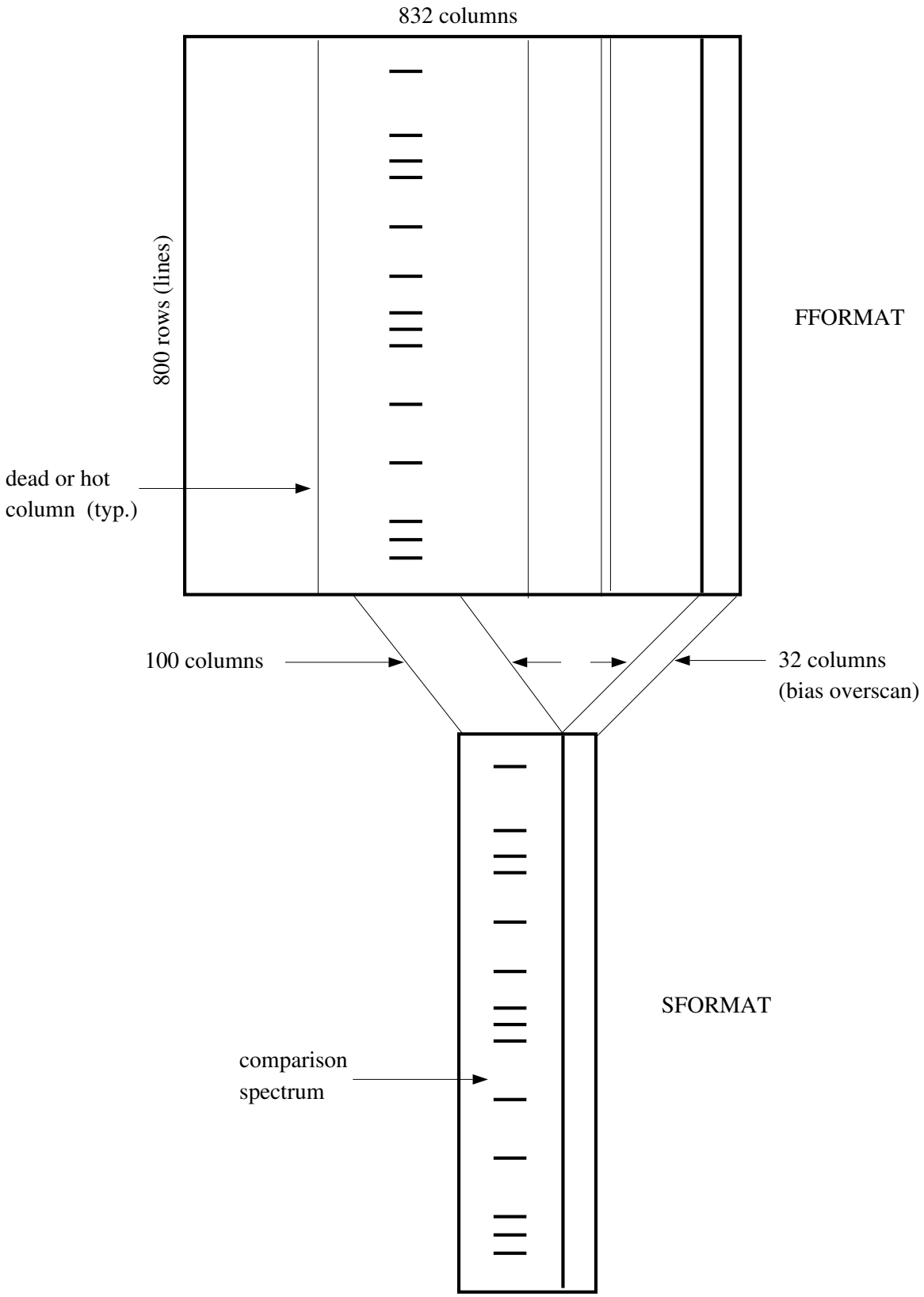

Figure 2. Comparison of full format and spectroscopic CCD formats.

```
    fits_file = "mta"           FITS data source
    file_list = ""              File list
    iraf_file = "nite1"         IRAF filename
  (make_image = yes)            Create an IRAF image?
 (long_header = no)             Print FITS header cards?
(short_header = yes)            Print short header?
    (datatype = "real")         IRAF data type
       (blank = 0.)             Blank value
       (scale = yes)            Scale the data?
 (oldirafname = no)             Use old IRAF name in place of iraf_file?
      (offset = 0)              Tape file offset
        (mode = "ql")
```

Figure 3. RFITS parameters.

```
direct          Current headers for Sun plus CCDPROC setup for direct CCD
specphot        Current headers for Sun plus CCDPROC setup for spectropho-
                  tometry, ie GoldCam, barefoot CCD
foe             Current headers for Sun plus CCDPROC setup for FOE
fibers          Current headers for Sun plus CCDPROC setup for fiber
array
coude           Current headers for Sun plus CCDPROC setup for Coude
cyrocam         Current headers for Sun plus CCDPROC setup for Cryo Cam
echelle         Current headers for Sun plus CCDPROC setup for Echelle
kpnoheaders     Current headers with no changes to CCDPROC parameters
fits            Mountain FITS header prior to Aug. 87 (?)
camera          Mountain CAMERA header for IRAF Version 2.6 and earlier
sunlink         Generic link to SUN
```

Figure 4. Possible answers to SETINSTRUMENT.

```
 (pixeltype = "real")         Output pixel type (real|short)
   (verbose = yes)            Print log information to the standard
                                 output?
   (logfile = "logfile")      Text log file
  (plotfile = "plotfile")     Log metacode plot file
    (backup = "")             Backup directory or prefix
(instrument = "ccddb$kpno/coude.dat") CCD instrument file
    (ssfile = "subsets")      Subset translation file
  (graphics = "stdgraph")     Interactive graphics output device
    (cursor = "")             Graphics cursor input
   (version = "2: October 1987")
      (mode = "ql")
    ($nargs = 0)
```

Figure 5. CCDRED parameters.

```
      images = "@stars"        List of CCD images to correct
    (ccdtype = "object")       CCD image type to correct
  (max_cache = 0)              Maximum image caching memory (in Mbytes)
     (noproc = no)             List processing steps only?\n
     (fixpix = no)             Fix bad CCD lines and columns?
   (overscan = yes)            Apply overscan strip correction?
        (trim = yes)           Trim the image?
    (zerocor = yes)            Apply zero level correction?
    (darkcor = no)             Apply dark count correction?
    (flatcor = yes)            Apply flat field correction?
   (illumcor = no)             Apply illumination correction?
  (fringecor = no)             Apply fringe correction?
    (readcor = no)             Convert zero level image to readout
                                   correction?
    (scancor = no)             Convert flat field image to scan
                                   correction?\n
   (readaxis = "line")         Read out axis (column|line)
    (fixfile = "")             File describing the bad lines and columns
    (biassec = "image")        Overscan strip image section
    (trimsec = "image")        Trim data section
       (zero = "Zero")         Zero level calibration image
       (dark = "")             Dark count calibration image
       (flat = "NflatA")       Flat field images
      (illum = "")             Illumination correction images
     (fringe = "")             Fringe correction images
   (scantype = "shortscan")    Scan type (shortscan|longscan)
      (nscan = "")             Number of short scan lines\n
(interactive = yes)            Fit overscan interactively?
   (function = "chebyshev")    Fitting function
      (order = 1)              Number of polynomial terms or spline
                                   pieces
     (sample = "*")            Sample points to fit
   (naverage = 1)              Number of sample points to combine
   (niterate = 1)              Number of rejection iterations
 (low_reject = 3.)             Low sigma rejection factor
(high_reject = 3.)             High sigma rejection factor
       (grow = 0.)             Rejection growing radius
       (mode = "ql")
```

Figure 6. CCDPROC parameters.

```
       images = "bias*"         List of zero level images to combine
      (output = "Zero")         Output zero level root name
       (sigma = "")             Output sigma image (optional)
     (combine = "avsigclip")    Type of combine operation
     (ccdtype = "zero")         CCD image type to combine
     (process = no)             Process images before combining?
     (subsets = no)             Combine images by subset parameter?
      (delete = no)             Delete input images after combining?
     (clobber = no)             Clobber existing output image?
    (exposure = no)             Scale by the exposure times?
       (scale = no)             Scale by the mode?
      (offset = no)             Add offset determined from the mode?
      (weight = no)             Use a weighted average?
     (modesec = "")             Image section for computing mode
   (lowreject = 3.)             Lower sigma clipping factor
  (highreject = 3.)             Upper sigma clipping factor
        (mode = "ql")


cc> zerocombine bias*
Jul 18 10:49 combine: avsigclip, lowreject=3., highreject=3.
                Images      N    Exp   Mode  Scale Offset Weight
           bias001.imh      1    0.0  INDEF  1.000     0.  0.200
           bias002.imh      1    0.0  INDEF  1.000     0.  0.200
           bias004.imh      1    0.0  INDEF  1.000     0.  0.200
           bias003.imh      1    0.0  INDEF  1.000     0.  0.200
           bias005.imh      1    0.0  INDEF  1.000     0.  0.200
  -------------------- ------ ------
                  Zero      5    0.0
cc>
```

Figure 7. ZEROCOMBINE parameters and output.

```
       images = "pflat"         List of flat field images to combine
      (output = "Flat")         Output flat field root name
       (sigma = "")             Output sigma image (optional)
     (combine = "avsigclip")    Type of combine operation
     (ccdtype = "flat")         CCD image type to combine
     (process = no)             Process images before combining?
     (subsets = yes)            Combine images by subset parameter?
      (delete = no)             Delete input images after combining?
     (clobber = no)             Clobber existing output image?
    (exposure = no)             Scale by the exposure times?
       (scale = no)             Scale by the mode?
      (offset = no)             Add offset determined from the mode?
      (weight = no)             Use a weighted average?
     (modesec = "")             Image section for computing mode
   (lowreject = 3.)             Lower sigma clipping factor
  (highreject = 3.)             Upper sigma clipping factor
        (mode = "ql")


cc> flatcom pflat*
Jul 18 11:21 combine: avsigclip, lowreject=3., highreject=3.
                Images      N    Exp   Mode  Scale Offset Weight
          pflat009.imh      1  100.0  INDEF  1.000     0.  0.333
          pflat010.imh      1  100.0  INDEF  1.000     0.  0.333
          pflat011.imh      1  100.0  INDEF  1.000     0.  0.333
  -------------------- ------ ------
                 FlatB      3  100.0
cc>
```

Figure 8. FLATCOMBINE parameters and ouptut.

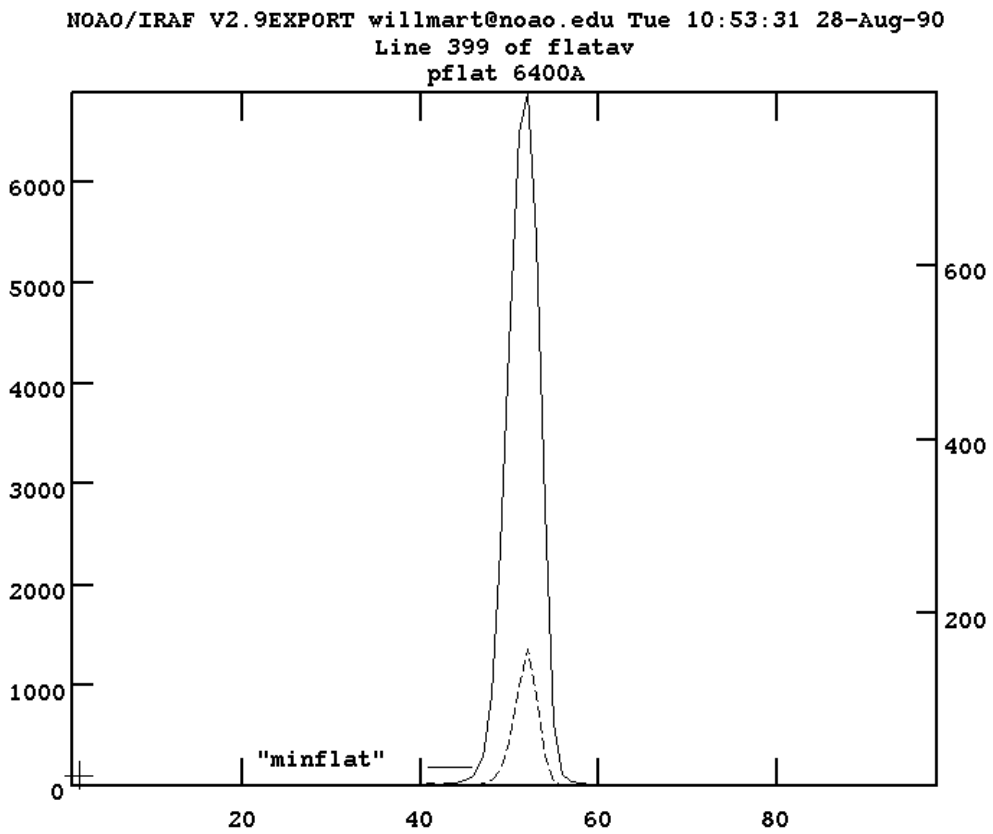

Figure 9. IMPLOT of flat with object overplotted (dashed).

```
       input = "FlatA"          Calibration images
      output = "NflatA"         Flat field images
       (axis = 2)               Axis to fit
(interactive = no)              Set fitting parameters interactively?
     (sample = "*")             Sample points to use in fit
   (naverage = 1)               Number of points in sample averaging
   (function = "legendre")      Fitting function
      (order = 1)               Order of fitting function
 (low_reject = 2.5)             Low rejection in sigma of fit
(high_reject = 2.5)             High rejection in sigma of fit
   (niterate = 3)               Number of rejection iterations
       (grow = 1.)              Rejection growing radius in pixels
    (minflat = 7.)              Minimum fit value for computing a flat
                                  field va
   (graphics = "stdgraph")      Graphics output device
     (cursor = "")              Graphics cursor input
       (mode = "ql")
```

Figure 10. FLAT1D parameters.

```
       input =                List of input images to edit
      output =                Output spectra rootname
         sky =                Output sky spectra rootname
    profiles =                Profile reference image
 (references = "")            Reference images
(interactive = yes)           Run task interactively?
   (recenter = yes)           Recenter reference apertures?
       (find = yes)           Find apertures automatically?
       (edit = yes)           Define and edit apertures interactively?
       (line = INDEF)         Dispersion line to graph
       (nsum = 10)            Number of dispersion lines to sum
      (width = 5.)            Profile centering width
     (radius = 5.)            Profile centering radius
  (threshold = 10.)           Detection threshold for profile
                                centering\n
       (mode = "a")
```

Figure 11a. APEDIT parameters.

```
       input =                List of input images
      (nfind = 1)             Number of apertures to be found
                                automatically
 (references = "")            Reference images
(interactive = yes)           Run task interactively?
   (recenter = yes)           Recenter reference apertures?
       (find = yes)           Find apertures automatically?
       (edit = yes)           Define and edit apertures interactively?
       (line = INDEF)         Dispersion line to graph
       (nsum = 10)            Number of dispersion lines to sum
     (minsep = 5.)            Minimum separation between spectra
       (mode = "a")
```

Figure 11b. APFIND parameters.

```
       input = @stars          List of input images to trace
 (references = "")             List of reference images
(interactive = yes)            Run task interactively?
   (recenter = yes)            Recenter reference apertures?
       (find = yes)            Find apertures automatically?
       (edit = yes)            Define and edit apertures interactively?
      (trace = yes)            Trace aperture features?
   (fittrace = yes)            Fit the traced points interactively?
       (line = INDEF)          Starting dispersion line
       (nsum = 10)             Number of dispersion lines to sum
       (step = 10)             Tracing step
   (function = "spline3")      Trace fitting function
      (order = 2)              Trace fitting function order
     (sample = "*")            Trace sample regions
   (naverage = 1)              Trace average or median
   (niterate = 3)              Trace rejection iterations
 (low_reject = 3.)             Trace lower rejection sigma
(high_reject = 3.)             Trace upper rejection sigma
       (grow = 0.)             Trace rejection growing radius
       (mode = "a")
```

Figure 11c. APTRACE parameters.

```
       input =                  List of input images
    (output = "")               List of output spectra
       (sky = "")               List of output sky spectra
(references = "")               List of aperture reference images
  (profiles = "")               List of profile reference images\n
  (recenter = yes)              Recenter reference apertures (if
                                  defined)?
      (find = yes)              Find apertures automatically (if none)?
     (trace = yes)              Trace aperture features?
   (extract = yes)              Extract 1D aperture sums?
(skyextract = no)               Output sky spectra (if background
                                  subtracting)?
(background = "none")           Background to subtract (none|average|fit)
     (clean = no)               Detect and replace bad pixels?\n
(interactive = yes)             Run task interactively?
      (edit = yes)              Define and edit apertures (if
                                  interactive)?
    (review = yes)              Review extractions and output names (if
                                  interac
   (weights = "profile")        Extraction weights (profile|variance)
  (naverage = 1000)             Number of profiles to average
(interpolator = "spline3")      Type of image interpolation
    (nclean = 2)                Number of pixels to clean per profile per
                                  point
    (lsigma = 3.)               Lower rejection threshold
    (usigma = 3.)               Upper rejection threshold
        (v0 = 1.)               Variance intercept
        (v1 = 0.)               Variance slope
      (mode = "a")
```

Figure 11d. APSUM parameters.

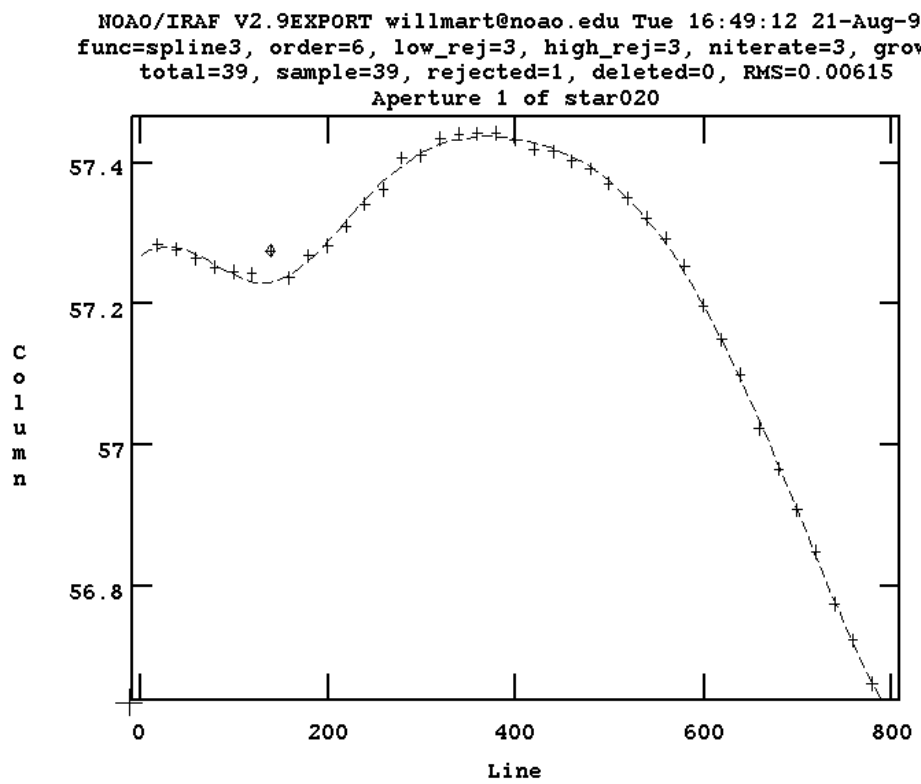

Figure 12. APTRACE plot.

```
      images = "thar001"       Images containing features to be
                                  identified
    (section = "middle line")  Section to apply to two dimensional
                                  images
   (database = "database")     Database in which to record feature data
  (coordlist = "onedstds$thorium.dat") User coordinate list
       (nsum = 10)             Number of lines or columns to sum in 2D
                                  images
      (match = 1.)             Coordinate list matching limit in user
                                  units
(maxfeatures = 20)             Maximum number of features for automatic
                                  identi
     (zwidth = 100.)           Zoom graph width in user units
      (ftype = "emission")     Feature type
     (fwidth = 3.)             Feature width in pixels
    (cradius = 5.)             Centering radius in pixels
  (threshold = 10.)            Feature threshold for centering
     (minsep = 4.)             Minimum pixel separation
   (function = "chebyshev")    Coordinate function
      (order = 3)              Order of coordinate function
     (sample = "*")            Coordinate sample regions
   (niterate = 0)              Rejection iterations
 (low_reject = 3.)             Lower rejection sigma
(high_reject = 3.)             Upper rejection sigma
       (grow = 0.)             Rejection growing radius
   (graphics = "stdgraph")     Graphics output device
     (cursor = "")             Graphics cursor input
       (mode = "ql")
```

Figure 13. IDENTIFY parameters.

```
 reference = ""              Reference image
    images =                 Images to be reidentified
  (section = "middle line")  Section to apply to two dimensional
                               images
     (shift = 0.)            Shift to add to reference features
      (step = 10)            Step for tracing an image
      (nsum = 10)            Number of lines or columns to sum
   (cradius = 5.)            Centering radius
(threshold = 10.)            Feature threshold for centering
     (nlost = 2)             Maximum number of features which may be
                               lost
     (refit = yes)           Refit coordinate function?
 (database = "database")     Database
 (plotfile = "")             Plot file for residuals
 (logfiles = "STDOUT,logfile") List of log files
  (verbose = yes)            Verbose log files?
     (mode = "ql")
```

Figure 14. REIDENTIFY parameters.

```
      input =                  List of input spectra
    records =                  Record number extensions
     answer =                  Accept assignment?
 (recformat = no)              Use record number extension format?
(references = "@comps")        List of reference spectra
 (apertures = "")              Input aperture selection list
    (refaps = "")              Reference aperture selection list
 (ignoreaps = yes)             Ignore input and reference apertures?
    (select = "interp")        Selection method for reference spectra
      (sort = "utmiddle")      Sort key
      (time = yes)             Is sort key a time?
  (timewrap = 17.)             Time wrap point for time sorting
  (override = no)              Override previous assignments?
   (confirm = yes)             Confirm reference spectrum assignments?
    (assign = yes)             Assign the reference spectra to the input
                                   spect
  (logfiles = "STDOUT,logfile") List of logfiles
   (verbose = no)              Verbose log output?
      (mode = "ql")
```

Figure 15. REFSPECTRA parameters.

```
        input = "@stars"        List of input spectra
       output = "@starsdc"      List of output spectra
      records =                 Record number extensions
   (recformat = no)             Use record number extension format?
    (database = "database")     Dispersion solution database
       (table = "")             Wavelength table
   (apertures = "")             Input aperture selection list
           (w1 = INDEF)         Starting wavelength
           (w2 = INDEF)         Ending wavelength
           (dw = INDEF)         Wavelength interval per pixel
           (nw = INDEF)         Number of output pixels
(interpolatio = "poly5")        Interpolation type
          (log = no)            Logarithmic wavelength scale?
         (flux = yes)           Conserve flux?
       (global = no)            Apply global defaults?
   (ignoreaps = no)             Ignore apertures in global defaults?
     (confirm = yes)            Confirm dispersion coordinates?
       (rebin = no)             Rebin previous dispersion corrections?
    (listonly = no)             List the dispersion coordinates only?
        (mode = "ql")
```

Figure 16. DISPCOR parameters.

```
       input = "@starfile"     Input spectra to be normalized
      output = "@cstarfile"    Output continuum normalized spectra
       (type = "ratio")        Type of output (fit, difference, ratio)
       (axis = 1)              Dispersion axis
(interactive = yes)            Set fitting parameters interactively?
     (sample = "*")            Sample of points to use in fit
   (naverage = 1)              Number of points in sample averaging
   (function = "spline3")      Fitting function
      (order = 1)              Order of fitting function
 (low_reject = 2.)             Low rejection in sigma of fit
(high_reject = 3.)             High rejection in sigma of fit
   (niterate = 10)             Number of rejection iterations
       (grow = 1.)             Rejection growing radius
   (graphics = "stdgraph")     Graphics output device
     (cursor = "")             Graphics cursor input
       (mode = "ql")
```

Figure 17. CONTINUUM parameters.