fringe your data.

Information about fringe removal can be found on the LWS Home page (http://ast.star.rl.ac.uk/isouk/iso/lws/lws.html) and the subject will be discussed in the Addendum to the LWS Observer's manual, which will be available around the end of July from the ISO WWW Site (http://isowww.estec.esa.nl/) as part of the material for the Supplementary call for proposals.

In brief, the current procedure makes use of the constancy of the period of the fringe to identify and isolate it. It requires at least three complete fringes on each detector. Given present understanding, IT IS IMPOSSIBLE TO DE-FRINGE spectra without this information.

The case of a point-like line source with strong extended continuum emission is particularly difficult, since the amplitude of the line will be unfringed, but the line will be superimposed on a fringed continuum. In this case there is no way of determining the true strength of the lines unless a spectrum of the surrounding continuum is also taken.

In detail, it is recommended:

A) For LWS01 observations, make sure that your range is sufficient to cover at least three fringes per detector used. (Refer to the figure on the WWW or in the Addendum, when it is available). The observation must also have sufficient S/N on the fringe (SNc) to get the desired S/N on the de-fringed line (SNl). If Nss is the number of spectral samples you have in your LWS01 spectrum (1,2,4 or 8 times the number of resolution elements; 65, for a full grating scan. See section 6.3 in the LWS Observer's Manual) then, at a minimum:

$$SNc = \frac{SNl}{\sqrt{Nss}} \qquad (1)$$

B) For LWS02,03,04 and narrow-range LWS01 consider an additional, preferably concatenated, LWS01 scan meeting the above criteria. The observer should calculate the S/N required as detailed in A).

You may wish to bear in mind that a full-range minimum scan (43 to 170μm, fast scan, 1 sample per resolution element, 3 scans) takes about 8 minutes, and that the time does not decrease much if you decrease the spectral range.

C) Note that if you are doing an off-source measurement or map you will need to characterise the fringes in ALL POINTINGs (e.g., for a 2x2 raster you would need to repeat the raster with the minimum LWS01 scan.) For the case of a point source embedded in extended emission, it is necessary to to do an off-source scan to remove the fringed spectrum of the extended emission.

3. For bright sources, use 1/4s ramps.

For sources $\sim 10^4$ Jy at 120μm, 1/4s ramps are necessary to prevent the detector integration ramps from becoming too non-linear to process successfully. Unfortunately, you must use Tint $\leq$ 0.7s to get 1/4s ramps, so you can only get 5 scans per AOT; to get more you must concatenate 2 or more successive AOTs or observe the same line repeatedly in one AOT. (In most cases 5 scans should be sufficient to deglitch the data.) For sources much brighter than 10^4 Jy, you should consider Fabry-Perot observations since even 1/4s ramps may become excessively nonlinear.

4. Use a wide scan for Fabry-Perot observations.

The Airy profile of a Fabry-Perot has broad wings and sufficient width around the line should be used to get down to the continuum. The maximum number of spectral elements to each side of the line as specified in PGA is 5, but the data suggest that 7 elements on either side is preferred, especially for resolved lines. Up-link calibration tables are therefore being modified to ADD 2 SPECTRAL ELEMENTS TO NSPEL. This will substantially increase observing time; if you wish, you may compensate for this by reducing NSPEL by 2, but use of NSPEL=5 is strongly recommended.

5. Reduce step size for well-sampled maps

The LWS beam width is not yet well known, however the data suggest that it varies non-monotonically with wavelength between 58" and 82". It is probable that 80" is a good working figure but it could be less than this at some wavelengths. Observers who are critically dependent on full sampling are advised to reconsider their step sizes.

To make an update to your program:

The procedure is the same as it was for releasing the proposals post-launch. You should contact the ISO helpdesk at helpdesk@iso.vilspa.esa.es (or IPAC at iso@ipac.caltech.edu if you have been doing your PGA work there) and request a visit to PDEC (or IPAC), a computer account to make remote changes or give explicit instructions for changes to made on your behalf. When the changes are completed you will be sent a PH report for confirmation – this is necessary to verify that the correct copy of your program will be uplinked to ISO!

Most of these changes will unfortunately increase the time needed for an observation. We remind you that the Supplemental Call for Observations will be issued soon, and that you may propose to complete or follow-up on your existing observing programmes.

Sincerely,
ISO Helpdesk