CARS Data Analysis Procedure

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Document properties

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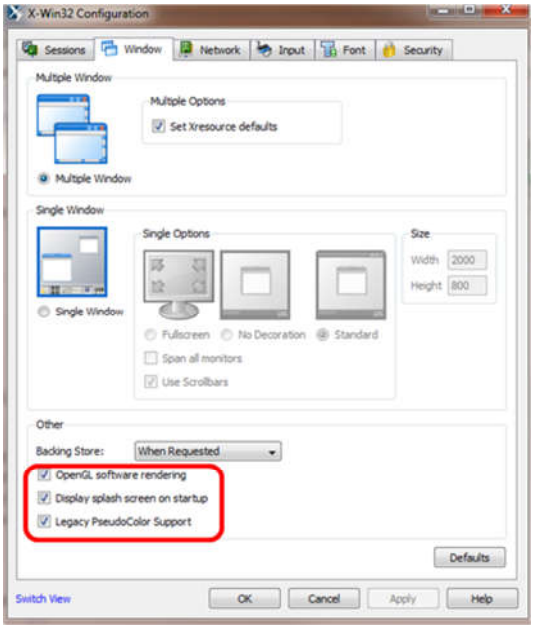
1. Preparation

- Login to MC (AIX) machine via MC terminal using the following credentials:
  - Login: **vtmess**
  - Password: ask to SV-CARS system supervisor
  - Run **tcars03.e** (or the number of the MC terminal) to tell MC machine which terminal is connecting to it

  To transfer the data from (or to) a Windows machine, use a file transfer protocol (STP) software (**FileZilla** at DLR) and use as host address:
  - **mc.vt.st.dlr.de**

  Login and password are the same listed above.

  It is also possible to connect remotely to MC machine through Windows systems; use **X-Win32** software and **telnet** connection type. Just remember to flag all the options in the window tab



- Create a directory on MC machine where to store all the raw data coming from DaVis software macro **Messung_svcars**. Note that the convention in use to name the data files is the following:

  s8a086 is a sample of raw file, where:
  - **s** = shifted
  - 8 = last digit of the last year (e.g. 2008 = 8, 2016 = 6)
  - **a** = average or e = einen pulse (single shot)

- 086 = day of the the year (varies from 001 to 365)

- Transfer the CARS data from DaVis computer to the MC terminal. A DaVis macro, **filecopy("E:\\hdc_brenner\\"+svcars_daydir);**, was created to avoid manual transfer. In any case, for each measurement point the following files must be present inside the designated folder in MC machine:
  - **.asc** = raw ASCII data
  - **.log** = header information (e.g. laser energies, location of measurement, etc…)
  - **.tst** = measurement protocol

- To make the scroll bar appears, type the following command:
  - **xterm –sb –sl 500 &**
- Run program setdir.e to copy from an old directory all the required codes and respective folders.
  - **setdir.e [old directory] [new directory]**

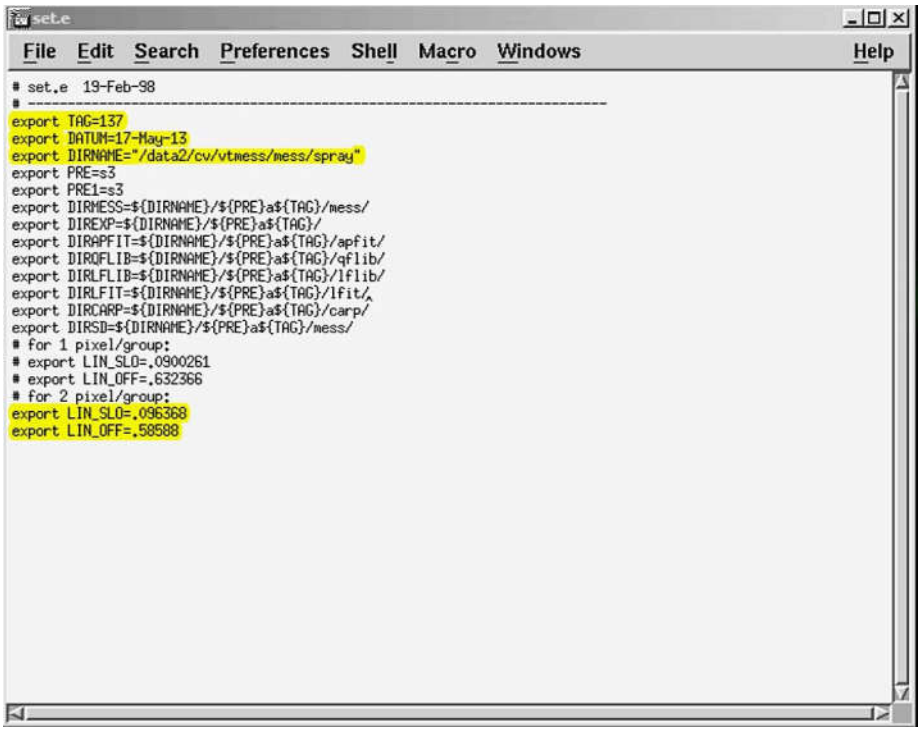
The following folders will be copied with the respective codes (no data):
- **apfit** folder designated to create/modify the slit (instrument) function
- **carp** folder designated to create/modify the dispersion (wavenumber/pixel)
- **lfit** folder designated for the fitted data (results): use inputs from quick fit and library fit
- **lflib** folder designated to library creation and library fit
- **mess** folder designated to correct the raw data for dye curve and background subtraction
- **qflib** folder designated to quick fit to select the best methods for fitting

- Useful commands for MC terminal:
  - **dir** lists all the files/folders inside the directory (same as Windows)
  - **cat** opens and print a file on screen
  - **pq** opens and print a file on screen but stops at the end of each page
  - **up** moves one directory up (or use the command **cd..** as in Windows)
  - **ho** moves back to the designated home directory
  - **mv** rename a file
  - **dfu** shows the size of folders
  - **xterm &** opens a new terminal leaving active the old one (they can be used simultaneously)
  - **pwd** shows the actual directory
  - **ne** opens the file editor
  - **mkdir** makes a new folder (same as Windows)
  - **cp –p** copies as original in a new folder
  - **ls *** shows only file with designate extension (e.g. ls *.e show only .e files)
  - **gm** shortcut to **mess** folder
  - **ga** shortcut to **apfit** folder
  - **gqf** shortcut to **qflib** folder
  - **gl** shortcut to **lfit** folder
  - **glf** shortcut to **lflib** folder
  - **gc** shortcut to **carp** folder
  - **chmod u+x *.e** gives the right to use all the executables inside the working folder
  - **asctommf [**input**.asc] [**output**.mmf]** converts input files in .asc to a .mmf file

2. Correction for dye curve and background

- Work inside **mess** folder

- Edit **ne set.e** (code which creates input files for all other programs) code:
  - **TAG** = day of the year (as in the name of raw data)
  - **DATUM** = date
  - **DIRNAM** = name of the directory
  - **export LIN_SLO** = non-linearity slope of the detector (modify only if unsatisfactory fit)
  - **export LIN_OFF** = non-linearity offset of the detector (modify only if unsatisfactory fit)



After setting all the required parameters according to the new dataset, run the code.
  - **set.e**

- Modify set-nr.e and set a range where N_2 is located in order to maintain the peak of the intensity as it was during the experiment:
  - SDEVSTART = minimum number of pixel where to find N_2 peak
  - SDEVEND = maximum number of pixel where to find N_2 peak

- Run **korsp-nr.e** (code to correct single shots for dye curve and background subtraction) code:
  - **korsp-nr.e [run # where the dye curve was saved] [# of dye curve to be saved]**

    e.g. korsp-nr.e 02 01

This code creates the following outputs:

- xx**m**yyy**.asc** corrected and normalized dye curve (ASCII)
- xx**n**yyy**.asc** normalized, relative single dye curves (ASCII)
- xx**u**yyy**.asc** background for dye curve (ASCII)
- **tn**yyy**.asc** normalized, relative single dye curves (ASCII)
- **dye**xx**.asc** corrected averaged dye curve (ASCII), only for visualization

To see and decide which dye curve use for the data analysis, run the **spi** code.

Here some useful commands for spi:

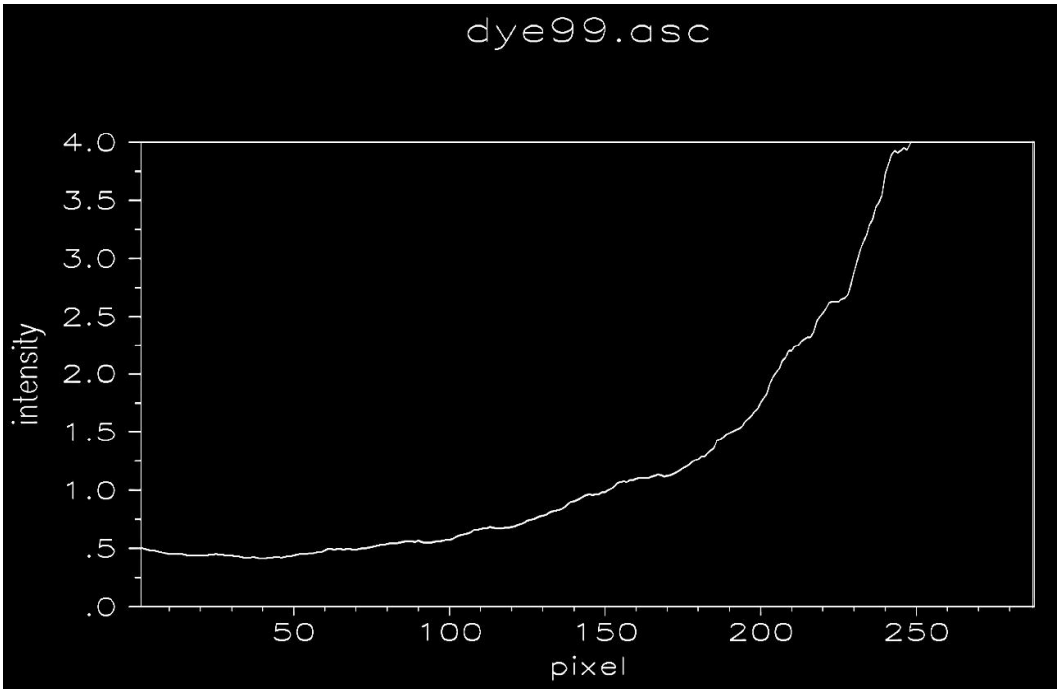
- **chd [file]** changes the default work file (e.g. chd s9m31101.asc)
- **gino** displays data (e.g. gin-(parameter1)-(parameter2), gin-asc-yma4)
- **load [file]** loads a file and keep into memory
- **load [file]-mean** loads a file and average with the one(s) in memory
- **unlock** unlocks all the file and enable modifications
- **sd** adds description to the head of the plot
- **save [filename]** saves the file in use with the chose filename (and extension)
- **gin-asc** displays ASCII format
- **gin-mmf** displays mmf (binary) format
- **gin-ymaX** sets y-maximum (X = maximum value, usually between 2 and 4)
- **gin-yminX** sets y-minimum (X = minimum value, usually -500)
- **gin-xmaX** sets x-maximum (X = maximum value, usually between 2 and 4)
- **gin-xminX** sets x-minimum (X = minimum value, usually -500)
- **gin-lasX** plots last files in one single graph (X = number of plots)
- **gin-pform pq** generates the postscript
- **@spek** displays all spectra in separated boxes
- **@fit** displays all the data, fitted spectra and difference in separated boxes
- **gin-mul** displays multi spectra (e.g. gin-mmf-mul-las20)
- **nomul** disables multiple plots (just a single plot with –eventually- multiple lines)
- **gin-ps** saves a copy of the plots in **.ps** format
- **charli** X **z2su** prints spectrum (X = filename)

e.g. To visualize the summary of dye curves use the following command sequences:

1. spi
2. chd dyexx.asc
3. gin-asc-yma4-fir1-las4 (open first 4 plots in gino ASCII format with ymax=4)

Note the color scale sequence:

- 1st curve is white
- 2nd curve is red
- 3rd curve is blue

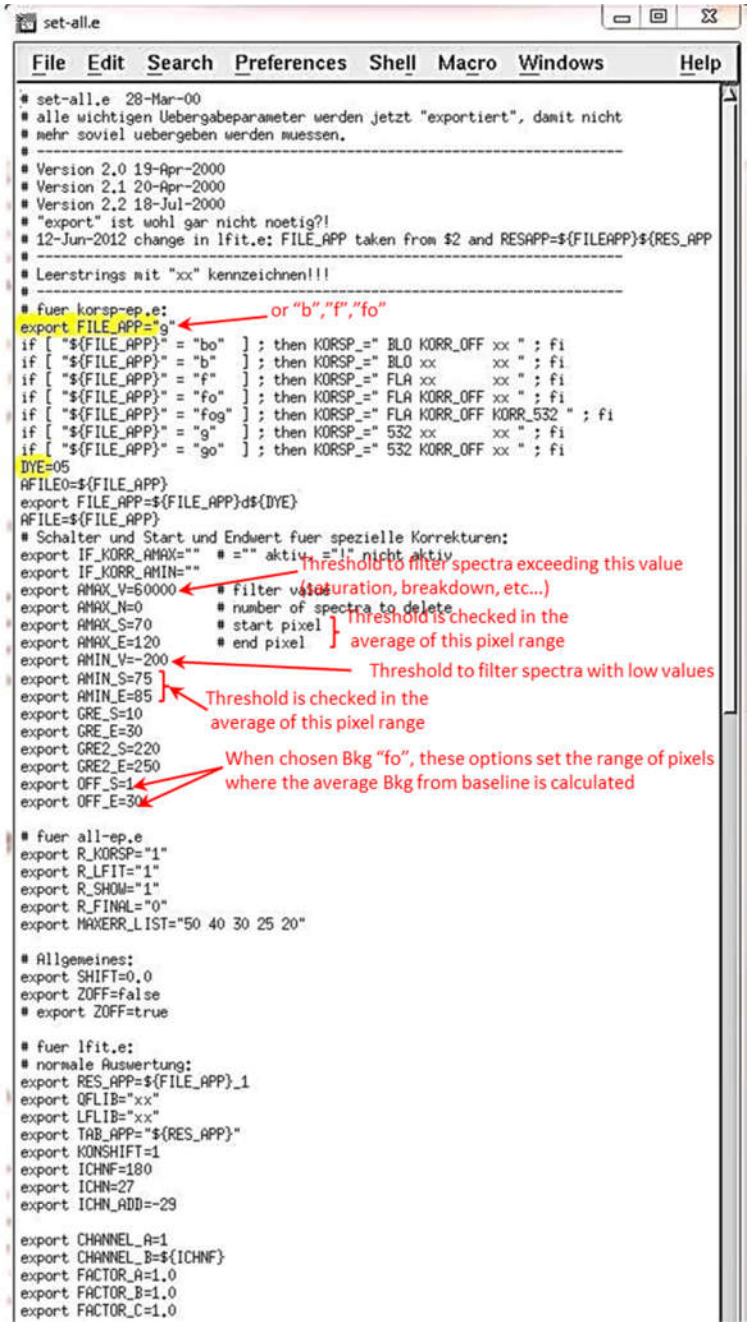


Run this code for all the dye curves recorded during the experiment. Verify that there is no significant changes between the begin and the end of the experiment; if so, additional correction need to be performed based on interpolation of the dye curve change during the experimental time.

e.g. To average to dye curves, use the following command sequences:

1. spi
2. chd dyexx.asc
3. unlock
4. load dyexx.asc (loads first dye curve)
5. load dyexx.asc-mean (loads second dye curve and average with the first one)
6. sd _DATE comments (adds date and description on the head of the plot)
7. save **sym**dddzz**.asc** (where y = year; ddd = day; zz = dye #)

- Edit **ne set-all.e** (code to correct single shots for dye curve and background subtraction) code:
  - **Export file_app =** **g** = narrow-band dye laser background
    f = flame background
    b = camera noise background
    fo = offset background (average from baseline)
  - **DYE=** xx = number of the run of the dye curve is in use for correction


set-all.e
File Edit Search Preferences Shell Macro Windows Help
set-all.e 28-Mar-00
alle wichtigen Uebergabeparameter werden jetzt "exportiert", damit nicht
mehr soviel uebergeben werden muessen.
Version 2.0 19-Apr-2000
Version 2.1 20-Apr-2000
Version 2.2 18-Jul-2000
"export" ist wohl gar nicht noetig?!
12-Jun-2012 change in lfit.e: FILE_APP taken from $2 and RESAPP=${FILEAPP}${RES_APP
Leerstrings mit "xx" kennzeichnen!!!
fuer korsp-ep.e:
export FILE_APP="g"
or "b","f","fo"
if ["${FILE_APP}" = "bo"] ; then KORSP_=" BLO KORR_OFF xx " ; fi
if ["${FILE_APP}" = "b"] ; then KORSP_=" BLO xx xx " ; fi
if ["${FILE_APP}" = "f"] ; then KORSP_=" FLA xx xx " ; fi
if ["${FILE_APP}" = "fo"] ; then KORSP_=" FLA KORR_OFF xx " ; fi
if ["${FILE_APP}" = "fog"] ; then KORSP_=" FLA KORR_OFF KORR_532 " ; fi
if ["${FILE_APP}" = "g"] ; then KORSP_=" 532 xx xx " ; fi
if ["${FILE_APP}" = "go"] ; then KORSP_=" 532 KORR_OFF xx " ; fi
DYE=05
AFILE0=${FILE_APP}
export FILE_APP=${FILE_APP}d${DYE}
AFILE=${FILE_APP}
# Schalter und Start und Endwert fuer spezielle Korrekturen:
export IF_KORR_AMAX="" # ="" aktiv, ="!" nicht aktiv
export IF_KORR_AMIN=""
export AMAX_V=60000
Threshold to filter spectra exceeding this value
(saturation, breakdown, etc...)
export AMAX_N=0 # number of spectra to delete
export AMAX_S=70 # start pixel
export AMAX_E=120 # end pixel
Threshold is checked in the
average of this pixel range
export AMIN_V=-200
Threshold to filter spectra with low values
export AMIN_S=75
export AMIN_E=85
Threshold is checked in the
average of this pixel range
export GRE_S=10
export GRE_E=30
export GRE2_S=220
export GRE2_E=250
When chosen Bkg "fo", these options set the range of pixels
where the average Bkg from baseline is calculated
export OFF_S=1
export OFF_E=30
fuer all-ep.e
export R_KORSP="1"
export R_LFIT="1"
export R_SHOW="1"
export R_FINAL="0"
export MAXERR_LIST="50 40 30 25 20"
Allgemeines:
export SHIFT=0.0
export ZOFF=false
export ZOFF=true
fuer lfit.e:
normale Auswertung:
export RES_APP=${FILE_APP}_1
export QFLIB="xx"
export LFLIB="xx"
export TAB_APP="${RES_APP}"
export KONSHIFT=1
export ICHNF=180
export ICHN=27
export ICHN_ADD=-29
export CHANNEL_A=1
export CHANNEL_B=${ICHNF}
export FACTOR_A=1.0
export FACTOR_B=1.0
export FACTOR_C=1.0

```
# nur Hot-Band:
# export RES_APP=${FILE_APP}hbs
# export LFLIB="_hb"
# export TAB_APP="_3_${RES_APP}"
# export KONSHIFT=0
# export ICHNF=120
# export ICHN=88
# export ICHN_ADD=50

# Variables for lfit.e, qflib_nls.e und lflib_nls.e (parameter for different flames):
if [ "${LFLIB}" = "xx" ] ;    then
export  LFIT_P="4.935"
export  LFIT_CONC="78.8426"
export  LFIT_S_CONC="-0.00247529"
export  LFIT_MIN_CONC="72.8"
export  LFIT_MAX_CONC="78.1"
export  LFIT_AXNRS="7.103"
export  LFIT_S_AXNRS="0.000555294"
export  LFIT_MIN_AXNRS="7.27"
export  LFIT_MAX_AXNRS="8.45"
export  LFIT_CONH2O="-0.01756235"
export  LFIT_S_CONH2O="0.00005854"
export  LFIT_MAX_CONH2O="0.1244"
export  LFIT_CONCO2="-0.01608"
export  LFIT_S_CONCO2="0.00005360"
export  LFIT_MAX_CONCO2="0.1139"
fi

# fuer show*.e:
export MAXERR=25
export METHOD=29
NEW=new
APP=app

# Spreadtest:
export DT="xx"
export M1="xx"
export M2="xx"
export M3="xx"
export SPREADTEST=" ${DT} ${M1} ${M2} ${M3} "
# ---------------------------------------------------

FLAMME="FIRST-III Referenzflamme"

#                              r HAB     Fl.       532 BB
EXP_06=" 06 ${AFILE} ${DYE}   0 107  FIRST-III 41 50 ${KORSP_} ${NEW} "
EXP_07=" 07 ${AFILE} ${DYE}   0 107  FIRST-III 38 50 ${KORSP_} ${APP} "
EXP_08=" 08 ${AFILE} ${DYE}   0  95  FIRST-III 32 50 ${KORSP_} ${APP} "
EXP_09=" 09 ${AFILE} ${DYE}   0  80  FIRST-III 22 50 ${KORSP_} ${APP} "
EXP_10=" 10 ${AFILE} ${DYE}   0  62  FIRST-III 35 50 ${KORSP_} ${APP} "
EXP_11=" 11 ${AFILE} ${DYE}   0  45  FIRST-III 35 50 ${KORSP_} ${APP} "
EXP_12=" 12 ${AFILE} ${DYE}   0  37  FIRST-III 41 50 ${KORSP_} ${APP} "
EXP_13=" 13 ${AFILE} ${DYE}   0  37  FIRST-III 41 50 ${KORSP_} ${APP} "
EXP_14=" 14 ${AFILE} ${DYE}   0  30  FIRST-III 38 50 ${KORSP_} ${APP} "
EXP_15=" 15 ${AFILE} ${DYE}   0  24  FIRST-III 44 50 ${KORSP_} ${APP} "
EXP_16=" 16 ${AFILE} ${DYE}   0  18  FIRST-III 48 50 ${KORSP_} ${APP} "
EXP_17=" 17 ${AFILE} ${DYE}   0  12  FIRST-III 55 50 ${KORSP_} ${APP} "
EXP_18=" 18 ${AFILE} ${DYE}   0   3  FIRST-III 10 50 ${KORSP_} ${APP} "
EXP_19=" 19 ${AFILE} ${DYE}   0   1  FIRST-III  8 50 ${KORSP_} ${APP} "
EXP_20=" 20 ${AFILE} ${DYE}   0  80  FIRST-III 28 50 ${KORSP_} ${APP} "

# Einstellungen fuer individuelle Namelists
#       SpekNr BKG     T      ConN2 ConH2O ConCO2 AXNRS PRESS

# NLS_04=" 04 ${AFILE}  1600.00 54.50 0.051  0.017  8.12  0.987"

# Kommentarstrings, die via gr.e in die Ausdrucke eingebunden werde
# ACHTUNG: Keine Leerzeichen im String verwenden !!

# GR_07="TLC_1bar_Phi=2.1_r=0mm_h=5mm_Gain=90"
```

The best way to check if the correction of the background and dye curve is correct is try to correct a room temperature spectrum. To do so, run **korsp-rt.e** program:

- **korsp-rt.e [room temperature run #] [dye curve run #]**

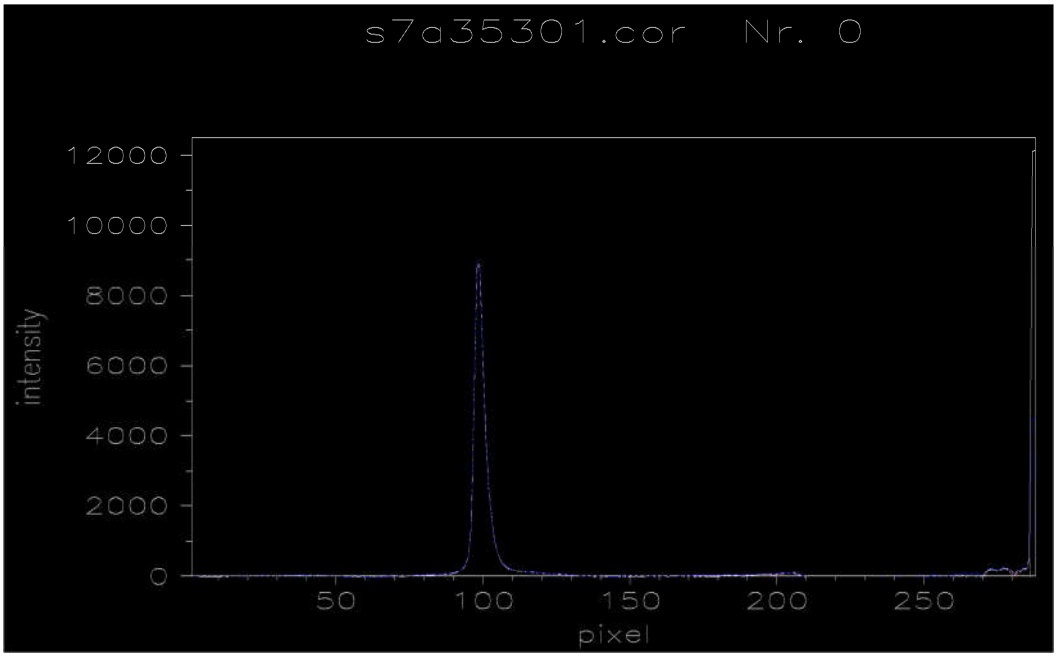
  e.g. korsp-rt.e 01 04

The program has he following outputs:

- xx**a**yyy**.cor** corrected averaged room temperature spectrum (carp format)

- xx**a**yy**.sd** normalized, averaged room temperature spectrum (ASCII format)
- xx**u**yy**.asc** background for room temperature spectrum (ASCII format)

To visualize the resulting spectrum use spi (e.g. spi -> chd xxayyy.cor -> gin).

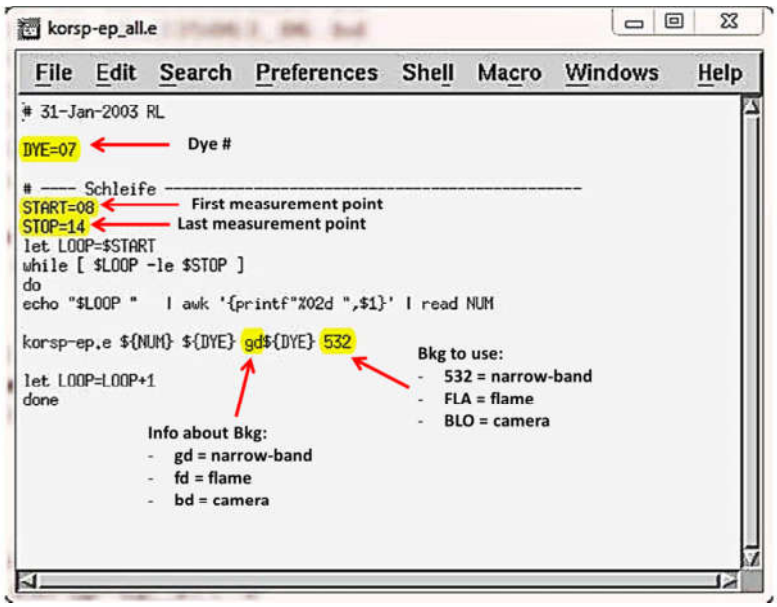


Repeat this procedure for all the room temperature spectra: the outputs of this program will be the inputs for the slit function calculation (see section 3).

After choosing the appropriate background and dye curve, save the changes and run **korsp-ep.e [run#] [dye#] [bkg information to filename] [bkg]** code to process one single shot

- e.g. korsp-ep.e 03 99 fd99 FLA

or **korsp-ep_all.e** (define the starting and ending point) to process all the data files (it calls korsp-ep for each single shot).



The code provides the following outputs:

- xx**s**yyy**fd.cor** corrected of single CARS spectra
- xx**a**yy**fd.cor** corrected averaged CARS spectrum (mmf format)
- xx**a**yy**fd.sd** corrected averaged CARS spectrum (carp format)
- xx**a**yy**fd.acs** corrected averaged CARS spectrum (ASCII format)
- xx**a**yy**fd_.mmf** contains 10 spectra for procedure summary and check
  1. narrow-band dye laser background (532)
  2. broad-band dye laser background
  3. flame luminosity (laser off) background (FLA)
  4. averaged spectrum with complete dye curve correction
  5. averaged spectrum with offset correction (special correction)
  6. averaged spectrum with (special) correction for narrow-band
  7. averaged spectrum with camera linearity correction (not applicable for FlameStar2 camera)
  8. averaged spectrum after filter for minimum values is applied
  9. averaged spectrum after filter for maximum values is applied
  10. averaged spectrum with background (and 1-2 pixels) subtraction

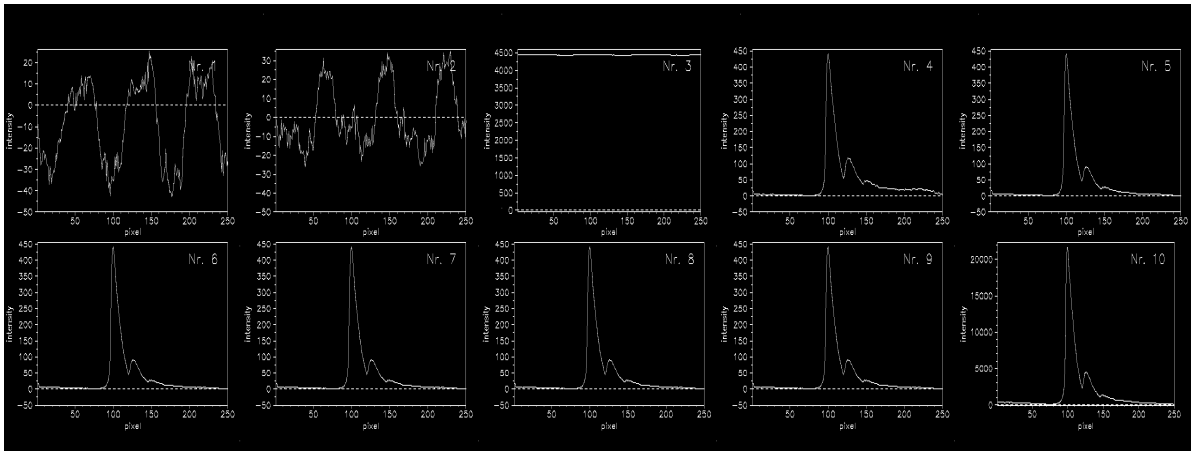
e.g. To visualize the summary spectra use the following command sequences:

1. spi
2. chd xxayyfd_.mmf
3. @spek
4. gino

Or in a different (and simpler) way you can use the **dis-bkg.e** command:

- **dis-bkg.e [name of corrected spectrum] ([ymin][ymax] optional)**

  e.g. dis-bkg.e 10fd99 0 500

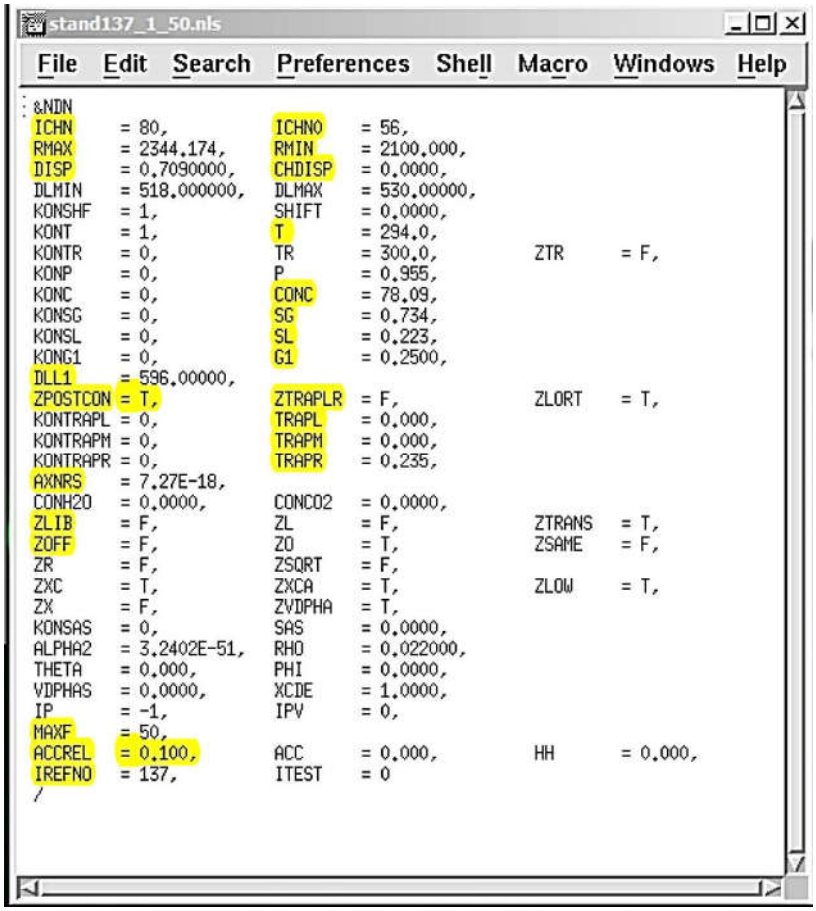

Nr. 1
Nr. 2
Nr. 3
Nr. 4
Nr. 5
Nr. 6
Nr. 7
Nr. 8
Nr. 9
Nr. 10
intensity
pixel

3. Calculation of the slit function

- Work in **apfit** folder

- The slit function is calculated in two steps; the first one involved the use of the room temperature spectrum recorded with the smaller slit width (usually 50µm, files are named with _50). The optimization involved the Lorentzian and Gaussian part of the slit function, and later the trapezoid part. The second part involved the room temperature spectrum recorded with a larger slit width (400 µm, file are named with _1). The optimization involved mostly the middle part of the trapezoid, leaving almost constant the previously found parameters. The quality of the fit is determined mostly by looking and the comparison fit to data and by the F(Sum) error parameter. Usually a value of F(Sum)<0.2 is an indication of a good fit but it is not a strict rule.

- Edit the name-list file **ne standyyy_x.nls** (file containing all the inputs for fitting). Remember to rename the name-list file with the current day number (yyy):
  - **ICHN** = number of pixels to fit (default 80)
  - **ICHN0** = starting pixel point (default 50) for the fit: everything before is ignored
  - **RMAX** = maximum wavenumber (calculated by shift parameter)
  - **RMIN** = minimum wavenumber (useless if ICHN and ICHN0 are in use)
  - **DISP** = dispersion of pixels (default 0.709)
  - **CHDISP** = non-linear dispersion (may be useful if DIS is not working by its own)
  - **KON_** = control variables for fit: 1=on, 0=off. Values aside are used as constant (KON=0) or starting values for fit (KON=1)
  - **SG** = Gaussian part of the slit (instrument) function
  - **SL** = Lorentzian part of the slit (instrument) function
  - **G1** = narrow-band dye laser linewidth
  - **DLL1** = narrow-band dye laser wavelength
  - **TRAPL** = trapezoid left part
  - **TRAPM** = trapezoid middle part
  - **TRAPR** = trapezoid right part
  - **ZTRAPLR** = symmetric trapezoid
  - **ZLORT** = Lorentzian part of the trapezoid
  - **ZPOSTCON** = postconvolution
  - **AXNRS** = non-resonant background (use 7.27 for air, otherwise use Gaseq software to calculate the chemical equilibrium at desired temperature and calculate the new value through the CARS_auswertung excel file)
  - **ZLIB** = creates libraries if true (T) (use it only after optimization)
  - **ZOFF** = fits for offset (use it only as last attempts if the background is very noisy)
  - **MAXF** = maximum iterations (remember that the error depends also on starting value)
  - **ACCREL** = relative accuracy (0.1 is a good value)
  - **IREFNO** = reference number (not used in the calculations, use the number of the day as identification)
  - **ZLOW** = collisional narrowing model for high pressure (p>3 atm) if T; otherwise uses model for low pressure (p<3 atm) when F.



- Edit **ne carp-rt_all.e** (program for room temperature fitting):
  - **NUM1** = number of run of room temperature spectrum (50 for 50µm, 1 for 400µm slit width)
  - **NLS** = number of namelist (.nls) file in use (**50** for 50µm, **1** for 400µm slit width)

carp-rt_all.e

File Edit Search Preferences Shell Macro Windows Help

```
# ------------------------------------------------------------------
# load variable definitions:
. ../mess/set.e
# ------------------------------------------------------------------
SPECSD1=${PRE}a${TAG}
KOMPAKT=kompakt.res
#
# ------------------------------------------------------------------
#
# No. of RT-spectra
NUM1=03
NUM2=-1
NUM3=-1
# No. of namelist to use
NLS=1
# ------------------------------------------------------------------
if [ $# -ge 1 ] ; then
   DUMMY=$1
else
   echo "use: $0 <run number> [<text for kompakt>]"
   exit
fi
# NUM=$3
# ------------------------------------------------------------------
echo " -${1}-${2}-----------------------------------" >>${DIRAPFIT}${KOMPAKT}
echo " ${SPECSD1}${NUM1}:" >>${DIRAPFIT}${KOMPAKT}
carp-rt.e ${NUM1} ${NLS} ecs $1 $2
# ---------------------
if [ ${NUM2} -ne "-1" ] ; then
  echo " ${SPECSD1}${NUM2}:" >>${DIRAPFIT}${KOMPAKT}
  carp-rt.e ${NUM2} ${NLS} ecs $1 $2
fi
# ---------------------
if [ ${NUM3} -ne "-1" ] ; then
  echo " ${SPECSD1}${NUM3}:" >>${DIRAPFIT}${KOMPAKT}
  carp-rt.e ${NUM3} ${NLS} ecs $1 $2
fi
# ------------------------------------------------------------------
#
#
```

Run the code:

- **carp-rt_all.e [fit trial #] [optional comments (useful to track the fitting changes & parameters)]**

  e.g. carp-rt_all.e 01 Fit:shift (2234)

This code creates the following outputs:

- file_**01.bd** Fitted spectra and residue (binary, carp-format)
- file_**01.zd** Fit information (all the iterations performed)
- **kompakt.res** List of selected parameters for the fit

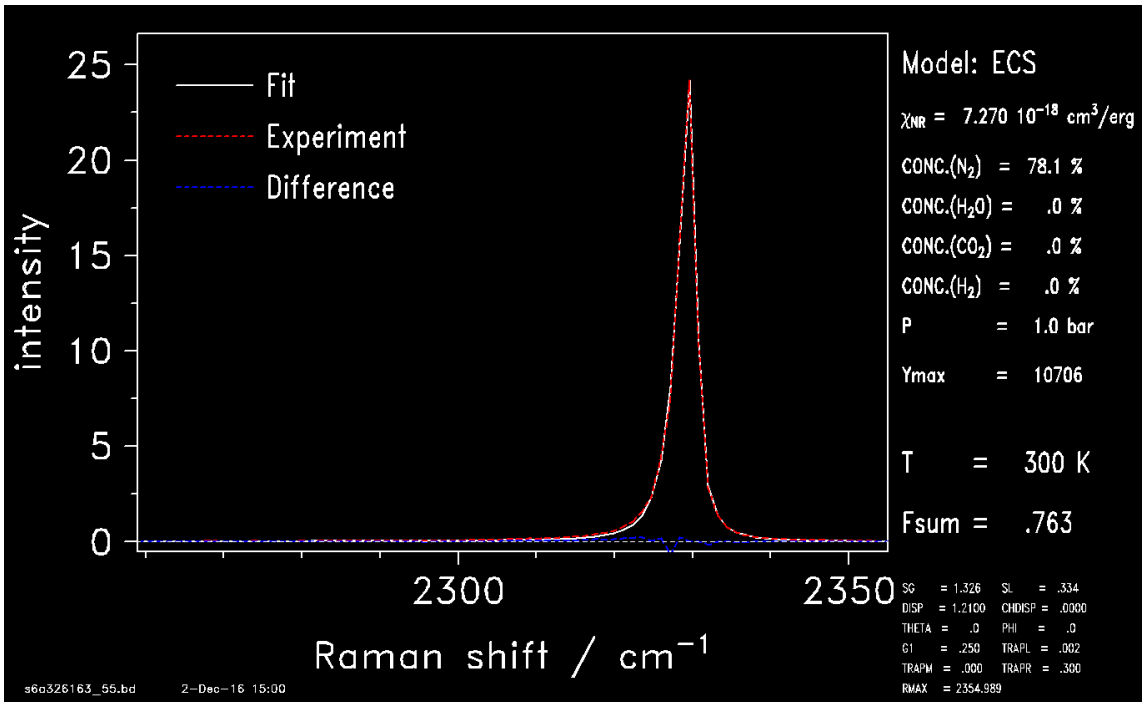
Verify the goodness of the fit by minimizing **F(Sum)** parameter.

```
 -103----------------------------------------
 s6a32616:
  SG     SL   TRAPL   TRAPM TRAPR   CONC     P      T      RMAX     CNT     FSUM     YMAX
1.378   .281   .015    .003  .303   78.09    1.0   300.0 2355.001   44     .8222   10865
1.378   .281   .014    .003  .306   78.09    1.0   300.0 2354.999   43     .8060   10689
1.378   .281   .002    .003  .302   78.09    1.0   300.0 2354.990   34     .7443   10706
```

Then check the the goodness of the fit by looking at theory to data plot using **gr.e** program:

- **gr.e [room temperature run #]_[fit trial #]**

e.g. gr.e 3314_01
(note: a black window pops up: double-click on mouse middle button to activate the plot)



Iterate fitting the room temperature spectra using the following procedure:

1. Start with room temperature spectrum with 50 µm slit width.
2. Fit only for horizontal shift (KONSHF=1, every other KON variable = 0, temperature fixed at measured room temperature value).
3. Update the starting value of the shift modifying ICNH0 value based on R_MAX fit.
4. Fit for Gaussian (SL=1) and Lorentzian (SG=1) part of the slit function coupled with horizontal shift (with updated ICNH0 starting value); keep TRAPM = 0.
5. Remove SL(=0) and SG(=0) from the fitting parameter (updating the values to the best fit) and activate left (TRAPL=1) and right (TRAPR=1) trapezoid part.
6. Fit one last time only for temperature (to verify the value of measured room temperature).
7. Switch to room temperature spectrum with 400 µm slit width and edit the carp-rt_all.e according to the new inputs.
8. Keep all the updated fitting values from the 50µm fit.
9. Activate only middle (TRAPM=1) trapezoid part and fit for it.
10. Once updated the value, fir only for TRAPL and TRAPR.
11. Last fit with only temperature again.

4. Calculation of dispersion

- If the spectra are not all corrected for background subtraction and dye curve, go to **mess** folder.

- Process a hot spectrum subtraction the background (**korsp-nr.e** code) and correcting for dye curve (**korsp-ep.e** code). Detailed instructions are provided in previous section 2.

- Copy **carp** folder from previous data analysis folder if it is not present

- Now work in **carp** folder.

- Edit **ne carp-fit_all.e**
  - **AFILE = "gdxx"** where xx is the value in the name-file of **.sd** output in mess folder
  - **NUM=xx${AFILE}** where xx is the run number of the hot spectrum to fit

carp-fit_all.e

File Edit Search Preferences Shell Macro Windows Help

```
# 27-Nov-2001: namelist now carp${TAG}_x.nls
# ------------------------------------------------------------------
# load variable definitions:
. ../mess/set.e
# ------------------------------------------------------------------
SPECSD1=${PRE}a${TAG}
MODEL=ecs
KOMPAKT=kompakt.res
if [ ! $# -ge 2 ] ;  then
  echo "use: $0 <run number> <text for kompakt.res> <number of exp.> <NLS number>"
  exit
else
#   ------------------------------------------------------------------
# create namelist files for different phi's:
NLS=carp${TAG}_
#NLS0=${NLS}1.nls
#   ------------------------------------------------------------------
AFILE="gd13"
#   ------------------------------------------------------------------
echo "${1} -- ${2} ----------" >>${KOMPAKT}
#   ------------------------------------------------------------------

#   ---------------------------------
if  [ $# -ge 4 ] ;  then
    NUM=$3
    NLS_NUM=$4
    echo " ${SPECSD1}${NUM}_${1}" >>${KOMPAKT}
    carp-fit.e ${NUM} ${NLS_NUM} ${MODEL} $1 $2
 exit
fi


if  [ 1 -eq 1 ] ;  then
AFILE="gd13"
#   ---------------------------------
    NUM=07${AFILE}
    echo " ${SPECSD1}${NUM}_${1}" >>${KOMPAKT}
    carp-fit.e ${NUM} 100 ${MODEL} $1 $2
#   ---------------------------------
fi

if  [ 1 -eq 0 ] ;  then

#   ---------------------------------
    NUM=04${AFILE}
    echo " ${SPECSD1}${NUM}_${1}" >>${KOMPAKT}
    carp-fit.e ${NUM} 1 ${MODEL} $1 $2
#   ---------------------------------
    NUM=05${AFILE}
    echo " ${SPECSD1}${NUM}_${1}" >>${KOMPAKT}
    carp-fit.e ${NUM} 1 ${MODEL} $1 $2
#   ---------------------------------
    NUM=06${AFILE}
    echo " ${SPECSD1}${NUM}_${1}" >>${KOMPAKT}
    carp-fit.e ${NUM} 1 ${MODEL} $1 $2
#   ---------------------------------
    NUM=07${AFILE}
    echo " ${SPECSD1}${NUM}_${1}" >>${KOMPAKT}
    carp-fit.e ${NUM} 1 ${MODEL} $1 $2
#   ---------------------------------
    NUM=08${AFILE}
    echo " ${SPECSD1}${NUM}_${1}" >>${KOMPAKT}
    carp-fit.e ${NUM} 1 ${MODEL} $1 $2
#   ---------------------------------
    NUM=11${AFILE}
    echo " ${SPECSD1}${NUM}_${1}" >>${KOMPAKT}
    carp-fit.e ${NUM} 1 ${MODEL} $1 $2
#   ---------------------------------
    NUM=12${AFILE}
    echo " ${SPECSD1}${NUM}_${1}" >>${KOMPAKT}
    carp-fit.e ${NUM} 1 ${MODEL} $1 $2
#   ---------------------------------
    NUM=13${AFILE}
    echo " ${SPECSD1}${NUM}_${1}" >>${KOMPAKT}
    carp-fit.e ${NUM} 1 ${MODEL} $1 $2
```

- Using the previous found slit function parameters, fit the hot spectrum for temperature first (**KONT = 1**) and then for dispersion (**DISP**) modifying the **carpxxx_100.nls**.

  Remember to modify **ZLOW =** (T for p < 1.5 atm or F for p > 1.5 atm).

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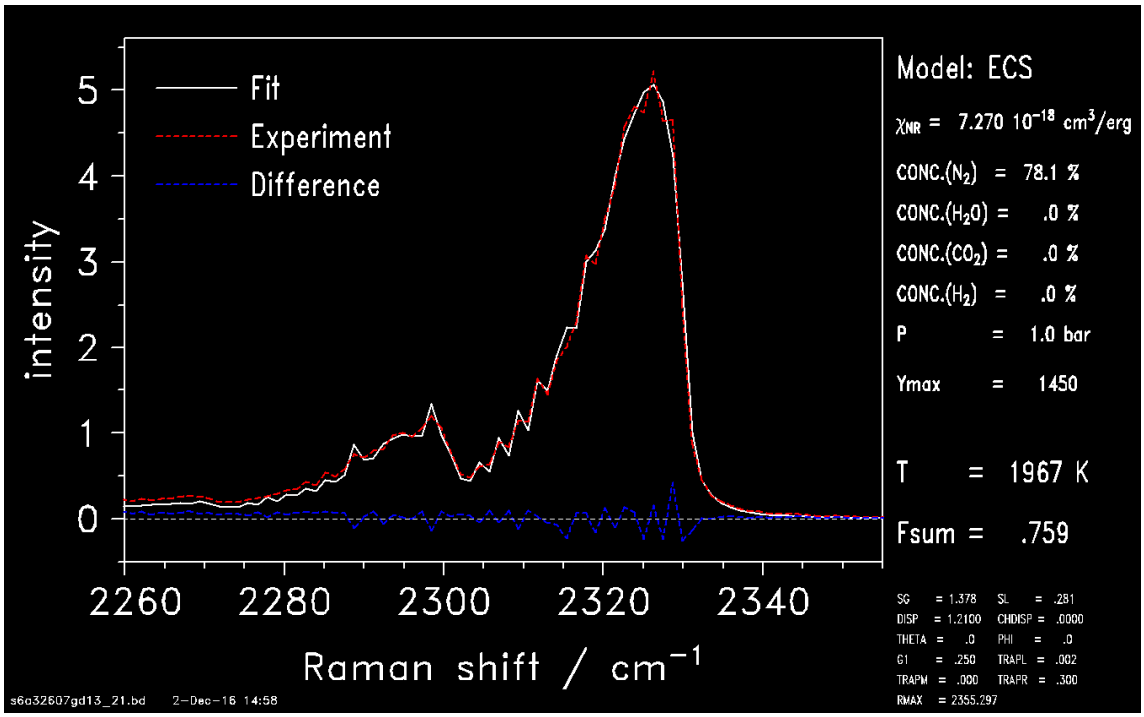
```
&NDN
ICHN     = 80,          ICHNO    = 56,
RMAX     = 2344.335,    RMIN     = 2100.000,
DISP     = 0.7090000,   CHDISP   = 0.0000,
DLMIN    = 518.000000,  DLMAX    = 530.00000,
KONSHF   = 0,           SHIFT    = 0.0000,
KONT     = 1,           T        = 294.0,
KONTR    = 0,           TR       = 300.0,       ZTR      = F,
KONP     = 0,           P        = 0.955,
KONC     = 0,           CONC     = 78.09,
KONSG    = 0,           SG       = 0.734,
KONSL    = 0,           SL       = 0.223,
KONG1    = 0,           G1       = 0.2500,
DLL1     = 596.00000,
ZPOSTCON = T,           ZTRAPLR  = F,           ZLORT    = T,
KONTRAPL = 0,           TRAPL    = 0.011,
KONTRAPM = 0,           TRAPM    = 2.100,
KONTRAPR = 0,           TRAPR    = 0.400,
AXNRS    = 7.27E-18,
CONH2O   = 0.0000,      CONCO2   = 0.0000,
ZLIB     = F,           ZL       = F,           ZTRANS   = T,
ZOFF     = F,           ZO       = T,           ZSAME    = F,
ZR       = F,           ZSQRT    = F,
ZXC      = T,           ZXCA     = T,           ZLOW     = T,
ZX       = F,           ZVIDPHA  = T,
KONSAS   = 0,           SAS      = 0.0000,
ALPHA2   = 3.2402E-51,  RHO      = 0.022000,
THETA    = 0.000,       PHI      = 0.0000,
VIDPHAS  = 0.0000,      XCIDE    = 1.0000,
IP       = -1,          IPV      = 0,
MAXF     = 50,
ACCREL   = 0.100,       ACC      = 0.000,       HH       = 0.000,
IREFNO   = 137,         ITEST    = 0
/
```

- Run **carp-fit_all.e**:
  - **carp-fit_all.e [# of fit] [basenamefile of spectrum to fit] [.nls#]**

    e.g. carp-fit_all.e 01 14fd99 100

- As for the slit function, first minimize the **F(sum)** and then check the goodness of the fit using the **gr.e** command.

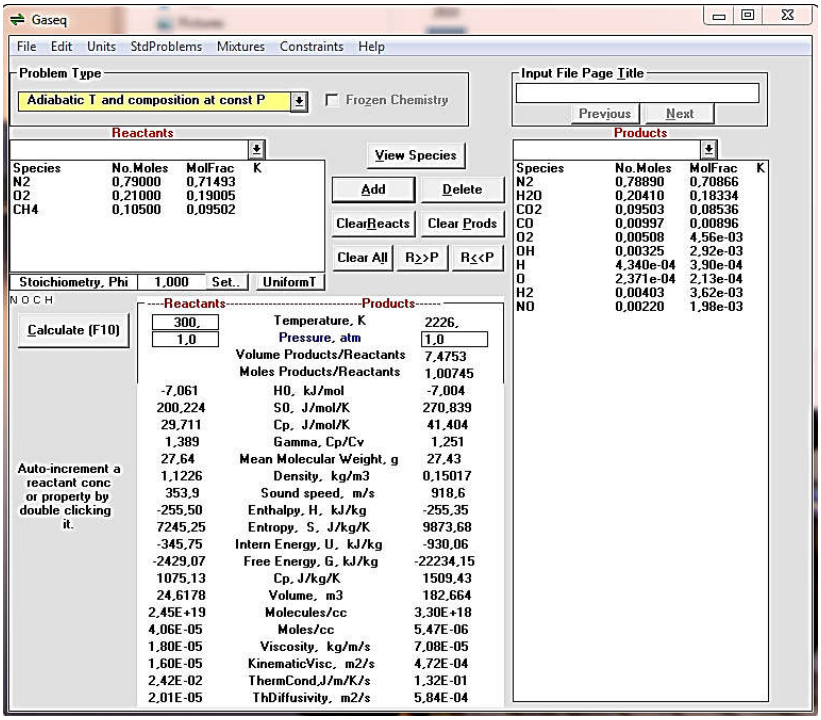


The goal is to align all the rotational lines even if the F(sum) may increase. Once found the optimum dispersion value, repeat the slit function calculation (section 3) using the new updated dispersion value. Iterate again between dispersion and slit function until convergence is found.

5. Creation of quick fit library

- Work in **mess** folder.

- Before starting, run **gaseq** code and note all the specie concentrations for the tested flame at maximum temperature (at stoichiometric conditions, phi = 1).



Use those values to update the tables in the excel file **CARS_auswertung**.
First update the value for the fuel with all the product concentration in order to evaluate the maximum AXNRS:

	A	B	C	D	E
1	JetA1-Air Flame				
2	Phi = 1,0				
3					
4	Moleküle	AXNRS	Konzentrationen	AXNRS	
5					
6	N_2	7,10	73,067	5,188	
7	H_2O	15,50	12,134	1,881	
8	CO_2	9,20	11,652	1,072	
9	CO	9,80	1,504	0,147	
10	O_2	7,80	0,667	0,052	
11	H_2	7,00	0,285	0,020	
12	Ar	9,60	0,000	0,000	
13	NO	18,90	0,276	0,052	
14	CH_4	31,80		0,000	
15	C_2H_4	84,90		0,000	
16	C_3H_6	126,70		0,000	
17	C_4H_8	147,80		0,000	
18	i-C_4H_{10}	130,60		0,000	
19					
20	Summe:		99,585	8,412	
21					

Then update also the table in tab **T-Abhängigkeiten** and note all the values inside: they will be the inputs to for the library creation.

				T-kalt 300			N2-kalt 79,1				min_axnrs 7,27								
CARS-Exp.	Flamme	p	Φ	T-heiß -Tad	N-0 conc	N-T a_conc	N2-heiß min_conc	N2-kalt max_conc	AXNRS-0 axnrs	AXNRS-T a_axnrs	AXNRS-heiß max_axnrs	H2O-0 con_h2o	H2O-T a_conh2o	H2O-heiß max_conh2o	CO2-0 con_co2	CO2-T a_conco2	CO2-heiß max_conco2	H2-0 con_h2	H2-T a_conh2	H2-heiß max_conh2
	Flamme-I	3%	0,86	2264	78,7263	-0,00208758	74,9	78,1	7,160020	0,000366599	7,99	-0,01680244	0,00005601	0,11	-0,01680244	0,00005601	0,11	-0,02205703	0,00007352	0,1444
	Flamme-II	3%	1,2	1726	78,5628	-0,00154278	75,9	78,1	7,147960	0,000409732	7,85	-0,01577840	0,00005259	0,075	-0,01577840	0,00005259	0,075	-0,03037868	0,00010126	0,1444
	Flamme-III	5%	0,67	1855	78,6595	-0,00186495	75,2	78,1	7,194759	0,000259804	7,66	-0,01717042	0,00005723	0,089	-0,01717042	0,00005723	0,089	-0,02765852	0,00009286	0,1444
	Flamme-IV	3%	0,64	1886	78,6107	-0,00170240	75,4	78,1	7,215145	0,00018295	7,56	-0,01607818	0,00005359	0,085	-0,01607818	0,00005359	0,085	-0,02731488	0,00009105	0,1444

Note that all the species (H_2O, CO_2, H_2) must be written in absolute mole fraction except N_2 which must be written in percentage.

- Edit the **ne set.all.e** program: update all the values about the slit function obtained in the previous section and update all the values regarding the specie concentrations, maximum and minimum values, non-resonant background, pressure and the values of the slopes. The last information are obtained from the excel sheet. Regarding the method, use the 29. It is proved to be best one (however, after fitting it is possible to compare different methods and choose the most appropriate one if 29 is not satisfactory).

set-all.e

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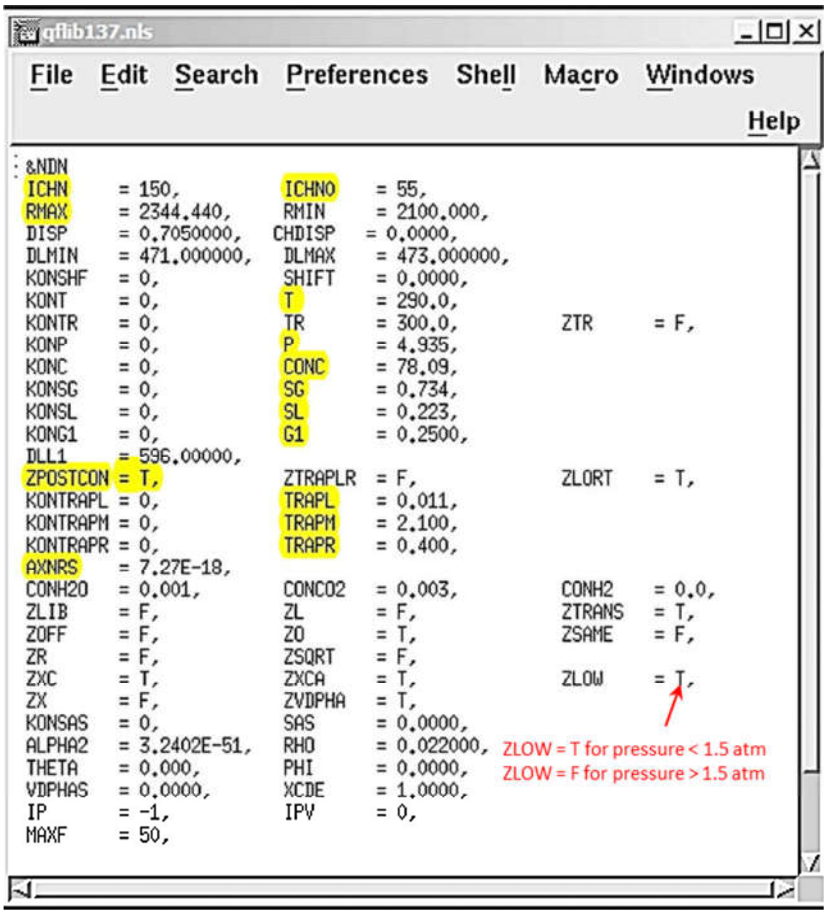
```
# set-all.e  28-Mar-00
# alle wichtigen Uebergabeparameter werden jetzt "exportiert", damit nicht
# mehr soviel uebergeben werden muessen.
# ------------------------------------------------------------------------
# Version 2.0 19-Apr-2000
# Version 2.1 20-Apr-2000
# Version 2.2 18-Jul-2000
# "export" ist wohl gar nicht noetig?!
# 12-Jun-2012 change in lfit.e: FILE_APP taken from $2 and RESAPP=${FILEAPP}${RES_APP}
# ------------------------------------------------------------------------
# Leerstrings mit "xx" kennzeichnen!!!
# ------------------------------------------------------------------------
# fuer korsp-ep.e:
export FILE_APP="g"
if [ "${FILE_APP}" = "bo"  ] ; then KORSP_=" BLO KORR_OFF xx " ; fi
if [ "${FILE_APP}" = "b"   ] ; then KORSP_=" BLO xx       xx " ; fi
if [ "${FILE_APP}" = "f"   ] ; then KORSP_=" FLA xx       xx " ; fi
if [ "${FILE_APP}" = "fo"  ] ; then KORSP_=" FLA KORR_OFF xx " ; fi
if [ "${FILE_APP}" = "fog" ] ; then KORSP_=" FLA KORR_OFF KORR_532 " ; fi
if [ "${FILE_APP}" = "g"   ] ; then KORSP_=" 532 xx       xx " ; fi
if [ "${FILE_APP}" = "go"  ] ; then KORSP_=" 532 KORR_OFF xx " ; fi
DYE=05
AFILE0=${FILE_APP}
export FILE_APP=${FILE_APP}d${DYE}
AFILE=${FILE_APP}
# Schalter und Start und Endwert fuer spezielle Korrekturen:
export IF_KORR_AMAX=""  # ="" aktiv, ="!" nicht aktiv
export IF_KORR_AMIN=""
export AMAX_V=60000     # filter value
export AMAX_N=0         # number of spectra to delete
export AMAX_S=70        # start pixel
export AMAX_E=120       # end pixel
export AMIN_V=-200
export AMIN_S=75
export AMIN_E=85
export GRE_S=10
export GRE_E=30
export GRE2_S=220
export GRE2_E=250
export OFF_S=1
export OFF_E=30

# fuer all-ep.e
export R_KORSP="1"
export R_LFIT="1"
export R_SHOW="1"
export R_FINAL="0"
export MAXERR_LIST="50 40 30 25 20"

# Allgemeines:
export SHIFT=0.0
export ZOFF=false
# export ZOFF=true

# fuer lfit.e:
# normale Auswertung:
export RES_APP=${FILE_APP}_1
export QFLIB="xx"
export LFLIB="xx"
export TAB_APP="${RES_APP}"
export KONSHIFT=1
export ICHNF=180
export ICHN=27
export ICHN_ADD=-29

export CHANNEL_A=1
export CHANNEL_B=${ICHNF}
export FACTOR_A=1.0
export FACTOR_B=1.0
```

```
# nur Hot-Band:
# export RES_APP=${FILE_APP}hbs
# export LFLIB="_hb"
# export TAB_APP="_3_${RES_APP}"
# export KONSHIFT=0
# export ICHNF=120
# export ICHN=88
# export ICHN_ADD=50

# Variables for lfit.e, qflib_nls.e und lflib_nls.e (parameter for different flames):
if [ "${LFLIB}" = "xx" ] ;    then
export  LFIT_P="4.935"
export  LFIT_CONC="78.8426"
export  LFIT_S_CONC="-0.0024752E"
export  LFIT_MIN_CONC="72.8"
export  LFIT_MAX_CONC="78.1"
export  LFIT_AXNRS="7.103"
export  LFIT_S_AXNRS="0.000555254"
export  LFIT_MIN_AXNRS="7.27"
export  LFIT_MAX_AXNRS="8.45"
export  LFIT_CONH2O="-0.0175623E"
export  LFIT_S_CONH2O="0.000058E4"
export  LFIT_MAX_CONH2O="0.1244"
export  LFIT_CONCO2="-0.01608"
export  LFIT_S_CONCO2="0.000053E0"
export  LFIT_MAX_CONCO2="0.1139"
fi

# fuer show*.e:
export MAXERR=25
export METHOD=29
NEW=new
APP=app

# Spreadtest:
export DT="xx"
export M1="xx"
export M2="xx"
export M3="xx"
export SPREADTEST=" ${DT} ${M1} ${M2} ${M3} "
# ----------------------------------------------------

FLAMME="FIRST-III Referenzflamme"

#                              r HAB     Fl.       532 BB
EXP_06=" 06 ${AFILE} ${DYE}   0 107  FIRST-III 41 50 ${KORSP_} ${NEW} "
EXP_07=" 07 ${AFILE} ${DYE}   0 107  FIRST-III 38 50 ${KORSP_} ${APP} "
EXP_08=" 08 ${AFILE} ${DYE}   0  95  FIRST-III 32 50 ${KORSP_} ${APP} "
EXP_09=" 09 ${AFILE} ${DYE}   0  80  FIRST-III 22 50 ${KORSP_} ${APP} "
EXP_10=" 10 ${AFILE} ${DYE}   0  62  FIRST-III 35 50 ${KORSP_} ${APP} "
EXP_11=" 11 ${AFILE} ${DYE}   0  45  FIRST-III 35 50 ${KORSP_} ${APP} "
EXP_12=" 12 ${AFILE} ${DYE}   0  37  FIRST-III 41 50 ${KORSP_} ${APP} "
EXP_13=" 13 ${AFILE} ${DYE}   0  37  FIRST-III 41 50 ${KORSP_} ${APP} "
EXP_14=" 14 ${AFILE} ${DYE}   0  30  FIRST-III 38 50 ${KORSP_} ${APP} "
EXP_15=" 15 ${AFILE} ${DYE}   0  24  FIRST-III 44 50 ${KORSP_} ${APP} "
EXP_16=" 16 ${AFILE} ${DYE}   0  18  FIRST-III 48 50 ${KORSP_} ${APP} "
EXP_17=" 17 ${AFILE} ${DYE}   0  12  FIRST-III 55 50 ${KORSP_} ${APP} "
EXP_18=" 18 ${AFILE} ${DYE}   0   3  FIRST-III 10 50 ${KORSP_} ${APP} "
EXP_19=" 19 ${AFILE} ${DYE}   0   1  FIRST-III  8 50 ${KORSP_} ${APP} "
EXP_20=" 20 ${AFILE} ${DYE}   0  80  FIRST-III 28 50 ${KORSP_} ${APP} "

# Einstellungen fuer individuelle Namelists
#       SpekNr BKG     T      ConN2 ConH2O ConCO2 AXNRS PRESS

# NLS_04=" 04 ${AFILE}  1600.00 54.50 0.051  0.017  8.12  0.987"

# Kommentarstrings, die via gr.e in die Ausdrucke eingebunden werde
# ACHTUNG: Keine Leerzeichen im String verwenden !!

# GR_07="TLC_1bar_Phi=2.1_r=0mm_h=5mm_Gain=90"
```

- Now work in **qflib** folder.

- Rename (with the data day number) and edit the name-list file (**qflibxxx.nls**): update all the values about the slit function obtained in the previous section.



- Run **qflib_nls.e** program to create all the filename lists to generate the the library (.cnr file).
  - **qflib_nls.e**
  - This code creates the following outputs:
    - **.crn** Large series for different temperatures (default every 50 K)

- Run **carp-qf.e** program to create the library through the already created .cnr filename list.
  - **carp-qf.e ""**

  This code creates the following outputs:
    - **.crl** Spectral library
    - **.zd** Input/output parameters
    - **output.log** Logfile with carp- errorlist
    - **kompakt.res** Selective outputs

- Run **anal.e** program to analyze the the library coefficients and write them into a table
  - **anal.e ""**

  This code creates the following outputs:

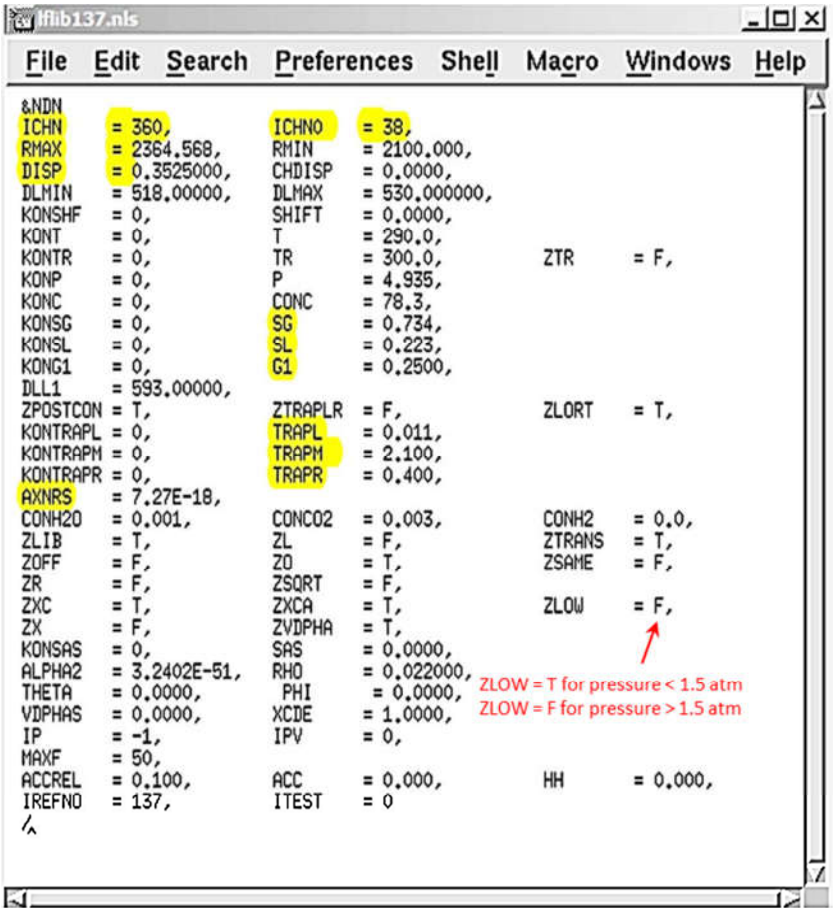
- **.cff** Input parameters
- **.cft** Table with spectra

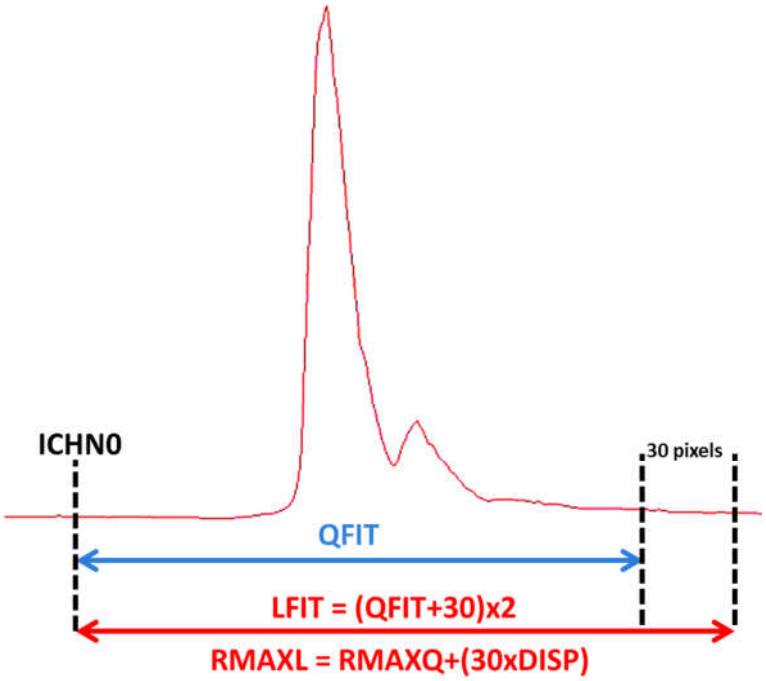
- Run **clean-qf.e** program to delete all the unnecessary file
  - **clean-qf.e**

6. Creation of fit library

- Work in **lflib** folder.

- Modify **lflibxxx.nls** accordingly to slit function and AXNRS values. Change the RMAX value taking into consideration that the quick fit library and the fit library are shifted by a certain amount of pixels (default value -30. This number is found in set-all.e file – mess folder – under ICHN_ADD variable). To align the two libraries **RMAX** value should be increased (or decreased) by the RMAX value of the quick fit library multiplied by the dispersion value: it is possible to find these numbers in the qflibxxx.nls file in qflib folder. Note also that the number of pixel to fit in the fit library is higher than the quick fit library (do not change **ICHN** value): this implies that the dispersion value (**DISP**) must be half of the one found in the quick fit library.





- Run **lflib_nls.e** program to create all the filename lists to generate the library (.cnr file).
    - **lflib_nls.e**
    - This code creates the following outputs:
- **.cnr** Large series for different temperatures (default every 50 K)

- Run **carp-lf.e** program to create the library through the already created .cnr filename list.
    - **carp-lf.e ""**
    - This code creates the following outputs:
- **.lib** Large spectral libraries for different temperatures

- Run **clean-lf.e** program to delete all the unnecessary file
    - **clean-lf.e**

A quick method to check if the two libraries are well aligned is to create some theoretical spectra (one every 50 K) using the QFit library and try to fit them using the LFit library. The initial temperature guess is set on purpose 200 K above the right temperature to force the LFit code to do some iterations. To do so, run the code **lfit_qlfit.e** in **lfit** folder. Results are found in **qflib** folder:

- **qflibxxx.dat**
- **qflibxxx.lft**
- **qflibxxx.log**
- **qflibxxx.res**

If the two libraries are well aligned the **F(Sum)** should be low and the temperatures very close. Check this on the **.log** file. Also, it is possible to see the fit using spi program:

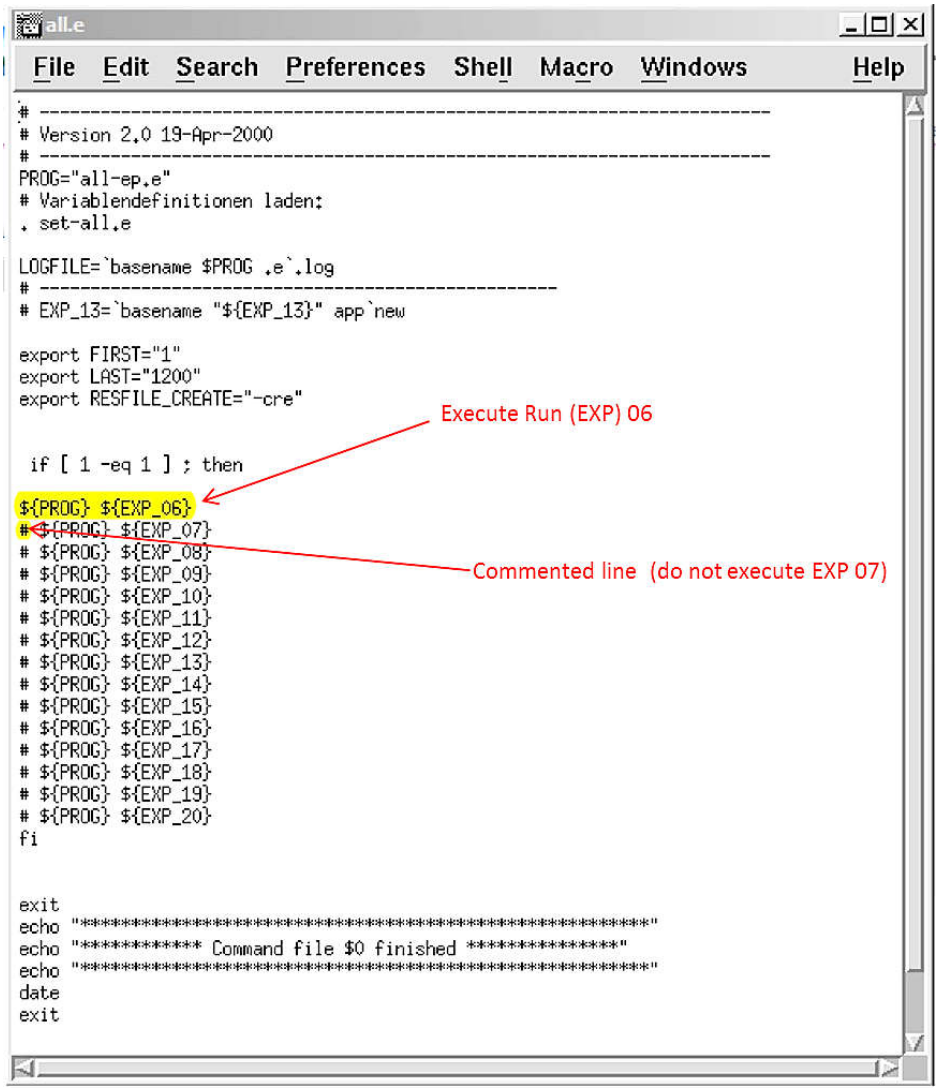
1. spi
2. chd qflibxxx.lft
3. @fit
4. gin

7. Fit the spectra

- Work in **mess** folder

- Edit **ne all.e** program (code to enable the fit to all single shots of every data point – remember: each data point contains 1200 single shots).

  All the lines with **#** are commented and not executed. **EXP**_xx is the data point followed by run number.



  - Edit **ne set-all.e**:
    - **AMAX_V** = filter for too high intensity / camera saturation (maximim value)
    - **AMAXN** = # of spectra to delete
    - **AMAX_S** = start point (pixel #) where to apply the max filter
    - **AMAX_E** = end point (pixel #) where to apply the max filter
    - **AMIN_V** = filter for too low intensity / camera noise (minimum value)

- **AMIN_S** = start point (pixel #) where to apply the min filter
- **AMIN_E** = end point (pixel #) where to apply the min filter
- **R_KORSP** = correct spectra (bkg, dye curve) if ="1" (skip process if ="0")
- **R_LFIT** = fit spectra if ="1" (skip process if ="0")
- **R_SHOW** = show results (table) if ="1" (skip process if ="0")
- **R_FINAL** = summarize results and statistics if ="1" (skip process if ="0")
- **MAXERR_LIST** = maximum F(Sum) error to reject spectra in statistics
- **ICHNF** = # of pixels used to fit by fit library (lflib): 180 is default value
- **ICHN** = # of pixels sikipped from data to library (use the same # used in standxxx_1.nls in apfit folder)
- **ICHN_ADD** = # of pixels added to match quick fit (smaller) to regular fit library

Remember to list all the run # in the experiment at the end of the program otherwise the code stops at the last EXP_xx. Also, it is possible to edit the measurement position modifying the values under the columns **r** (radial position) and **HAB** (height above burner).

set-all.e

File Edit Search Preferences Shell Macro Windows Help

```
# set-all.e  28-Mar-00
# alle wichtigen Uebergabeparameter werden jetzt "exportiert", damit nicht
# mehr soviel uebergeben werden muessen.
# ------------------------------------------------------------------------
# Version 2.0 19-Apr-2000
# Version 2.1 20-Apr-2000
# Version 2.2 18-Jul-2000
# "export" ist wohl gar nicht noetig?!
# 12-Jun-2012 change in lfit.e: FILE_APP taken from $2 and RESAPP=${FILEAPP}${RES_APP}
# ------------------------------------------------------------------------
# Leerstrings mit "xx" kennzeichnen!!!
# ------------------------------------------------------------------------
# fuer korsp-ep.e:
export FILE_APP="g"
if [ "${FILE_APP}" = "bo"  ] ; then KORSP_=" BLO KORR_OFF xx " ; fi
if [ "${FILE_APP}" = "b"   ] ; then KORSP_=" BLO xx       xx " ; fi
if [ "${FILE_APP}" = "f"   ] ; then KORSP_=" FLA xx       xx " ; fi
if [ "${FILE_APP}" = "fo"  ] ; then KORSP_=" FLA KORR_OFF xx " ; fi
if [ "${FILE_APP}" = "fog" ] ; then KORSP_=" FLA KORR_OFF KORR_532 " ; fi
if [ "${FILE_APP}" = "g"   ] ; then KORSP_=" 532 xx       xx " ; fi
if [ "${FILE_APP}" = "go"  ] ; then KORSP_=" 532 KORR_OFF xx " ; fi
DYE=05
AFILE0=${FILE_APP}
export FILE_APP=${FILE_APP}d${DYE}
AFILE=${FILE_APP}
# Schalter und Start und Endwert fuer spezielle Korrekturen:
export IF_KORR_AMAX=""  # ="" aktiv, ="!" nicht aktiv
export IF_KORR_AMIN=""
export AMAX_V=60000     # filter value
export AMAX_N=0         # number of spectra to delete
export AMAX_S=70        # start pixel
export AMAX_E=120       # end pixel
export AMIN_V=-200
export AMIN_S=75
export AMIN_E=85
export GRE_S=10
export GRE_E=30
export GRE2_S=220
export GRE2_E=250
export OFF_S=1
export OFF_E=30

# fuer all-ep.e
export R_KORSP="1"
export R_LFIT="1"
export R_SHOW="1"
export R_FINAL="0"
export MAXERR_LIST="50 40 30 25 20"

# Allgemeines:
export SHIFT=0.0
export ZOFF=false
# export ZOFF=true

# fuer lfit.e:
# normale Auswertung:
export RES_APP=${FILE_APP}_1
export QFLIB="xx"
export LFLIB="xx"
export TAB_APP="${RES_APP}"
export KONSHIFT=1
export ICHNF=180
export ICHN=27
export ICHN_ADD=-29

export CHANNEL_A=1
export CHANNEL_B=${ICHNF}
export FACTOR_A=1.0
export FACTOR_B=1.0
export FACTOR_C=1.0
```

ZOFF = false → vertical shift fixed
ZOFF = true → vertical shift fitted

Fit starts at that pixel

Fit ends at that pixel

Weight for ErrSum in 1st region 0 < #pixel < start fit

Weight for ErrSum in 2nd region start fit < #pixel < end fit

Weight for ErrSum in 3rd region end fit < #pixel < end file

```
# nur Hot-Band:
# export RES_APP=${FILE_APP}hbs
# export LFLIB="_hb"
# export TAB_APP="_3_${RES_APP}"
# export KONSHIFT=0
# export ICHNF=120
# export ICHN=88
# export ICHN_ADD=50

# Variables for lfit.e, qflib_nls.e und lflib_nls.e (parameter for different flames):
if [ "${LFLIB}" = "xx" ] ;    then
export  LFIT_P="4.935"
export  LFIT_CONC="78.8426"
export  LFIT_S_CONC="-0.00247529"
export  LFIT_MIN_CONC="72.8"
export  LFIT_MAX_CONC="78.1"
export  LFIT_AXNRS="7,103"
export  LFIT_S_AXNRS="0.000555294"
export  LFIT_MIN_AXNRS="7.27"
export  LFIT_MAX_AXNRS="8.45"
export  LFIT_CONH2O="-0.01756235"
export  LFIT_S_CONH2O="0.00005854"
export  LFIT_MAX_CONH2O="0.1244"
export  LFIT_CONCO2="-0.01608"
export  LFIT_S_CONCO2="0.00005360"
export  LFIT_MAX_CONCO2="0.1139"
fi

# fuer show*.e:
export MAXERR=25
export METHOD=29
NEW=new
APP=app

# Spreadtest:
export DT="xx"
export M1="xx"
export M2="xx"
export M3="xx"
export SPREADTEST=" ${DT} ${M1} ${M2} ${M3} "
# ----------------------------------------------------

FLAMME="FIRST-III Referenzflamme"

#                              r HAB     Fl.       532 BB
EXP_06=" 06 ${AFILE} ${DYE}   0 107  FIRST-III 41 50 ${KORSP_} ${NEW} "
EXP_07=" 07 ${AFILE} ${DYE}   0 107  FIRST-III 38 50 ${KORSP_} ${APP} "
EXP_08=" 08 ${AFILE} ${DYE}   0  95  FIRST-III 32 50 ${KORSP_} ${APP} "
EXP_09=" 09 ${AFILE} ${DYE}   0  80  FIRST-III 22 50 ${KORSP_} ${APP} "
EXP_10=" 10 ${AFILE} ${DYE}   0  62  FIRST-III 35 50 ${KORSP_} ${APP} "
EXP_11=" 11 ${AFILE} ${DYE}   0  45  FIRST-III 35 50 ${KORSP_} ${APP} "
EXP_12=" 12 ${AFILE} ${DYE}   0  37  FIRST-III 41 50 ${KORSP_} ${APP} "
EXP_13=" 13 ${AFILE} ${DYE}   0  37  FIRST-III 41 50 ${KORSP_} ${APP} "
EXP_14=" 14 ${AFILE} ${DYE}   0  30  FIRST-III 38 50 ${KORSP_} ${APP} "
EXP_15=" 15 ${AFILE} ${DYE}   0  24  FIRST-III 44 50 ${KORSP_} ${APP} "
EXP_16=" 16 ${AFILE} ${DYE}   0  18  FIRST-III 48 50 ${KORSP_} ${APP} "
EXP_17=" 17 ${AFILE} ${DYE}   0  12  FIRST-III 55 50 ${KORSP_} ${APP} "
EXP_18=" 18 ${AFILE} ${DYE}   0   3  FIRST-III 10 50 ${KORSP_} ${APP} "
EXP_19=" 19 ${AFILE} ${DYE}   0   1  FIRST-III  8 50 ${KORSP_} ${APP} "
EXP_20=" 20 ${AFILE} ${DYE}   0  80  FIRST-III 28 50 ${KORSP_} ${APP} "

# Einstellungen fuer individuelle Namelists
#       SpekNr BKG     T      ConN2 ConH2O ConCO2 AXNRS PRESS

# NLS_04=" 04 ${AFILE}  1600.00 54.50 0.051  0.017  8.12  0.987"

# Kommentarstrings, die via gr.e in die Ausdrucke eingebunden werde
# ACHTUNG: Keine Leerzeichen im String verwenden !!

# GR_07="TLC_1bar_Phi=2.1_r=0mm_h=5mm_Gain=90"
```

- Run **all.e** to run the fitting program. This code save all the corrected spectra (bkg, dye curve) inside **mess** folder:
  - s3**a**…..**.cor** = average of corrected single shots
  - s3**s**…..**.cor** = corrected single shots

  While all the fitted spectra are saved into **lfit** folder:

- **.lft** = big file containing corrected spectrum, fit and difference (multiplied by 100) for each single shot (3 columns)
- **.sta** = table containing all the temperature fitting statistics relative to different methods; it also includes the number of spectra rejected by filters
- **.res** = results file: it contains temperature and statistics information

```
--------------------------------------------------------------------------------

Resultfile: s3s13706gd05_1.res
11-Jul-16 16:53:36 s3s13706gd05  HTVflexOP3-FLOX FIRST-III, x=0,z=107;532:41,Dye
:50

Method          5     6     7    20    21    26    27    29    31    32
              h/c ch/cc  h/cc   75%   50%  6or7        LFIT  Fsum  Conc
Results       942   942   942   938   941   942   942   942   942   942
Sigma K       200   202   198   246   217   200   198   191   512     1
      %        13    13    13    15    14    13    13    12    75     1
T-mean       1518  1503  1515  1606  1601  1514  1515  1570   678    75
 T-mp        1449  1438  1446  1526  1540  1448  1447  1507   305    75
T-5%         1249  1240  1250  1239  1292  1247  1249  1313   160    66
  (Diff.)    -200  -198  -196  -287  -248  -201  -198  -194  -145    -9
T-95%        1920  1905  1910  2049  2010  1909  1909  1952  1789    84
  (Diff.)     471   467   464   523   470   461   462   445  1484     9
T-min        1022  1033  1025   967  1031  1033  1036  1126    66    73
T-max        2329  2441  2355  2604  2446  2355  2355  2372  2482    76

total Results:     filter    1   2   3   4   5   6   7   8
   1200            #        46   5   0   0   0   0   0   0

 maxerrsum: +2.500E+01,  rejected:  207
```

To open the .res file it is necessary to use the **qui** program (similar to spi).

Once opened the new window, use the **open** command to read the file:

- **open [filename].res**

To see the tabled results use **show** command: it show a table with similar but more complete information than the .sta file.

Since the table is very large, filtering the results by fitting methods may simplify the visualization; to do that use **set mask** command:

- **set mask [method # method # …]**
  e.g. set mask [20 27 29 31]

- **_1.tab** = table showing the filtering results

```
xterm
11-Jul-2016 16:58
-----------------------------------------------------------------------------
|Experiment|   x   |   h   | Tmean | Sigma |  Tmp  |T95-Tmp|T5-Tmp |   N   |maxerr|
|          |/ mm   |/ mm   | / K   | / K   | / K   | / K   | / K   |       |      |
|----------|-------|-------|-------|-------|-------|-------|-------|-------|------|
|13706gd05_1
|          |     0|   107| 1579  |  200  | 1509  |  472  | -198  | 1149  |  .000|
|----------|-------|-------|-------|-------|-------|-------|-------|-------|------|
|13706gd05_1
|          |       |       | 1576  |  194  | 1508  |  457  | -192  | 1037  |  50.0|
|----------|-------|-------|-------|-------|-------|-------|-------|-------|------|
|13706gd05_1
|          |       |       | 1574  |  193  | 1507  |  453  | -191  | 1012  |  40.0|
|----------|-------|-------|-------|-------|-------|-------|-------|-------|------|
|13706gd05_1
|          |       |       | 1572  |  193  | 1507  |  449  | -193  |  977  |  30.0|
|----------|-------|-------|-------|-------|-------|-------|-------|-------|------|
|13706gd05_1
|          |       |       | 1570  |  191  | 1507  |  445  | -194  |  942  |  25.0|
|----------|-------|-------|-------|-------|-------|-------|-------|-------|------|
|13706gd05_1
|          |       |       | 1569  |  191  | 1506  |  447  | -194  |  914  |  20.0|
|----------|-------|-------|-------|-------|-------|-------|-------|-------|------|
vtmess@mc:vtmess/spray/s3a137/lfit_$
```

- **_1_m**xx**.tab** = table showing the statistics about temperature measurement relative to maximum error F(Sum) = xx (it could be 0 for no filtering or 25, as default value, or any value chosen by the user)

```
vtmess@mc:vtmess/spray/s3a137/lfit_$ cat s3s137xxgd05_1_m25.tab
11-Jul-2016 16:58
-----------------------------------------------------------------------------
|Experiment|   x   |   h   | Tmean | Sigma |  Tmp  |T95-Tmp|T5-Tmp |   N   |maxerr|
|          |/ mm   |/ mm   | / K   | / K   | / K   | / K   | / K   |       |      |
|----------|-------|-------|-------|-------|-------|-------|-------|-------|------|
|13706gd05_1
|          |     0|   107| 1570  |  191  | 1507  |  445  | -194  |  942  |  25.0|
|----------|-------|-------|-------|-------|-------|-------|-------|-------|------|
vtmess@mc:vtmess/spray/s3a137/lfit_$
```

- **_1_m**xx_**fsum.tab** = table showing the statistics about maximum error F(Sum)=xx

```
                          **** Fsum ****

-----------------------------------------------------------------------------
|Experiment|   x   |   z   | Fmean | Sigma |  Fmp  |F95-Fmp|F5-Fmp |   N   |maxerr|
|          |/ mm   |/ mm   |/ 0.01 |/ 0.01 |/ 0.01 |/ 0.01 |/ 0.01 |       |      |
|----------|-------|-------|-------|-------|-------|-------|-------|-------|------|
|13706gd05_1
|          |     0|   107| 2213  |  6319 |  305  | 4706  | -138  | 1149  |  .000|
|----------|-------|-------|-------|-------|-------|-------|-------|-------|------|
```

- **_1_m**xx_**shift.tab** = table showing the statistics about the horizontal shift relative to maximum error F(Sum)=xx
- **_1_m**xx_**ymax.tab** = table showing the statistics about the signal maximum peak relative to maximum error F(Sum)=xx
- **.log** = log file containing all input and fitting value information

s3s13706gd05_1.log

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```
LOG-File: s3s13706gd05_1.log
Date: 11-Jul-16 16:53:37        QUI Version: V3.4 AIX (ohne AXMD)
Spectra: s3s13706gd05.cor       QFLIB: qflib137.cff    LFLIB: lflib137.lib

Concentration                   (CONC):              78.84 %
 (= CONC + S_CONC * T)          (S_CONC):            -.002475 %
 max. allowed concentration     (MAX_CONC):          78.10 %
 min. allowed concentration     (MIN_CONC):          72.80 %
Nonresonant background          (AXNRS):             7.000 E-18 cm3/erg
 (= AXNRS + S_AXNRS * T)        (S_AXNRS):           .000555 E-18 cm3/erg
 max. allowed nonr. background  (MAX_AXNRS):         8.450 E-18 cm3/erg
 min. allowed nonr. background  (MIN_AXNRS):         7.270 E-18 cm3/erg
Temperature                     (T):                 300 K
Shift                           (SHIFT):             .0000 channels
Pressure                        (P):                 4.935 atm
No. of spectral channels        (ICHNF):             180
No. of skipped spectr. channels (ICHN):              27
Channels for weighting of fsum and scaling
                                (CHANNEL_A):           1
                                (CHANNEL_B):         180
Factors for weighting of fsum   (FACTOR_A):          +1.000E+00
                                (FACTOR_B):          +1.000E+00
                                (FACTOR_C):          +1.000E+00
Fit Offset                      (ZOFSET):            FALSE
Accuracy                        (ACCREL):            .1000
Max. no. of iterations          (MAXF):              50
QFIT method for start temp.     (QUIFIT):            26
Diff. starttemp. - QFIT temp.   (DIFF):              .0000 K
Fitting control parameter
  Temperature    fitting        (KONT):              active
  Concentration  fitting        (KONC):              NOT active
  Pressure       fitting        (KONP):              NOT active
  Spectrum shift fitting        (KONSHF):            active
```

#	Time	Knt	Fsum	T	Axnrs	Conc	P	Shift	ichn	QF-T	Ymax
1	16:53:37	6	36.027	1753	7.973	74.50	4.935	.1663	180	1654	800
2	16:53:37	11	88.803	1409	7.782	75.36	4.935	.3494	180	1291	570
3	16:53:37	11	4.9063	1736	7.964	74.54	4.935	.3198	180	1682	3268
4	16:53:38	8	10.632	1395	7.775	75.39	4.935	.0934	180	1258	2640
5	16:53:38	8	2.5256	1706	7.947	74.62	4.935	-.0395	180	1684	17734
6	16:53:38	11	107.42	1280	7.711	75.68	4.935	.0808	180	1027	678
7	16:53:38	10	5.7459	1520	7.844	75.08	4.935	.0731	180	1405	3979
8	16:53:39	8	47.462	1412	7.784	75.35	4.935	.3139	180	1326	1100
9	16:53:39	8	8.7693	1442	7.801	75.27	4.935	-.1427	180	1301	2722
10	16:53:39	7	23.041	1570	7.872	74.96	4.935	-.0506	180	1446	1292
11	16:53:40	12	96.661	1826	8.014	74.32	4.935	-.8203	180	1847	473
12	16:53:40	12	366.47	1221	7.678	75.82	4.935	-1.657	180	915	551
13	16:53:40	7	3.2360	1592	7.884	74.90	4.935	-.2734	180	1506	11754
14	16:53:40	7	4.3463	1511	7.839	75.10	4.935	.3446	180	1451	6211
15	16:53:41	7	4.7094	1549	7.860	75.01	4.935	-.2667	180	1528	7860
16	16:53:41	7	4.4265	1481	7.823	75.18	4.935	-.2308	180	1431	13286
17	16:53:41	5	7.3452	1877	8.042	74.20	4.935	-.1674	180	1864	2433
18	16:53:41	4	9.6808	2210	8.227	73.37	4.935	.0000	180	2203	2037
19	16:53:41	7	3.4574	1352	7.751	75.50	4.935	.3320	180	1377	10839
20	16:53:41	7	2.7282	1368	7.760	75.46	4.935	-.0688	180	1350	5139
21	16:53:42	5	5.6328	1863	8.035	74.23	4.935	-.2676	180	1847	2542
22	16:53:42	8	19.233	1628	7.904	74.81	4.935	.4644	180	1486	1330
23	16:53:42	5	2.9861	1555	7.863	74.99	4.935	-.1145	180	1548	11771
24	16:53:42	7	1.6082	1417	7.787	75.34	4.935	.0499	180	1333	23504
25	16:53:42	6	19.157	1685	7.935	74.67	4.935	-.2784	180	1685	1329
26	16:53:43	12	39.296	1636	7.908	74.79	4.935	.4869	180	1510	704
27	16:53:43	6	2.4291	1800	8.000	74.39	4.935	.1759	180	1741	9626
28	16:53:43	8	16.266	1445	7.803	75.26	4.935	1.062	180	1273	1746
29	16:53:43	12	11.453	1474	7.818	75.19	4.935	-.2209	180	1340	2695
30	16:53:43	6	2.6595	1855	8.030	74.25	4.935	.2588	180	1807	5278
31	16:53:44	8	19.319	1663	7.923	74.73	4.935	.3356	180	1612	1646
32	16:53:44	6	8.2641	2181	8.211	73.44	4.935	.8663	180	2112	1040
33	16:53:44	7	8.2372	1532	7.851	75.05	4.935	.1946	180	1414	2343
34	16:53:44	7	4.0500	1636	7.908	74.79	4.935	-.2637	180	1557	9774
36	16:53:45	10	2.6364	1378	7.765	75.43	4.935	.3651	180	1285	29534
37	16:53:45	8	2.7085	1800	7.999	74.39	4.935	.6099	180	1748	9935
38	16:53:45	10	7.9013	1590	7.883	74.91	4.935	.4022	180	1561	2707

- **.dat** = output of results; it also show differences in fit methods; note that the values of Fsum and Shift are multiplied by 100: this is because the code requires only integers numbers

s3s13706gd05_1.dat

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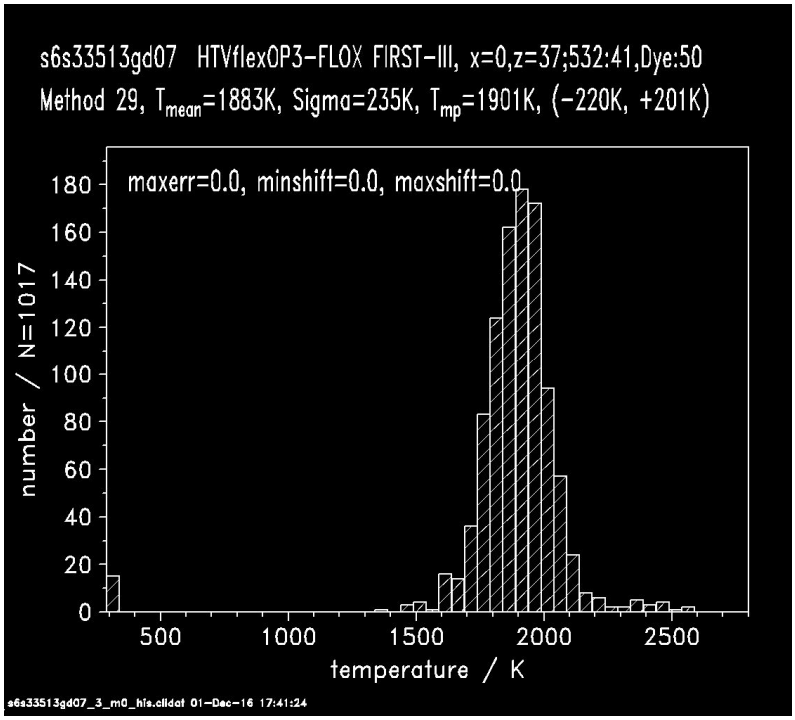
```
Program version during data evaluation: V3.4 AIX (ohne AXMD) 15-May-13 15:35:02

Resultfile: s3s13706gd05_1.res
11-Jul-16 16:53:36 s3s13706gd05  HTVflexOP3-FLOX FIRST-III, x=0,z=107:532:41,Dye:50

                          Method
   # F  T     6     7    20    21    26    27    29    31    33
          ch/cc  h/cc   75%   50%  6or7        LFIT  Fsum  Shift
   1 0 29   1730  1654  1753  1921  1654  1654  1753  3603    17
   2 0 29   1387  1291  1338  1339  1291  1291  1409  8880    35
   3 0  0   1607  1682  1762  1703  1682  1682  1736   491    32
   4 0  0   1339  1258  1519  1491  1258  1258  1395  1063     9
   5 0  0   1634  1684  1611  1630  1684  1684  1706   253    -4
   6 0 29   1240  1027  1495  1370  1027  1027  1280 10742     8
   7 0  0   1504  1405  1636  1626  1405  1405  1520   575     7
   8 0 29   1363  1326  1267  1526  1326  1326  1412  4746    31
   9 0  0   1398  1301  1506  1484  1301  1301  1442   877   -14
  10 0  0   1546  1446  1816  1698  1446  1446  1570  2304    -5
  11 0 29   1965  1847  2144  1993  1847  1847  1826  9666   -82
  12 0 29   1466   915  1100  1263   915   915  1221 36647  -166
  13 0  0   1608  1506  1672  1738  1506  1506  1592   324   -27
  14 0  0   1427  1451  1532  1600  1451  1451  1511   435    34
  15 0  0   1447  1528  1561  1506  1528  1528  1549   471   -27
  16 0  0   1446  1431  1435  1554  1431  1431  1481   443   -23
  17 0  0   1866  1864  1676  1875  1864  1864  1877   735   -17
  18 0  0   2241  2203    -1  2207  2203  2203  2210   968     0
  19 0  0   1307  1377  1202  1260  1377  1377  1352   346    33
  20 0  0   1348  1350  1327  1381  1350  1350  1368   273    -7
  21 0  0   1935  1847  1872  2021  1847  1847  1863   563   -27
  22 0  0   1601  1486  1930  1864  1486  1486  1628  1923    46
  23 0  0   1461  1548  1584  1456  1548  1548  1555   299   -11
  24 0  0   1396  1333  1388  1458  1333  1333  1417   161     5
  25 0  0   1832  1685  1365  1854  1685  1685  1685  1916   -28
  26 0 29   1571  1510  1618  1714  1510  1510  1636  3930    49
  27 0  0   1761  1741  1932  1938  1741  1741  1800   243    18
  28 0  0   1243  1273  1706  1556  1273  1273  1445  1627   106
  29 0  0   1336  1340  1719  1512  1340  1340  1474  1145   -22
  30 0  0   1779  1807  1924  1968  1807  1807  1855   266    26
  31 0  0   1662  1612  1511  1817  1612  1612  1663  1932    34
  32 0  0   2038  2112  2013  2285  2112  2112  2181   826    87
  33 0  0   1442  1414  1598  1526  1414  1414  1532   824    19
  34 0  0   1596  1557  1780  1663  1557  1557  1636   405   -26
  35 1  0      0     0     0     0     0     0     0     0     0
  36 0  0   1245  1285  1468  1455  1285  1285  1378   264    37
  37 0  0   1737  1748  1757  1855  1748  1748  1800   271    61
  38 0  0   1556  1561  1400  1600  1561  1561  1590   790    40
  39 0  0   1586  1606  1718  1696  1606  1606  1659   526    35
  40 0  0   1359  1268  1443  1530  1268  1268  1426   937    69
  41 0  0   1446  1491  1499  1504  1491  1491  1522   213    14
  42 0  0   1538  1492  1496  1623  1492  1492  1576  1570    41
  43 0  0   1231  1203  1632  1416  1203  1203  1395  1498   -14
  44 0  0   1343  1314  1644  1533  1314  1314  1448   950     7
  45 0  0   1413  1365  1844  1612  1365  1365  1520   821    24
  46 0  0   1538  1555  1338  1493  1555  1555  1541   870    10
  47 0  0   1592  1511  1423  1615  1511  1511  1547   604   -32
  48 0  0   1482  1467  1595  1613  1467  1467  1560  1014    34
```

- **m**xx_**his.clidat** = histogram plot relative to maximum error F(Sum)=xx

To visualize the histogram use **charli** command:

- **charli [filename without extension] xw**

Note that the histogram could be also obtained in ASCII format by activating **R_FINAL = '1'** in set-all.e program

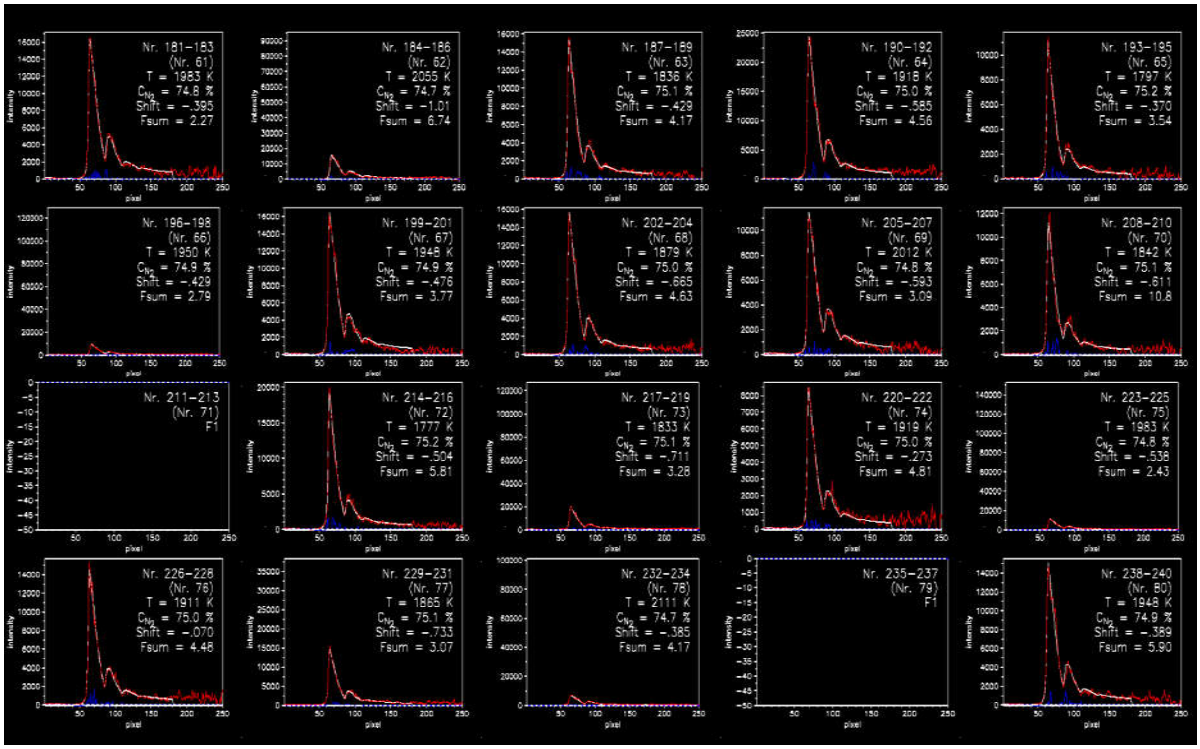


To check the quality of the fit, it is useful to use the **spi** code on **.lft** file (remember to type first **chd** and copy the filename to change the default values); then the command **@fit** display the results of the first 20 data (in principle 60 data since each single points consists in 3 columns as explained before) on the screen. To see the following data, use the command **gin –next60**. The visualization of the spectra is also useful to understand the quality of the fit and the type of filtering and the type of threshold to apply. Each plot displays the temperature value and some information about the rejection of the data point from the statistical analysis:

- **F1** = filtered for too low counts (close to background level)
- **F2** = filtered for too high counts (camera saturation)
- **T** = Threshold for a too high F(Sum) (bad fit)

As alternative you can use the **show-fit.e** command:

- **show-fit.e [name of file] ([xmin] [ymin] [ymax] optional)**



Based on these numbers, the **.tab** file and the visualization of the fit it is possible to evaluate the quality of the spectra and eventually change the threshold parameters (rarely the fitting method) to obtain better results. Iteration on the used parameters may occur.

Usually one of the reasons of a bad fit is a bad horizontal shift; the code is not good in fitting temperature and shift at the same time, so providing the exact shift ($\pm$ 1 pixel) will improve a lot the fit and decrease the F(Sum) value. To change the starting position it is necessary to edit **ICHN** value in **set_all.e** program inside **mess** folder.

Sometimes the criteria to exclude one spectrum from the fitting (because the signal is too low or the signal saturates the camera) are not well set for the experiment. To modify these criteria, edit **lfit.e**:

- **set filter** = how many and which type of filters are in use
- **set fparm 1** = filtered for too low counts (250 default value)
- **set fparm 2** = filtered for too high counts - saturation (64000 default value): this filter takes into account also the bkg subtraction and the dye curve correction: so, this value could be lower than the "nominal" 65000 counts for camera saturation.

Note that it is possible to convert each single column of data from .lft file to ASCII file; this could be useful to export some spectra on Windows machine and plot them. However, this procedure can convert and save only one column per time.
Use spi program and open the .lft file as explained above.
Then use the command:

- **load –mmf** x where x is the column # (remember: for each measurement point there are 3 colums: data, fit and difference * 100)
- **save** name**.ascii – asc** saves the selected column as ASCII with the chosen name

It is also possible to fit the average of the spectra instead of the individual single shots. In lfit.e replace the "s" in the base filename with an "a".

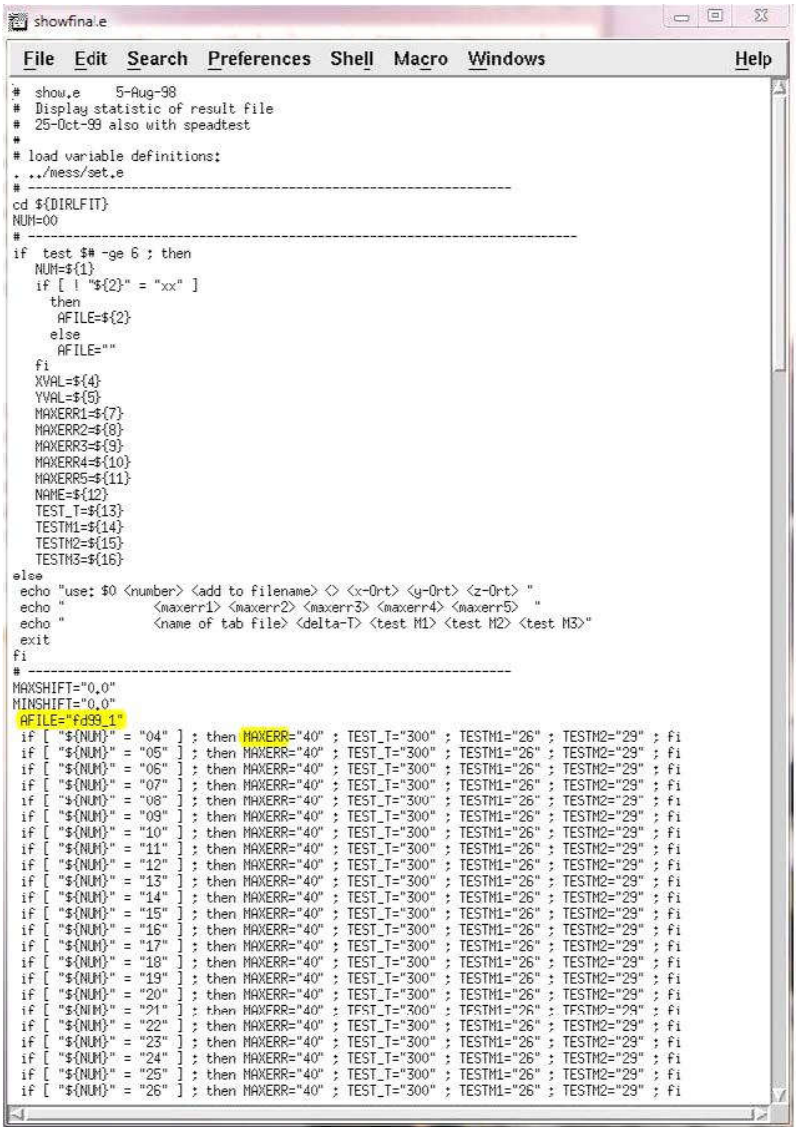
```
RD1="HTVflexOP3-FLOX "${6}", "
RD3="532:${RD4},Dye:${RD5}"
# ------------------------------------------------------------------------
FILE=${PRE}s${TAG}${NUM}${AFILE}
EXPFILE=${DIRMESS}${FILE}.cor
QFFILE=${DIRQFLIB}qflib${TAG}${QFLIB_}
LFFILE=${DIRLFLIB}lflib${TAG}${LFLIB_}.lib
RESFILE=${PRE}s${TAG}${NUM}${RESAPP}
LOGFILE=${DIRLFIT}log/`basename $0 .e`_${NUM}${RESAPP}.log
if [ ! -d ${DIRLFIT}/log ] ; then mkdir ${DIRLFIT}/log ; fi
date +"%e-%b-%Y %H:%M"  >${LOGFILE}
# ------------------------------------------------------------------------
if [ ! "$ZOFFSET" = "false" -a ! "$ZOFFSET" = "true" ] ; then
   echo "wrong option for 'set lfit -zoffset ...' "
   exit
fi
# ------------------------------------------------------------------------
```

Replace with an "a" to fit average spectra

Finally create and save the final results (final table and histograms) in ASCII file, readable on Windows machine. Modify **showfinal.e** in **lfit** folder:

- **AFILE** = last part of the basenamefile
- **MAXERR** = firlter for maximum err(Sum)

Remember to list all the run # in the experiment at the end of the program otherwise the code stops at the last #.



Other filtering options are available: check the user manual or contact Dr. Lückerath for further details. One option is to filter unbalanced cold and hot part of Nitrogen spectrum once the measurement was performed in a region where hot and cold spectra are simultaneously present: in this case the fit would be very poor even if the err(Sum) is low. The filter check the difference in temperature between two different methods and discard the measurement if the discrepancy is a above an imposed threshold.

- **TEST_T** = maximum temperature difference
- **TESTM1** = # of method to compare with (usually use 26 which is the combination of method 6 – cold hot/cold cold – and method 7 – hot / cold cold-)
- **TESTM2** = fitting method (default 29)

Then go to **mess** folder and enable in **set.e** only **R_FINAL="1"** (set to "0" all the other R_ parameters). Enable all the run # you want to process in **all.e** and run all.e for the last time.

The final table and histograms are created in **lfit** folder; however the table is not designed for an easy import in excel (or origin), so to remove the table borders, run **replace_tab.e**:

- **replace_tab.e [tab name without extension]**

Sometimes check the status of the MC machine memory since the storage is limited. To do so use the **dfu** command directly in any folder. If the memory is full, create a compressed backup file (.tar) in data1 partition:

- **tar –cvf /data1/cv/vtmess/[name of the file].tar [name of the folder]**

Once the tar file is completed, copy it on Windows through a FTP program as backup file and free both data1 and data2 memory.

8. Print results

It is possible to print directly from the MC machine:

- **export RZ_POST = vt-p-05**
- **echo $RZ_POST**

or from charli:

- charli …… xw — print on screen
- charli …… z2su — print on printer

or from gino:

- gino …….. –noopt -pform z2su -nodash — print on printer
- gino …….. –opt –pform xw — back to screen
- gino …….. –ps — alternative method for printer